WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN PENNSYLVANIA, 1986-87

Compiled and Edited By Robert E. Helm

U.S. GEOLOGICAL SURVEY

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DEPARTMENT OF THE INTERIOR

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PREFACE

Pennsylvania has many natural resources; large stands of timber, rich soils for farmland, coal and other valuable minerals, and relatively large quantities of water. With its 45,000 miles of rivers and streams, and numerous lakes and reservoirs, Pennsylvania is indeed a 'water rich' state. All this water ably provides for public and domestic supplies, electrical power, recreational, and navigational uses.

Although water in the Commonwealth is abundant, competition for usable water continues to escalate, and prudent use is necessary if this vital resource is to be preserved for future generations. Pennsylvania has experienced many water problems over the years, but through scientific studies--such as those described in this report--and wise water management, solutions have been found. For example, the Schuylkill River is no longer thought of as "too thick to drink and too thin to plow," as Ben Franklin once described it.

New problems are always facing water users. Currently there is much concern regarding the degradation of ground-water quality. Because water is the one natural resource necessary to sustain life, it should be used wisely by everyone. It is in this regard that the Water Resources Division of the U.S. Geological Survey continues its close association with the Commonwealth of Pennsylvania in the appraisal of this natural resource.

Efforts are continuing in the collection of hydrologic data for investigative projects, but considerable attention is now being focused on two, somewhat new, areas: 1) the completion of a statewide, comprehensive, and field verified water-well data base, and 2) expansion of the network of sophisticated data-collection and transmission equipment in order to provide users with real-time data.

The U.S. Geological Survey looks forward to continuing the program of providing timely and accurate hydrologic data and water resource appraisals for use by Commonwealth, local, and Federal water managers in the protection and prudent use of this invaluable natural resource.

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WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN PENNSYLVANIA, 1986-87

INTRODUCTION

Effective management of water resources requires an understanding of hydrologic systems and the factors that determine the distribution, availability, and quality of water. Within the Federal Government, the U.S. Geological Survey, Water Resources Division, has the principal responsibility for providing hydrologic information and for appraising the Nation's water resources. The water-resources activities of the U.S. Geological Survey are diverse, ranging from research investigations of specific aspects of the hydrologic cycle to large programs of regional water-resources investigations, such as the Regional Aquifer System Analyses.

To accomplish the Division's objective of presenting impartial, accurate data and scientific analyses equally to all interested parties, the Division releases its information through Federal, State, and local publications, technical journals, and computerized data files. Users of the information include legislative bodies and associated committees; courts; other Federal agencies; State, regional, and local agencies; water-management, irrigation, drainage, and conservation districts; industry; public interest groups, universities, and consultants; and the public.

This report describes the U.S. Geological Survey's water-resources activities in Pennsylvania. Some activities are topics of general interest to the water resources community while others are related to current water issues. The report also describes the mission of the Water Resources Division of the U.S. Geological Survey, and program funding, water issues, a listing of selected literature on water resources in Pennsylvania, and how to obtain reports and information.

WATER-RESOURCES MISSION OF THE U.S. GEOLOGICAL SURVEY

The water-resources mission of the U.S. Geological Survey is to provide the hydrologic information needed by others to help manage the Nation's water resources. To accomplish its mission the Survey, in cooperation with State and local governments and other Federal agencies:

- Collects data on a systematic basis to determine the quantity, quality, and use of surface and ground water, and the quality of precipitation.

- Conducts water-resources investigations and assessments at national, State, and local scales, characterizes water-resources conditions, and provides the capability to predict the impact on the resource of managerial actions, proposed development plans, and natural phenomena.

- Conducts basic and problem-oriented hydrologic and water-related research that is likely to produce knowledge useful for the resolution of water-resources problems facing the States, regions, and Nation.

- Acquires information useful in predicting and delineating water-related natural hazards from flooding, volcanoes, mudflows, and land subsidence.

- Coordinates the activities of all Federal agencies in the acquisition of water data, and operates water-information centers.

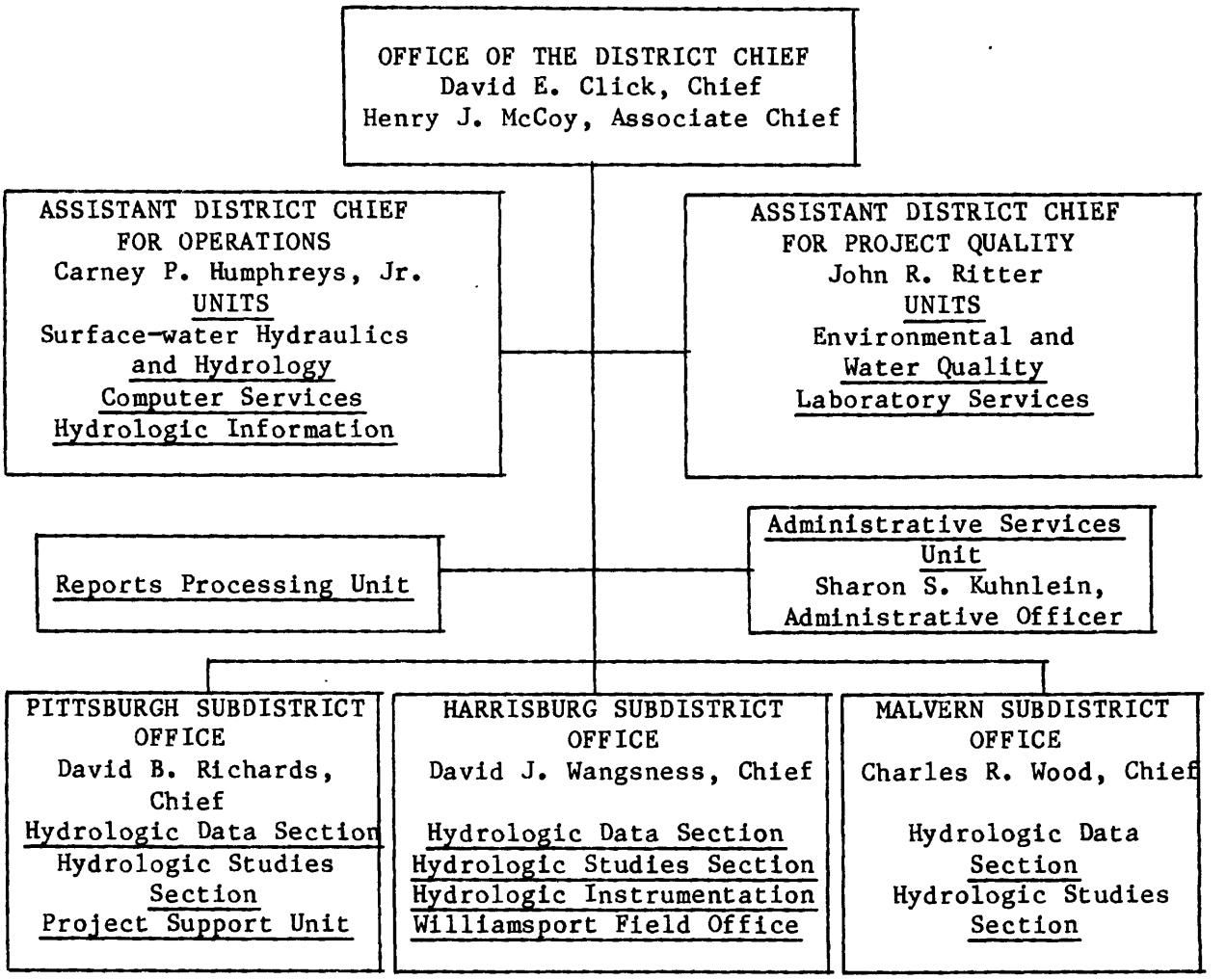
- Disseminates data and the results of investigations through reports, maps, and other forms of public release.

- Provides scientific and technical assistance in hydrology to other Federal agencies, to State and local agencies, to licensees of the Federal Energy Regulatory Commission, and, on behalf of the U.S. Department of State, to international agencies.

- Administers the provisions of the Water Resources Research Act of 1984 which include the State Water Resources Research Institute Program (Section 104) and the Water Resources Research Grant Program (Section 105).

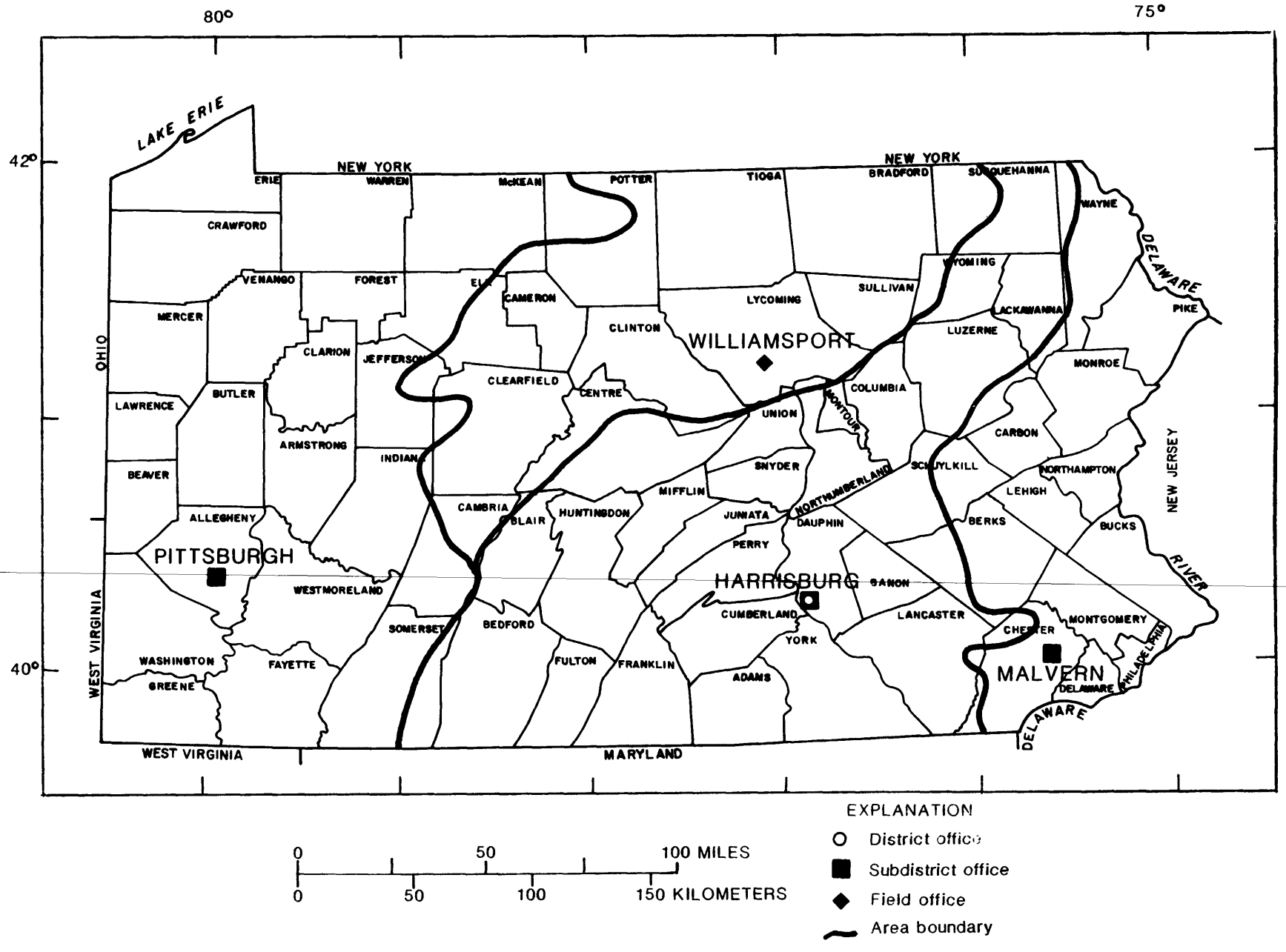
Authority for carrying out the Survey's mission derives from legislation of 1879, which established the Geological Survey; and legislation of 1888 and 1894, which authorized the survey of irrigable lands in arid regions and provided funds for gaging streams and determining the water supply of the Nation. Congressional appropriations have been made annually since 1894 for gaging streams and performing other functions relating to water resources. In 1964, the mission was broadened to include the role of lead agency in the coordination of the activities of all Federal agencies in the acquisition of certain water data. This responsibility, assigned to the Department of the Interior by Office of Management and Budget Circular A-67, was delegated to the U.S. Geological Survey and its Water Resources Division by the Department. Most recently, the Department of the Interior designated the Survey as the administering agency for Title I of the Water Resources Research Act of 1984.

DISTRICT ORGANIZATION CHART



PENNSYLVANIA DISTRICT OFFICE ADDRESSES

DISTRICT OFFICE: (717) 782-4514	U.S. Geological Survey Water Resources Division Federal Building P.O. Box 1107 Harrisburg, PA 17108
HARRISBURG SUBDISTRICT OFFICE: (717) 782-4515	Same as above
Williamsport Field Office: (717) 323-7736	P.O. Box 1805 Room 301 Federal Building Williamsport, PA 17703
PITTSBURGH SUBDISTRICT OFFICE: (412) 644-2863	Room 2204 Federal Building 1000 Liberty Avenue Pittsburgh, PA 15222
MALVERN SUBDISTRICT OFFICE: (215) 647-9008	111 Great Valley Parkway Malvern, PA 19355



Areas covered by subdistrict and field offices.

LIST OF COOPERATORS

Agencies Supporting Water-resources Investigations
during Fiscal Years 1986-87

Commonwealth of Pennsylvania Agencies

Department of Environmental Resources
- Bureau of Water Resources Management
- Bureau of Topographic and Geologic Survey
- Bureau of Surface Mine Reclamation
- Bureau of Water Quality Management

Local Agencies

City of Allentown
City of Bethlehem
City of Harrisburg
City of Philadelphia
City of Williamsport
Chester County Water Resources Authority
Letort Regional Authority
Millcreek Township
Warren County Commissioners
Lancaster County Planning Commission
University Area Joint Authority
Neshaminy Water Resources Authority
Media Borough Water Department
Erie County Department of Health
Indiana County Commissioners

Federal Agencies

Federal Energy Regulatory Commission
Federal Emergency Management Agency
U.S. Department of Agriculture
- Soil Conservation Service

U.S. Environmental Protection Agency
U.S. Army Corps of Engineers
- Baltimore District
- Philadelphia District
- Pittsburgh District

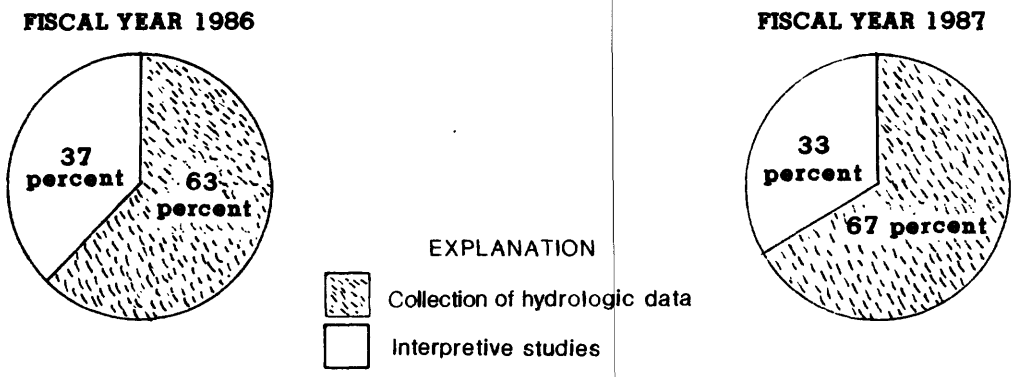
U.S. Department of Commerce/National Oceanic and Atmospheric Administration
National Park Service-Fort Collins

Other Agencies

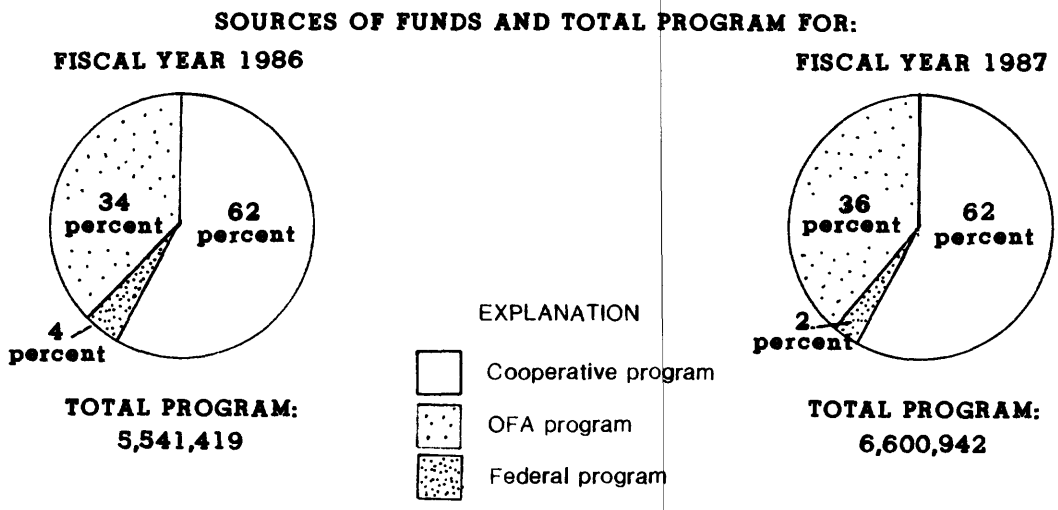
Delaware River Basin Commission
New York State Department of Environmental Conservation
Susquehanna River Basin Commission

TYPES OF FUNDING

The diagram below shows the percentage of the investigations for fiscal years 1986 and 1987 in each of the broad categories of collection of hydrologic data and interpretive studies (areal appraisals and applied research projects):



These investigations are directed toward obtaining the information needed by managers and planners for the solution of water problems in the Commonwealth. They are supported by services and funds provided by the Commonwealth and other agencies and matched on a 50-50 basis by Federal funds (cooperative program); by funds transferred from Other Federal Agencies (OFA program); and by funds appropriated directly to the Geological Survey (Federal program). The diagram below shows the percentage of funding for fiscal years 1986 and 1987.



WATER ISSUES

Summary of Issues and Their Relation to District Projects

Pennsylvania water issues are varied; however, the issues do not change as often as their locations. The threat of drought continues to be a problem in the Delaware River basin; the transport of nutrients by the Susquehanna River to Chesapeake Bay continues to make headlines; ground-water contamination from hazardous-waste sites and other sources is a widening cause for concern; and acid rain is still considered a danger to aquatic life in headwater streams and lakes. A recent issue is the contamination of ground water by radium and radon. Besides these relatively new issues, the old ones of acid mine drainage, industrial pollution of streams and lakes, and water allocation continue to cause concern for water managers in Pennsylvania.

Ground-Water Contamination - Sources of ground-water contamination in Pennsylvania include agricultural lands, hazardous-waste sites, industry, and radium and radon. Contamination by agriculture is chiefly from fertilizers and pesticides. Fertilizers introduce excess amounts of nutrients, usually species of nitrogen, to the hydrologic system, and the pesticides introduce organic compounds that are often carcinogenic. Ground-water contamination by agriculture is being studied in the Conestoga River basin (PA118).[1/]

This is one of 21 basins approved for implementation of best management practices as part of the Rural Clean Waters Program and is one of only two basins in the nation selected for ground-water studies in this program. The purpose of this long-term study is to evaluate the effectiveness of best management practices for improving ground- and surface-water quality in agricultural areas.

About 800 waste-disposal sites in the State have the potential for causing ground-water contamination. Many of these sites are on the U.S. Environmental Protection Agency's (USEPA) National Priorities list, and several more have been proposed. Most of the sites are in the southeastern part of the state.

The known extent of ground-water contamination by industrial wastes is increasing as methods of identifying more organic compounds become available. For example, TCE, a known carcinogen, has been found in many wells sampled in southeastern and south-central Pennsylvania.

The presence of radium and radon in the ground water of the Chickies Formation in southeastern Pennsylvania is being assessed (PA170). This project started in 1987 to delineate the extent and magnitude of high concentrations of those radioactive elements.

At the other end of the State a project (PA168) is also getting started on the quality of ground water in Erie County. This evaluation will determine sites of contamination and the effects of land use on ground-water quality as well as the availability of abundant supplies of ground water.

[1/] Project numbers refer to projects listed numerically in the section "Current Projects" p. 17-64.

Some of the objectives of the study of ground-water flow in the Valley Creek basin in Chester County (PA165) are to determine the general direction of contaminant movement and to delineate areas of contamination. These are also the objectives of the study of ground-water quality at Gettysburg (PA164). Nutrients, pesticides, and trace metals, in particular, are being analyzed.

The overall quality of ground water throughout the state is being evaluated in a project covering aquifer characteristics of the rocks of Pennsylvania (PA171). Besides water quality, aquifer lithology, recharge, flow, and discharge characteristics are also being summarized.

Water Supply and Demand - As water allocation became a major issue in the State a few years ago, the Pennsylvania Department of Environmental Resources (PaDER) has become heavily involved in making plans for allocations. Pennsylvania usually has sufficient water available to meet its needs, but during droughts different users may compete for water. For example, during droughts in the Monongahela River basin, streamflows and reservoir storage may not provide adequate water for navigation, power generation, and industrial and municipal uses; in the Delaware River basin reservoirs may have insufficient storage to supply water to New York City and still maintain a minimum flow of 1,750 ft^3/s (cubic feet per second) at Montague, New Jersey, as required by a 1954 Supreme Court Decree. A recent agreement by New York City and the four states bordering the river provides a series of actions to alleviate storages, including modifying reservoir operations and developing additional reservoir storage in the basin.

Because ground-water withdrawal from the Triassic sandstone aquifer often exceeds recharge in parts of five counties of southeastern Pennsylvania, the Delaware River Basin Commission (DRBC) has designated that area as a protected area and requires a permit for all new ground-water uses exceeding 10,000 gallons per day (gal/d).

Evaluation of ground-water resources for management purposes is one of the reasons for undertaking PA143, PA146, and PA148. These projects will provide models or information on ground-water flow in glaciated valleys (PA143) and carbonate rocks (PA146 and PA148), so that water managers in those areas will have a basis for making decisions on water use.

Stream Quality- Pennsylvania streams are degraded mainly by runoff from agricultural lands, acid mine drainage from coal areas, and discharges from industrial and municipal sources. Project PA118, described above in the section on ground-water contamination, and project PA158 include an evaluation of the effects of agricultural best-management practices on streams.

The Susquehanna River's nutrient loads have been pinpointed as causing some of the water-quality problems in Chesapeake Bay. An assessment of nutrient loadings in the lower Susquehanna basin (PA159) will determine the relative contributions of nutrients from the chief tributaries, the seasonal variations of the loads, and the annual nutrient discharge by the river to the bay.

More than 2,000 miles of major streams in Pennsylvania are degraded by discharges from abandoned coal mines. PaDER and U.S. Bureau of Mines are studying ways to reduce acid mine drainage; projects PA142 and PA160 will evaluate the effectiveness of applying limestone quarry waste on strip-mine spoil

in abating acid mine drainage. Other projects related to coal mining are described in the section, "Hydrologic Effects of Fossil Fuel and Mineral Extraction."

PaDER has an extensive network of stream-sampling sites throughout the State to monitor industrial pollution. Data from these sites and data from our NASQAN and Benchmark stations and other sampling sites printed in our annual publication, "Water-Resources Data for Pennsylvania," have been used in various projects.

Hydrologic Hazards - Drought presently is a chief concern in the State, especially in the Delaware River basin, and we are providing PaDER, through our Hydrologic Data Collection program, data and interpretations that will help them recognize and manage water shortages. For example, records of wells in our ground-water network were statistically analyzed so that PaDER will have a basis for estimating the severity of a drought.

U.S. Geological Survey, Susquehanna River Basin Commission, and National Weather Service are increasing the number of Satellite Data Collection Platforms (DCPs) in the Susquehanna River basin to enhance flood forecasting capabilities. A Federal Emergency Management Agency (FEMA) project, PA006 is underway to provide additional flood information.

Other hazards include the formation of sinkholes in areas underlain by limestone and landslides in the Pittsburgh area when "redbed" clay topsoil or subsoil becomes unstable after being saturated with water. Dam safety is a serious issue in the State. A dam inspection program has found 208 unsafe dams, most of which are in the Pocono Mountains, Wyoming Valley and Schuylkill, Blair, Cambria and Westmoreland Counties. A $300 million Commonwealth bond issue was endorsed to offer low interest loans to dam owners for needed repairs.

Acid Rain - Pennsylvania is receiving some of the most acidic precipitation in the country. The precipitation-weighted mean pH at 12 rain gages monitored by Pennsylvania State University and PaDER ranged from 3.98 to 4.17 in 1982. Some areas have the buffering capacity to neutralize the acid precipitation; others do not. The Pennsylvania Fish Commission and PaDER have received reports on the adverse effects on aquatic life from acidic precipitation, especially in headwater streams.

Our project on acid rain in Somerset County (PA145) will continue for several years. Its objective is to determine the effects of acid deposition on the chemistry of a group of poorly buffered headwater streams. The effects of storms and snowmelt will be evaluated as well as temporal trends. The measured pH at this site has been as low as 3.75, but the sulfate concentrations have been less than 5.0 mg/L (milligrams per liter). Aluminum concentrations rapidly increase during storms.

Hydrologic Effects of Fossil Fuel and Mineral Extraction - Coal deposits underlie much of Pennsylvania, and coal mining has detrimentally affected the water quality of streams and ground water. Acid mine drainage, as mentioned earlier, is a major problem, but metals and the smothering effects of iron precipitates and large sediment discharges, also associated with coal mines, may make affected streams unsuitable for aquatic life. Measures being used

to minimize or abate pollution from mines include diversion of surface runoff from mines, sediment control ponds, removing or covering acid-forming refuse piles, sealing entrances to underground mines, and chemical treatment, which includes spraying spoils with detergents.

Two ongoing projects (PA166 and PA163) evaluate the effects of coal mining on water resources in western Pennsylvania. PA166 besides appraising the water resources of Indiana County, will determine the effects of mines on the hydrology of the county, in general, and on the ground-water supplies in populated areas, in particular. A model will be developed to predict the consequences of future underground mining on those supplies. PA163 will determine the effects of surface mining on the streamflow and water quality of a small basin (0.93 mi^2) in Fayette County. The results of this study are being used by PaDER to evaluate permit applications for surface mining. A project in another part of Fayette County, (PA161), also will furnish information that will serve as a basis for permit evaluation.

An investigation of ground-water pollution by oil and gas operations in northwestern Pennsylvania (PA157) is being carried out in Warren County. Polluted areas range from less than an acre to more than 50 mi^2. The Warren County Commissioners are deeply concerned over this problem as brines, drilling muds, and well-development chemicals have contaminated shallow ground water, which is the principal source of water supplies in the county. The objectives of the project include the identification of contaminants and the delineation of the areal extent of the ground-water degradation.

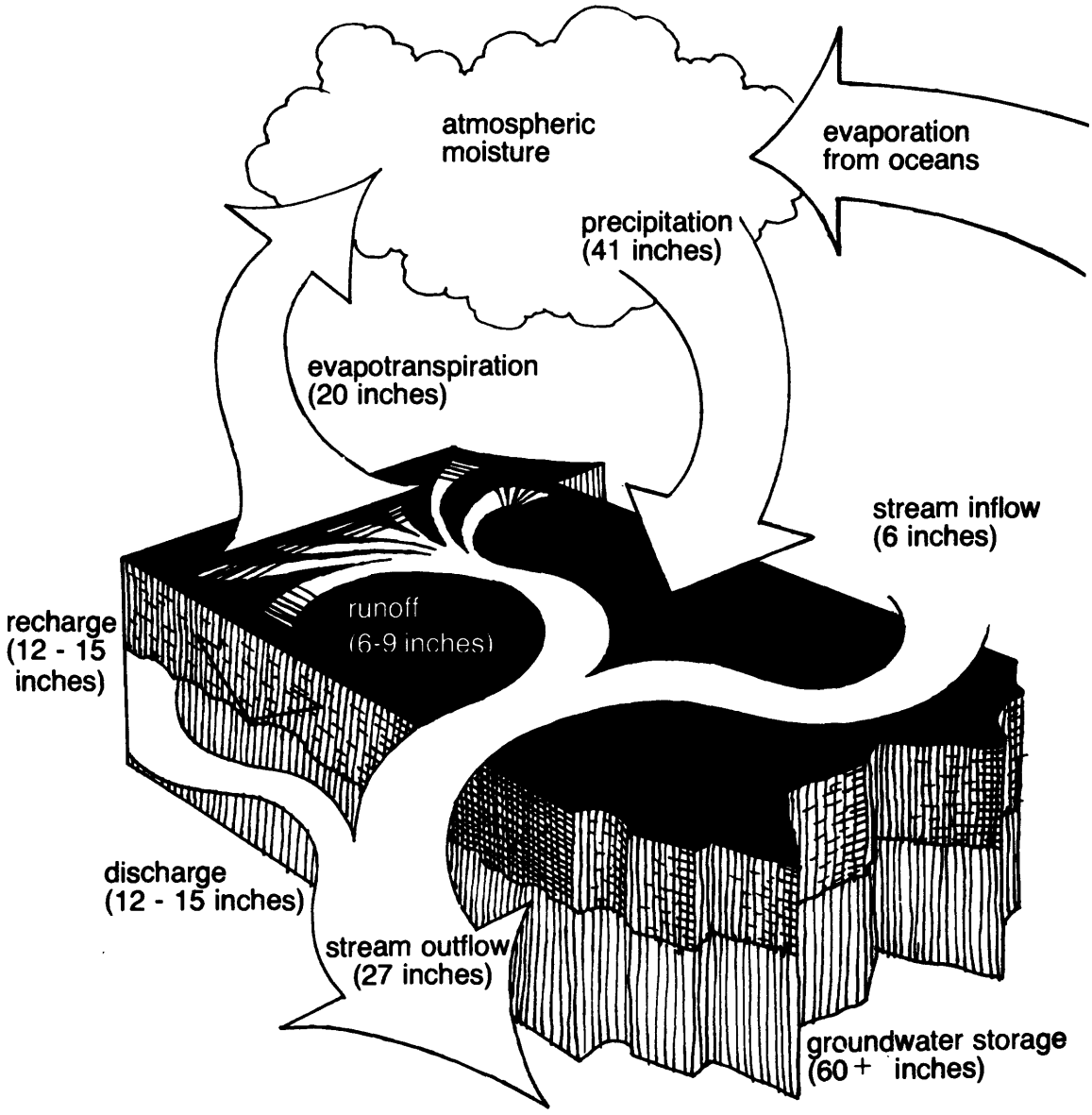
Erosion and Sedimentation - Erosion and sediment transport are a problem at surface mines, developing urban areas and agricultural lands. To decrease the amount of sediment reaching streams, sedimentation ponds and erosion controls have been used near mines and sediment-control ordinances have been enacted for urban developments near Philadelphia.

Collection and analysis of sediment-transport data are parts of several projects, such as PA163 and PA169. The data for PA163 are used to define trends in sediment discharges and yields due to changes in coal-mine development. The data for PA169 are used to predict the rate of sediment accumulation in a reservoir and to estimate loads of chemical constituents carried in suspension.

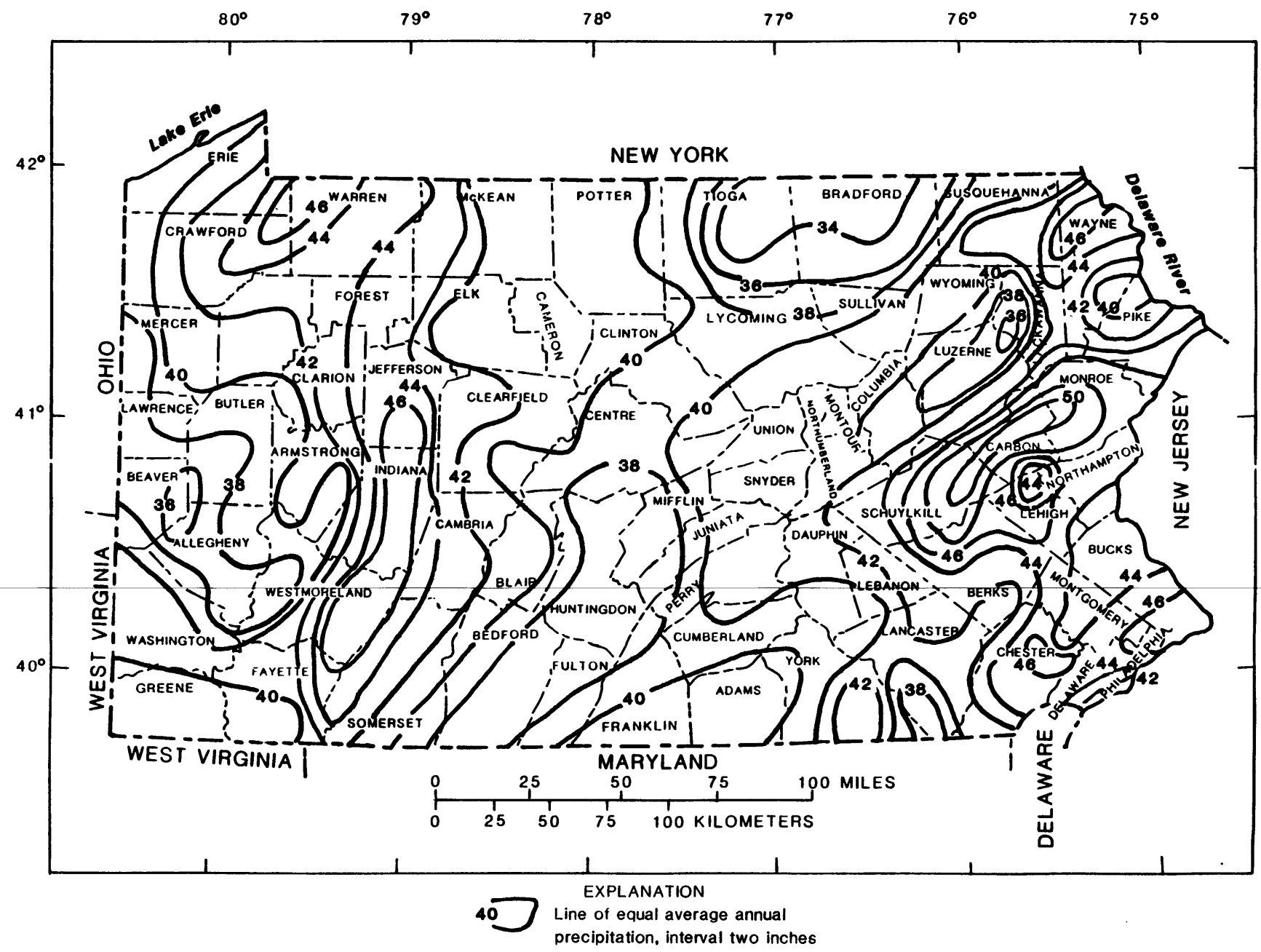
Wetlands, Lakes and Estuaries - The greatest concentration of wetlands in Pennsylvania is in the Pocono Mountains where the building of second homes threatens their areal extent and water quality. Pumping of ground water at coal mines near wetlands sometimes causes them to go dry, and the areas of wetlands are also reduced by road construction, flood-plain management and impoundments. Few studies have been done on wetlands in the State.

Interest in lakes, especially lake eutrophication, has increased recently due to the increased demand for high quality water, recreational use, and acid rain. In the past, several studies were done by U.S. Geological Survey in cooperation with PaDER and the Army Corps of Engineers, but at present only PA169 a study of water quality in Prompton Reservoir, is being done.

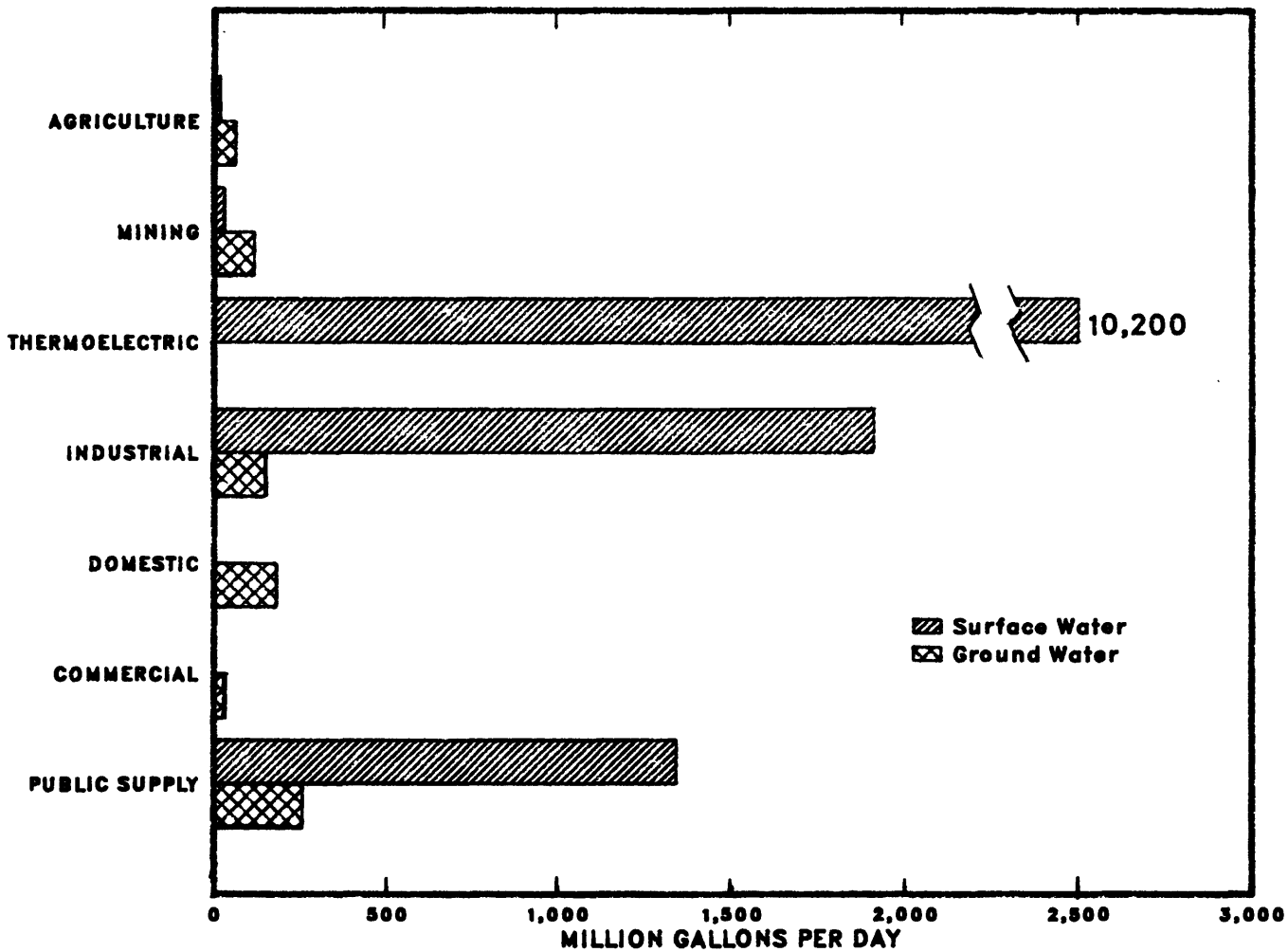
The Delaware River Estuary, the State's only estuary, is sampled routinely by the City of Philadelphia, and we have operated water-quality monitors at several sites for many years. Besides water-quality problems, the estuary must be dredged periodically becaused of sediment deposition. An overview of the water quality and physical processes in the estuary is needed to evaluate the effects of improved waste-water treatment that has cost more than a billion dollars.



Hydrologic cycle and water budget in Pennsylvania.



Average annual precipitation, in inches, 1951-80. (National Weather Service Data)



Water use in Pennsylvania based on 1985 data.

NATIONAL WATER DATA EXCHANGE

The National Water Data Exchange (NAWDEX) is a confederation of organizations that was established in 1976 as the outgrowth of recommendations made by the two advisory committees to the Secretary of the Interior to improve access to all federally acquired water data. Its primary objective is to assist in the identification, location, and acquisition of water data. Toward this goal, the NAWDEX Program Office and its 75 Assistance Centers, which include the Water Resources Division District Offices, provide a variety of services:

(1) Identification of Water-Data Collection Sites--the NAWDEX Master Water Data Index identifies 460,000 water-data sites (collection organizations, site locations, data types, measurement frequencies, and storage media).

(2) Identification of Water-Data Sources--the NAWDEX Water Data Source Directory identifies the more than 800 organizations that collect water data, the specific locations within the organizations that provide data, the organizations' geographic coverage and data types, and alternate sources of data.

(3) Water-Data Search Assistance--the NAWDEX Program Office and its 75 Assistance Centers help water-data users locate and obtain data. For instance, they will make bibliographic searches in the Water Resources Scientific Information Center's selected water resources abstracts. Charges for services depend on the type of service requested and the organization fulfilling the request.

The NAWDEX headquarters address is: National Water Data Exchange, U.S. Geological Survey, 421 National Center, Reston, VA 22092 (703) 648-5677.

NATIONAL WATER-DATA STORAGE AND RETRIEVAL SYSTEM

The National Water-Data Storage and Retrieval System (WATSTORE) provides the data which are the basis of book and map reports that describe and analyze the Nation's water resources. These hydrologic data are used not only in determining the adequacy of water supplies, but also in designing dams, bridges, and flood-control projects; in allocating irrigation waters; in locating sources of pollution; in planning for energy development; and in predicting the potential effects on water supplies of the storage of radioactive waste. The U.S. Geological Survey began WATSTORE in 1971, to improve access to the vast amount of water data collected by the Water Resources Division.

All types of water data are accessed through WATSTORE. The data in WATSTORE are grouped and stored in five files, depending on common characteristics and data collection frequencies:

(1) Station Header File--an index for the 320,000 water-data storage sites;

(2) Daily Values File--more than 240,000 daily parameters such as streamflow, ground-water levels, specific conductance, and water temperatures;

(3) Peak Flow File--460,000 records on annual maximum streamflow gage height values;

(4) Water-Quality File--2,300,000 analytical results that describe biological, chemical, and physical water characteristics; and

(5) Ground-Water Site-Inventory File (independent but cross-referenced to Daily Values and Water-Quality Files)--data on 850,000 sites (construction history, geohydrologic data, and one-time field measurements).

Information on availability of specific types of data, acquisition of data or products, and on user charges can be obtained from the Water Resources Division District Offices.

WATER RESOURCES SCIENTIFIC INFORMATION CENTER

The Water Resources Scientific Information Center (WRSIC) was established in 1966 as a national center to increase the availability and knowledge of water-related scientific and technical information. To accomplish this purpose, WRSIC abstracts water-resources publications from throughout the world and makes this bibliographic information available to the water-resources community and the public through publications and computerized bibliographic information services. WRSIC formerly was located in the Office of Water Research and Technology, and, in late 1982, the Secretary of the Interior transferred it to the Geological Survey's Water Resources Division where it would complement the Division's longstanding program of disseminating water information to the public. Information on WRSIC products, such as "Selected Water Resources Abstracts," can be obtained from the WRSIC Program Office, Branch of Water Information Transfer at Water Resources Scientific Information Center, U.S. Geological Survey, 425 National Center, Reston, VA 22092 (703) 648-6821.

PUBLIC INFORMATION SERVICE

Hundreds of hours are spent annually by the Pennsylvania District responding to over 1,000 data/information requests. These requests are received from public officials at all levels of government, water management personnel, consultants, universities, industry, and the public. In addition to providing information and materials for specific needs and making distribution of water-resource reports, district staff answer general questions on hydrology, water as a resource, and hydrologic mapping, as well as on the products, projects, and services of the Water Resources Division.

CURRENT PROJECTS

SURFACE-WATER STATIONS (PA001)

LOCATION: Statewide

COOPERATOR(S): PaDER, Bureau of Water Resources Management; National Oceanic and Atmospheric Administration (NOAA)

PERIOD OF PROJECT: Continuous since June 1931

PROJECT CHIEF: Carney P. Humphreys, Jr.

HEADQUARTERS OFFICE: Harrisburg, PA

PROBLEM: Surface-water information is needed for purposes of surveillance, planning, design, hazard warning, operation and management in water-related fields such as water supply, hydroelectric power, flood control, irrigation, bridge and culvert design, wildlife management, pollution abatement, flood-plain management, and water resources development. To provide this information, an appropriate data base is necessary.

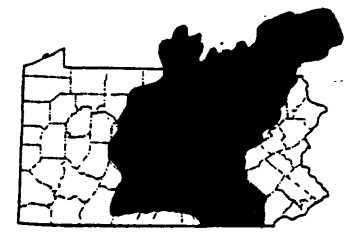
OBJECTIVE: A. To collect surface-water data sufficient to satisfy needs for current-purpose uses, such as 1) assessment of water resources, 2) operation of reservoirs or industries, 3) forecasting, 4) disposal of wastes and pollution controls, 5) discharge data to accompany water-quality measurements, 6) compact and legal requirements, and 7) research or special studies. B. To collect data necessary for analytical studies to define for any location the statistical properties of, and trends in, the occurrence of water in streams, lakes, and estuaries for use in planning and design.

APPROACH: To collect stream discharge, stream and lake stage data from a network of gaging stations to define streamflow conditions within the state of Pennsylvania. Standard methods of data collection will be used as described in the series, "Techniques of Water Resources Investigations of the U.S. Geological Survey."

PROGRESS: Hydrologic data for continuous record, reservoir, and partial-record surface-water stations in the state of Pennsylvania are published in the annual series "Water Resources Data - Pennsylvania." These data reports are published in three volumes: Volume 1 - Delaware River Basin; Volume 2 - Susquehanna and Potomac River Basins; and Volume 3 - Ohio and St. Lawrence River Basins. Presently operating 529 active sites; 275 continuous recording and 254 others.

PLANS: Continue operation of the surface water data network incorporating changes by supplementing network with new, discontinued, or relocated data sites.

SUSQUEHANNA FLOOD FORECASTING SYSTEM IMPROVEMENT PROGRAM



LOCATION: Central Pennsylvania

COOPERATOR(S): NOAA, National Weather Service

PERIOD OF PROJECT: February 1986 to September 1988

PROJECT CHIEF: Clayton D. Kauffman, Jr.

HEADQUARTERS OFFICE: Harrisburg, PA

PROBLEM: Average annual flood damages in the Susquehanna Basin are about $82,500,000 (1984 dollars). Studies indicate that improved flood warning coupled with various preparedness measures can reduce damages by 10 to 15 percent.

OBJECTIVE: To upgrade the data collection network in the basin as part of the overall improvement program which also includes improved hydrologic forecasting capability, enhanced forecast and warning dissemination, and improved radar coverage.

APPROACH: Provide more data to the Middle Atlantic River Forecast Center by constructing 13 new stream gages and installing 33 air temperature and 61 precipitation gages in the basin. Accomplish more timely collection of data by installing satellite telemetry DCPs and landline telemetry (telephone modems) on 39 stream, 33 air temperature, and 79 precipitation gages, and improving the Harrisburg satellite receive site by upgrading computer capabilities and providing an uninterruptible power supply and spare components to virtually eliminate down time.

PROGRESS: All instruments have been purchased, 50 percent have been installed, one construction site is essentially completed, three are ready for invitation for bids, a new computer upgrade has been ordered, and data collection training has been accomplished.

PLANS: Continue the same as in the past until all elements of the project are completed.

GROUND-WATER STATIONS (PA002)

LOCATION: Statewide

COOPERATOR(S): PaDER, Bureau of Topographic and Geologic Survey

PERIOD OF PROJECT: Continuous since January 1931

PROJECT CHIEF: Henry J. McCoy

HEADQUARTERS OFFICE: Harrisburg, PA

PROBLEM: Long-term water-level records are needed to evaluate the effects of climatic variations on the recharge to and discharge from the ground-water systems, to provide a data base from which to measure the effects of development, to assist in the prediction of future supplies, and to provide data for management of the resource.

OBJECTIVE: To collect water-level data sufficient to provide a minimum long-term data base so that the general response of the hydrologic system to natural climatic variations and induced stresses is known and potential problems can be defined early enough to allow proper planning and management. To provide a data base against which the short-term records acquired in areal studies can be analyzed. This analysis must 1) provide an assessment of the ground-water resource, 2) allow prediction of future conditions, and 3) provide the data base necessary for management of the resource.

APPROACH: Data from the observation well network and project wells will be collected and processed in the subdistricts. PaDER's well completion reports will be translated to the Ground Water Site Inventory (GWSI) file.

PROGRESS: All ground-water network data were collected on schedule and published in the annual series "Water Resources Data-Pennsylvania." Translation of well completion reports to GWSI file continued.
Presently operating 62 continuous sites.

PLANS: Continue with translation of PaDER well completion reports to GWSI file. Continue to operate network through subdistrict offices.

FLOOD INVESTIGATIONS (PA006)

LOCATION: Statewide

COOPERATOR(S): Federal Emergency Management Agency (FEMA)

PERIOD OF PROJECT: July 1972 to September 1987

PROJECT CHIEF: Herbert N. Flippo

HEADQUARTERS OFFICE: Harrisburg, PA

PROBLEM: 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 needs flood studies in selected areas to determine applicable flood insurance premium rates.

OBJECTIVE: To conduct the necessary hydrologic and hydraulic evaluations and studies of areas assigned by FEMA and to present the results in an appropriate format.

APPROACH: To conduct the necessary evaluations or to conduct surveys by ground or photogrammetric methods. Determine flood-discharge frequency relationships using local historical information, gaging station records, or other applicable information. Determine water-surface profiles using step-backwater models or by other acceptable methods and furnish the results in reports prepared to FEMA specifications.

PROGRESS: All 197 studies have been completed, 157 of which have been submitted to FEMA and the remainder are in review. A procedure for estimating 100-year depths, Water Resources Investigations Report (WRIR 86-4195) was prepared to provide data for part of the community studies.

PLANS: Complete review of the remaining studies.

PROGRAM FOR THE COLLECTION, STORAGE, AND RETRIEVAL OF WATER-USE DATA IN PENNSYLVANIA (PA007)

LOCATION: Statewide

COOPERATOR(S): PaDER, Bureau of Water Resources Management

PERIOD OF PROJECT: Continuous since October 1977

PROJECT CHIEF: John R. Ritter

HEADQUARTERS OFFICE: Harrisburg, PA

PROBLEM: Waters in Pennsylvania are under stress to supply increasing demands for domestic, industrial, agricultural, and other uses. Competition for water dictates that available supplies be matched with uses most beneficial to the common good. Information has been collected for many years describing quantity and quality of available water. Information on use of water is needed also if the best decisions are to be made about critical water problems such as resource allocations, water-quality residuals, environmental impact, and energy development.

OBJECTIVE: To provide water-use information for the optimum utilization and management of the State's water resources for the overall benefit of the people of Pennsylvania and the United States. This program will modify and improve the State's existing system to collect, store, and disseminate water-use data to complement data on availability and quality of the State's water resources. The new system will be responsive to the data needs of local users, the Geological Survey, and other federal agencies.

APPROACH: Responsibilities will be divided between the cooperator and the Geological Survey to reflect the most efficient means of meeting the objectives of the program. Direction, management, and standards development to meet the National needs will be the responsibility of the Geological Survey. Field activities for the acquisition and storage of the data at the State level will be the primary responsibility of the PaDER, Bureau of Resources Management.

PROGRESS: Water use data were entered into the system. A report on water use in Pennsylvania was written, reviewed and revised.

PLANS: Submit report for approval. Obtain and enter data on return discharges for sewage treatment plants.

APPRAISAL OF WATER RESOURCES AND THE EFFECTS OF COAL MINING ON THE WATER RESOURCES OF WASHINGTON COUNTY, PA (PA107)

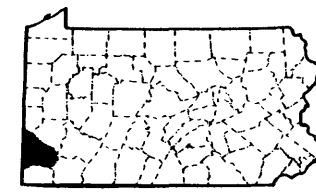
LOCATION: Southwestern Pennsylvania

COOPERATOR(S): PaDER, Bureau of Topographic and Geologic Survey

PERIOD OF PROJECT: October 1982 to September 1986

PROJECT CHIEF: Donald R. Williams

HEADQUARTERS OFFICE: Pittsburgh, PA



PROBLEM: Washington County authorities and citizens are concerned about the effect that large-scale mining will have on their water resources. They are particularly concerned about the reduction of ground-water storage in shallow aquifers and the effect on municipal reservoirs which service about 75 percent of the county residents. There is also concern of the acid mine drainage problem expanding to uneffected areas of the county. The problems confronting Washington County are compatible with priorities established for federal energy resource studies, particularly in the field of coal hydrology.

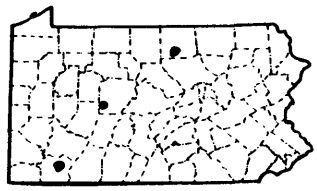
OBJECTIVE: (1) Appraise the ground-water resources of Washington County. (2) Evaluate the effect of mining on hydrology in general and on ground-water supplies serving populated areas overlying subsurface coal yet to be mined, in particular. (3) Define the surface-water characteristics throughout the county in general and a main water-supply reservoir, in particular.

APPROACH: County-wide records of wells and springs will be compiled, field checked, and tabulated. Ground-water occurrence and availability will be further quantified with hydrologic testing of existing open wells. The hydrologic effects of coal mining will be determined principally by comparing hydrologic conditions in a mined and unmined watershed. Streamflow data collected at six gaging stations and approximately 40 intermittent sites will be used to develop low-flow frequency data. Water quality data will be collected at selected ground-water and surface-water sites to delineate geochemical trends along the ground-water flow path and to determine the severity of acid mine drainage throughout the county.

PROGRESS: Report completed - currently in the review process. Removed most of the gaging stations and observation well shelters from the county. Project complete except report.

PLANS: Revise report after reviews. Transmit for approval.

DISTRIBUTED PARAMETER AND STORM LOAD SEDIMENT MODELS FOR SURFACE MINING IN PENNSYLVANIA (PA108)



LOCATION: Central Pennsylvania

COOPERATOR(S): None

PERIOD OF PROJECT: November 1979 to September 1985

PROJECT CHIEF: Lloyd A. Reed

HEADQUARTERS OFFICE: Harrisburg, PA

PROBLEM: Control of suspended sediment from areas affected by surface mines depends on the amount of sediment and runoff produced, and the effectiveness of the methods used to control the sediment. Methods are needed to predict sediment concentrations and yields from surface mines with respect to different soil types, the different phases associated with surface mining, and the sediment control ponds.

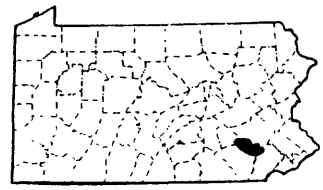
OBJECTIVE: Measure sediment discharge on a storm basis from five hydrologic response units that are affected by surface mining. Develop a model to predict sediment discharges based on precipitation, area, mining phase, season, soil particle size distribution, soil type, slope, and pre- and post land use. Predict the effectiveness of sediment-control ponds in reducing sediment loads and sediment concentrations.

APPROACH: Rainfall runoff and sediment discharge will be measured from five hydrologic response units where coal is being surface mined, above and below three sediment control ponds. The area disturbed by different phases of mining will be determined monthly, and the areas that drain internally (slope toward the pit) will also be determined. A sediment discharge highway construction model developed for the Pennsylvania Department of Transportation will be modified for surface mining sites. The model predicts sediment discharge on a storm by storm basis. The distributed parameter model that predicts instantaneous water discharge and sediment concentration will be tested using the data collected from the eight gaging stations.

PROGRESS: Project complete except report.

PLANS: Revise report and submit for approval.

EFFECTS OF AGRICULTURAL BEST MANAGEMENT PRACTICES ON NONPOINT SOURCES IN THE CONESTOGA RIVER BASIN ABOVE LANCASTER, PA (PA118)



LOCATION: Southeastern Pennsylvania

COOPERATOR(S): PaDER, Bureau of Water Quality Management

PERIOD OF PROJECT: January 1981 to September 1991

PROJECT CHIEF: Patricia L. Lietman

HEADQUARTERS OFFICE: Harrisburg, PA

PROBLEM: The surface and ground waters of the Upper Conestoga River basin, Lancaster County, are degraded by runoff and infiltration from intensive agriculture. Suspended sediment, phosphorus, nitrates, and bacteria are excessive in many parts of the basin, particularly those areas underlain by carbonate formations. The basin is one of the twelve watersheds designated for implementation of Best Management Practices (BMPs) as part of the National Rural Clean Water Program (RCWP). Minimal data are available to assess the effectiveness of BMPs in controlling agricultural runoff and infiltration to the ground water system. Virtually no data are available to assess the effects of BMP installation on water chemistry, particularly bacteria and nitrate.

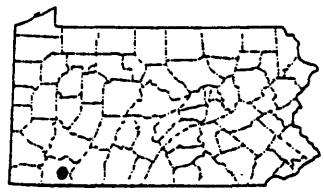
OBJECTIVE: To define the surface-water and ground-water quality and to monitor any changes in water quality during and after BMP installations in the Upper Conestoga River basin. To evaluate changes in runoff and surface-water and ground-water quality due to installation of BMPs at two small sites (about 50 acres each) and one larger site (about 5 square miles) in the basin.

APPROACH: Nutrient and herbicide concentrations in ground and surface water and suspended-sediment concentrations in surface water will be monitored before and after the implementation of BMPs at three sites. Two field sites and a small watershed will be monitored for water quality through the use of continuous-record or partial-record gaging stations, automatic samplers, recording rain gages and wells. Statistical analysis and hydrologic models will be used to evaluate changes in water quality.

PROGRESS: Post-BMP monitoring was continued at Field Site 1. Pre-BMP monitoring was completed in the small watershed basin in March 1986; nutrient management BMPs were implemented at that time and post-BMP monitoring began. Pre-BMP monitoring was completed at Field Site 2; nutrient management practices will be installed and post-BMP monitoring began in October 1986. Preliminary data analysis of Field Site 1 shows increasing trends in ground water nitrate concentrations, decreasing suspended sediment and phosphorus concentrations in runoff, and increasing nitrogen concentrations in runoff as a result of terracing and nutrient management. One report and a journal article have been published and a Fact Sheet has been approved.

PLANS: Post-BMP monitoring will continue at all sites. Two more reports will be written and entered in the review process.

IMPACTS OF SURFACE MINING ON WATER QUALITY OF THE STONY FORK WATERSHED, FAYETTE COUNTY, PENNSYLVANIA (PA124)



LOCATION: Southwestern Pennsylvania

COOPERATOR(S): PaDER, Bureau of Surface Mine Reclamation

PERIOD OF PROJECT: October 1981 to September 1986

PROJECT CHIEF: John R. Ritter

HEADQUARTERS OFFICE: Pittsburgh, PA

PROBLEM: The PaDER, Bureau of Mining and Reclamation (BMR), and other regulatory agencies need to know the impacts of surface mining on the hydrologic environment in order to properly evaluate permit applications for surface mining. The BMR is particularly interested in areas which they consider sensitive; for example, watersheds of high quality and low buffering capacity. Stony Fork is considered a sensitive watershed by the BMR; its alkalinity averages 10 mg/L, its pH ranges between 6.0 and 7.0 and its specific conductance is usually less than 200 µS/cm. A substantial data base has already been established under Project PA080, but an extension of the data-collection program is needed so that the hydrologic impacts of future mining and reclamation practices can be determined.

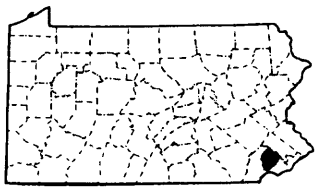
OBJECTIVE: To determine the cumulative impacts of mining, particularly reclamation, on the hydrologic environment with respect to water quality, and patterns of streamflow during mining and reclamation.

APPROACH: The gaging stations 03070420 (Stony Fork Tributary near Gibbon Glade, PA) and 03070455 (Stony Fork near Elliottsville, PA) would continue data collection including surface water discharge, precipitation, suspended sediment, and water quality (pH, specific conductance and water temperature). The gaging stations are equipped with analog digital recorders (ADR) for stream stage, U.S. Geological Survey flow thru water quality monitors (pH, specific conductance, and temperature), PS-69 pumping sediment samplers and recording rain gages. One of the gaging stations (03070420) is upstream from all mining and has had no land-use change during the data collection. The other gaging station (03070455) is downstream from all mining activity. Samples are collected at five partial record stations for laboratory analysis.

PROGRESS: Report written and in technical review. Project complete except report.

PLANS: Publish report.

IMPACT OF URBANIZATION ON THE QUALITY AND QUANTITY OF STREAMFLOW AND GROUND-WATER RECHARGE IN EASTERN CHESTER COUNTY, PENNSYLVANIA (PA129)



LOCATION: Southeastern Pennsylvania

COOPERATOR(S): Chester County Water Resources Authority

PERIOD OF PROJECT: October 1981 to September 1985

PROJECT CHIEF: Ronald A. Sloto

HEADQUARTERS OFFICE: Malvern, PA

PROBLEM: A large regional sewer system constructed in the Valley Forge area has reduced the quantity of ground-water recharge and streamflow in the Crum, Valley, Darby, Pickering, and Ridley Creek basins. The quality of water in the streams and ground may have changed.

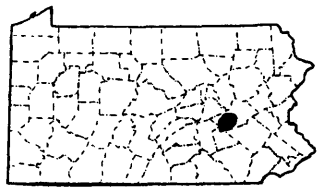
OBJECTIVE: Determine to what extent streamflow and recharge to ground water has been reduced by urbanization. Determine how quality of both ground and surface water has been changed by urbanization. Special emphasis will be placed on the impact of sewering the study area.

APPROACH: A 6- month planning study will be made to: (1) do a literature search, (2) collect and evaluate existing data, (3) evaluate applicable models, (4) plan data collection program, (5) prepare a report outline, and (6) prepare detailed project documents detailing manpower and cost.

PROGRESS: Project is complete except reports.

PLANS: Reports are in review. Director's approval anticipated in FY87.

PREIMPOUNDMENT STUDY OF THE QUALITY OF WATER OF
SWATARA STATE PARK RESERVOIR (PA132)



LOCATION: Central Pennsylvania

COOPERATOR(S): PaDER, Bureau of State Parks

PERIOD OF PROJECT: November 1981 to March 1985

PROJECT CHIEF: David Fishel

HEADQUARTERS OFFICE: Harrisburg, PA

PROBLEM: A multipurpose reservoir is to be built in Swatara State Park. Although the primary purpose is for recreation, storage in the impoundment will also be allocated for supplemental water supply. The proposed impoundment will be downstream from an area that has been extensively mined for anthracite. Acid mine drainage from the headwaters of Swatara Creek, culm and sediment from abandoned and active mines, and nutrient loads from agricultural drainage will flow into the reservoir. The effect of these discharges on the quality of water in the reservoir and water to be released to downstream users is unknown.

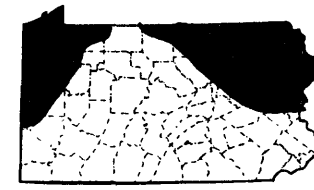
OBJECTIVE: To characterize the water and sediment entering the impoundment area and to estimate the effect of the reservoir on water quality. Specific objectives are: (1) To determine concentrations of sediment, nutrients, major ions, and selected metals common to acid mine drainage and the average annual load of constituents entering the impoundment area. (2) To determine the concentration of nutrients and metals in the streambed material and soils in the impoundment area. (3) To estimate the future quality of water in the reservoir and Swatara Creek downstream of the reservoir.

APPROACH: Water discharge will be monitored continuously at two sites upstream from the proposed impoundment. Suspended sediment will be sampled daily during base flow conditions and more frequently during storms. Automatic samplers will be used. Daily, monthly, and annual sediment discharges will be determined at each site. Water-quality samples will be collected monthly and during three storms per year to define temporal variation in constituent concentrations for nutrients, major ions and trace metals. A third monitoring site downstream of the impoundment will consist of a rated wire-weight gage with monthly and storm sampling for sediment and chemical constituents. Data at the downstream site will be used to compare preimpoundment water quality with estimated quality of water released from the reservoir. All water-quality data will be entered into the U.S. Geological Survey Water Data Storage and Retrieval System (WATSTORE).

PROGRESS: The published preliminary report was given to the cooperator on September 2, 1986. An abstract of the final results was presented at the U.S. Geological Survey Northeast Region Water Quality Conference. The final report has been reviewed by the cooperator, and PaDER, Bureau of Water Quality, Dams and Waterways, and Mining and Reclamation. The final report is at regional review. Project complete except report.

PLANS: Final report will be prepared for Director's approval.

NORTHEAST GLACIAL VALLEYS REGIONAL AQUIFER SYSTEM ANALYSIS (RASA) (PA133)



LOCATION: North-central Pennsylvania

COOPERATOR(S): None

PERIOD OF PROJECT: February 1982 to September 1984

PROJECT CHIEF: David J. Wangsness

HEADQUARTERS OFFICE: Harrisburg, PA

PROBLEM: Hydrologic, hydraulic, and geologic data are needed on the glacial valleys of Pennsylvania for the Northeast Glacial Valleys Regional Aquifer System Analysis (RASA).

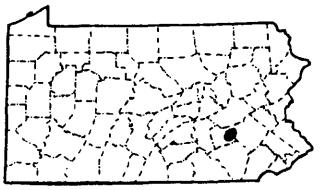
OBJECTIVE: To collect, compile, and interpret data to determine the geohydrologic character of the glacial valleys in Pennsylvania.

APPROACH: Proposals were prepared to do interpretive studies in three areas in northwestern and northcentral Pennsylvania. None of the areas were selected for the first phase of studies. Geohydrologic data are collected, compiled, and interpreted as directed by the RASA Team.

PROGRESS: Analyzed geologic, geophysical, and surface- and ground-water hydrologic data at the tributary-stream infiltration sites in Tioga County. Began development of ground-water flow model at Asaph. Began preparation of report.

PLANS: Complete development of ground-water flow model and prepare report.

WATER RESOURCES OF THE FURNACE CREEK BASIN,
LEBANON AND BERKS COUNTIES, PA (PA139)



LOCATION: Southeastern Pennsylvania

COOPERATOR(S): Mill Creek Township

PERIOD OF PROJECT: October 1982 to September 1985

PROJECT CHIEF: L. DeWayne Cecil

HEADQUARTERS OFFICE: Malvern, PA

PROBLEM: Pumpage will increase with increasing population. Because much of the rock in the basin has a very low permeability and specific yield, interference between wells may be serious. Also, runoff available to a public-supply reservoir will decline. The hydrology needs to be studied to manage the water resources properly.

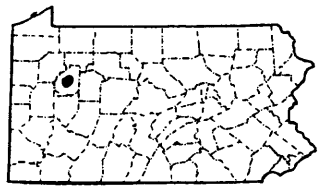
OBJECTIVE: Describe the availability and quality of the water resources of the Furnace Creek basin. Show how this study can be used to understand the water resources of the rest of the Reading Prong.

APPROACH: A recording gage (pipe well) will be established on Furnace Creek and 2 years of data collected. Three nonrecording daily precipitation stations and 10 observation wells will be operated. A water budget will be prepared from these data. Wells will be inventoried, a water-table map prepared, pumping tests conducted, and well yields will be estimated. Ground and surface-water samples will be collected and analyzed.

PROGRESS: Project in report writing stage. Daily diversion values from Womelsdorf- Womelsdorf Robesonia Joint Water Authority for 1985 and 1986 WYs have been obtained and will be applied to surface water station data for baseflow separation and water budget calculations. Project complete except report.

PLANS: Complete report.

APPLICATION OF LIMESTONE QUARRY WASTE IN THE ABATEMENT OF ACIDIC DRAINAGE FROM A COAL STRIP-MINE SITE (PA142)



LOCATION: West-central Pennsylvania

COOPERATOR(S): PaDER, Bureau of Surface Mine Reclamation

PERIOD OF PROJECT: January 1983 to September 1988

PROJECT CHIEF: David J. Wangsness

HEADQUARTERS OFFICE: Harrisburg, PA

PROBLEM: Acid from strip-mine spoil is a major source of acidic drainage in Pennsylvania and other eastern coal-producing states. Applying limestone quarry waste on strip-mine spoil promises to abate acid mine drainage. Research is needed to test this abatement technique at a large field site.

OBJECTIVE: To evaluate the effectiveness of applying limestone quarry waste on coal strip-mine spoil in abating acidic drainage.

APPROACH: The study will be a cooperative effort of the U.S. Geological Survey, Pennsylvania State University, and PaDER. Limestone quarry waste will be applied (250 and 500 tons per acre) on strip-mine spoil at two test plots (each 2.5 acres in size). A third area will serve as a control plot. Water quality of the saturated and unsaturated zones, seeps, springs and streams at the test site will be monitored in order to evaluate the abatement technique.

PROGRESS: Twelve months of pretreatment and 36 months of post-treatment water-quality data have been collected from the saturated zone, seeps, and stream at the test site. Two months of pretreatment and 36 months of post-treatment data have been collected from the unsaturated zone. Preliminary analysis of data indicates positive benefits to the mine discharges as a result of the limestone application. Pretreatment data collection has been completed. An interim report describing the hydrology and geochemistry of the mine site has been written and is on-going.

PLANS: Interpret the data and complete the report.

HYDROLOGY OF THE GLACIATED VALLEYS OF THE SUSQUEHANNA RIVER BASIN, APPALACHIAN PLATEAU PROVINCE, PENNSYLVANIA (PA143)

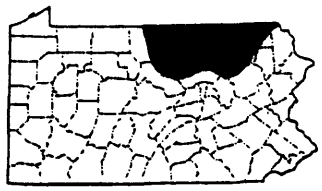
LOCATION: Northeastern and North-Central Pennsylvania

COOPERATOR(S): PaDER, Bureau of Topographic and Geologic Survey

PERIOD OF PROJECT: January 1983 to September 1987

PROJECT CHIEF: David J. Wangsness

HEADQUARTERS OFFICE: Harrisburg, PA



PROBLEM: The many surface-water withdrawals from the Susquehanna River may affect the availability of water to some users and the quality of the river during drought conditions. A possible solution to the problem is the availability of water in the unconsolidated aquifers underlying the glaciated valleys in the upper part of the Susquehanna River basin. Information is needed on the hydrogeology of the valley-fill aquifers for proper water-resource management and development.

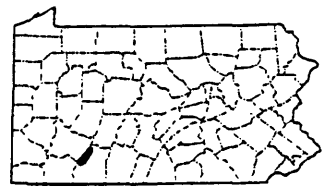
OBJECTIVE: To evaluate the unconsolidated aquifers underlying the glaciated valleys of the study area.

APPROACH: Will do surficial mapping, geophysical investigations, test drilling, well inventory, pumping-test analysis, ground-water level monitoring, seepage runs, collection and analysis of water-quality samples, and development of a ground-water flow model in a selected area (possibility Towanda).

PROGRESS: Analyzed geologic, geophysical, and ground-water hydrologic and water-quality data and began preparation of final report.

PLANS: Complete final report.

EFFECTS OF ACID RAIN ON THE WATER QUALITY OF LAUREL RIDGE, SOMERSET COUNTY, PENNSYLVANIA (PA145)



LOCATION: Southwestern Pennsylvania

COOPERATORS(S): U.S. Environmental Protection Agency

PERIOD OF PROJECT: April 1983 to September 1993

PROJECT CHIEF: Emitt C. Witt

HEADQUARTERS OFFICE: Pittsburgh, PA

PROBLEM: Headwater streams in portions of Somerset County, Pennsylvania are extremely sensitive to acidic deposition and chemical weathering of soils. As a result of this situation there is possible damage to fish and other components of the aquatic ecosystem.

OBJECTIVE: To determine the effects of acidic deposition on the chemistry of a group of poorly buffered headwater streams. The immediate effects of storms and snowmelt will be assessed as well as temporal trends over a period of several years.

APPROACH: Approximately seven 2 to 3 mi^2 forested basins have been selected for long-term (10 years plus or minus) monitoring. One fully instrumented primary site will be equipped with stage recorder, precipitation monitor, wet/dry deposition collector, and automatic pumping sampler. The primary site will be sampled for a number of indicator constituents monthly at various flows, and intensively during about four storms and snowmelt each year. The six satellite sites will be sampled monthly. The data will be treated to a 'Seasonal Kendall' test for trend.

PROGRESS: Completed over 40 months of base flow chemical analyses at long-term monitoring site. Completed data summary for national report by headquarters. Sampling of satellite sites terminated as of March 1986.

PLANS: Continue monthly baseflow chemical analyses at long-term monitoring site at North Fork Bens Creek. Publish comprehensive report showing results of data collected through September 1986.

GROUND WATER RESOURCES OF CAMBRIAN AND ORDOVICIAN CARBONATE ROCKS IN THE VALLEY AND RIDGE PROVINCE IN PENNSYLVANIA (PA146)

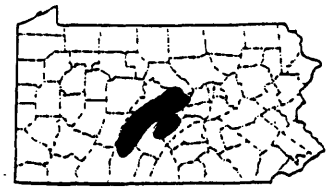
LOCATION: Central Pennsylvania

COOPERATOR(S): PaDER, Bureau of Topographic and Geologic Survey

PERIOD OF PROJECT: July 1983 to December 1986

PROJECT CHIEF: Albert E. Becher

HEADQUARTERS OFFICE: Harrisburg, PA



PROBLEM: During the drought period of 1980-81, eight communities using water from the Cambrian and Ordovician carbonate rocks in several elongated, anticlinal valleys in central Pennsylvania experienced severe water shortages. High concentrations of nitrate have been found in the water supply of another community and recent water-quality data indicates the problem may be widespread. Detailed hydrologic information is needed to aid in efforts to reduce the impact of drought and to define the areal extent and severity of nitrate contamination.

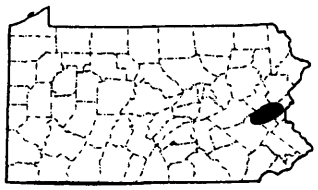
OBJECTIVE: (1) To evaluate and describe quantitatively the ground-water resources of the Cambrian and Ordovician carbonate rocks in the Appalachian Mountain Section of the Valley and Ridge Province in Pennsylvania. (2) To determine the areal extent and degree of nitrate contamination and the quality of ground water. (3) To estimate the effects of below normal recharge on water levels.

APPROACH: Analyze existing data in the Ground Water Site Inventory (GWSI), Water Quality and Daily Values files, published reports and unpublished information from other sources to determine new data needs. Inventory wells and obtain continuous water-level data from about five wells and area-wide synchronous measurements for two periods. Collect about 75 ground-water samples to be analyzed for the major ions including nitrate, and selectively for lead, silver, arsenic, zinc, cadmium, chromium, nickel, organics and fecal coliform. Statistical Analysis Sytem (SAS) univariate and plot statistical procedures will be used to create graphs and tables to describe and compare properties of the ground-water resource.

PROGRESS: All water quality data have been entered into the database. The water quality and ground-water site inventory files have been corrected and manipulated to produce tables and statistical analysis of stored data. Base maps for the final report were prepared and the geology was drafted on these. Well locations and numbers were drafted on the mylar base by computer and plotter.

PLANS: Complete writing of report and submit for review.

A MODEL OF GROUND-WATER FLOW IN THE CARBONATE ROCK OF THE LITTLE LEHIGH CREEK BASIN, LEHIGH COUNTY, PA (PA148)



LOCATION: Southeast Pennsylvania

COOPERATOR(S): Delaware River Basin Commission

PERIOD OF PROJECT: October 1983 to September 1986

PROJECT CHIEF: Ronald A. Sloto

HEADQUARTERS OFFICE: Malvern, PA

PROBLEM: The Delaware River Basin Commission (DRBC) and the basin states want to protect and possibly augment the base flows of streams while permitting some additional ground-water development. Although ground-water flow models exist for metamorphic rocks and the Coastal Plain, none have been developed within the Delaware River basin for other rock types. Because the carbonate rock aquifers are among the most important in terms of both use and yield, the DRBC wants a flow model of a carbonate rock area.

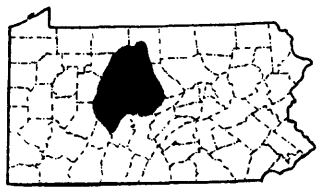
OBJECTIVE: Develop a ground-water flow model of the carbonate aquifer system in the Little Lehigh Creek basin to gain a detailed understanding of the hydrologic system to provide a foundation for sound water management practices. The conclusions reached in this study may be useful in the planning of withdrawals in other carbonate rock areas in the Delaware River basin.

APPROACH: A three-dimensional digital ground-water flow model of the carbonate rock aquifers in the Little Lehigh Creek basin will be calibrated, and if possible, verified. The completed model will be used to estimate the impacts of pumping wells on the base flow of Little Lehigh Creek.

PROGRESS: Second multiple observation well, 72 hour aquifer test completed. Calibration of steady state three-dimensional ground-water flow model for 1984 hydrologic conditions completed. Began simulation of 1981 drought conditions. Results for 1984 and 1981 simulations are computed. Generally, model results are used in refining hydrologic budgets. Some geophysical well logging was completed. Writing report. Project complete except report.

PLANS: Report in review process.

DETERMINATION OF THE CUMULATIVE IMPACT OF ACID MINE DISCHARGES TO THE WEST BRANCH SUSQUEHANNA RIVER BETWEEN CURWENSVILLE AND RENOVO, PENNSYLVANIA (PA150)



LOCATION: North-central Pennsylvania

COOPERATOR(S): None

PERIOD OF PROJECT: January 1984 to September 1984

PROJECT CHIEF: Robert A. Hainly

HEADQUARTERS OFFICE: Harrisburg, PA

PROBLEM: Many tributaries to the West Branch of the Susquehanna River between Curwensville and Renovo are inaccessible by roads. Because of the surface mining common in this area, it is suspected that many of these tributaries could be significantly affected by acid mine drainage. None of these tributaries have ever been sampled and their water quality is not known. The effect of these tributaries on the West Branch was indicated as recently as July 27, 1983, when the discharge of a regulated stream used to control the quality of the West Branch was decreased and the pH of the River at Williamsport dropped from 6.7 to 5.3 units in a 24-hour period.

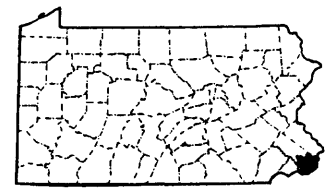
OBJECTIVE: (1) To measure the acid mine discharge of all the significant tributaries to the West Branch of the Susquehanna River between Clearfield and Renovo. (2) To determine the cumulative impact of the discharges on the water quality of the river.

APPROACH: Water-quality samples will be collected at 98 sites in the spring and summer of 1984. The water-quality constituents commonly associated with acid mine drainage will be determined. Field analyses will include water discharge, pH, specific conductance, acidity and alkalinity. Sulfate and dissolved and total iron, aluminum, manganese and zinc will be included in the laboratory analyses. Statistical analyses of concentration data and constituent load computations will be used to determine impacts of individual tributaries and the cumulative impact of all tributaries on the water quality of the West Branch.

PROGRESS: District review of the interpretive report indicated that more revision and reorganization is necessary before the report could be sent out for colleague review. Project complete except report.

PLANS: Revise the report as indicated by District reviewers and submit for colleague review. Planned publication date is December 1987.

CHEMICAL QUALITY OF GROUND WATER AS RELATED TO LAND USE ON THE ATLANTIC COASTAL PLAIN IN THE PHILADELPHIA, PA - CAMDEN, NJ AREA (PA153)



LOCATION: Southeastern PA, Southwestern NJ

COOPERATOR(S): None

PERIOD OF PROJECT: February 1984 to March 1985

PROJECT CHIEF: Charles R. Wood

HEADQUARTERS OFFICE: Malvern, PA

PROBLEM: Baseline ground-water quality needs to be appraised, especially for trace elements and organics. Several water quality problems have been identified in Philadelphia including high concentrations of iron, manganese, sulfate and locally volatile organic compounds. This poor quality water is moving under the Delaware River threatening water supplies in southern New Jersey.

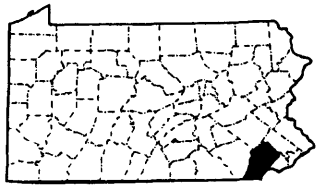
OBJECTIVE: (1) Compile existing land use, water quality and water use data. (2) Relate the effects of urbanization and land use on water quality in the shallow, unconfined coastal plain aquifer, the confined PRM aquifer system, and the related bedrock aquifer. (3) Estimate future impacts on water resources in the region. (4) Formulate hypotheses explaining unusual occurrences or quantities of various chemical constituents. (5) Define data needs with special regard for organics and trace metals.

APPROACH: Much hydrogeologic and water chemistry data exist for the region. Therefore, the major thrust will be to synthesize the existing data and compare it to land use type using graphical and statistical methods. Emphasis will be placed on organics, trace metals and contaminants derived from sewage sludge, although common constituents exceeding USEPA criteria for drinking water will also be studied.

PROGRESS: Report through colleague review. Project complete except report.

PLANS: Complete report.

WATER USE IN CHESTER COUNTY, PA (PA154)



LOCATION: Southeastern Pennsylvania

COOPERATOR(S): Chester County Water Resources Authority

PERIOD OF PROJECT: March 1984 to September 1987

PROJECT CHIEF: Karen Vogel

HEADQUARTERS OFFICE: Malvern, PA

PROBLEM: For its water supply, much of Chester County depends on small water companies that utilize only ground water. Many of these companies are withdrawing water at or near the sustained yield of the aquifers. Increased urbanization will produce local shortages. Also, existing adverse impacts of streamflow due to ground-water pumping will be further aggravated. These problems have become so serious that the DRBC has declared the eastern part of the county a ground-water protected area. Data on water use are needed to assess past, present and future effects of urbanization on ground water and other water supplies.

OBJECTIVE: To provide a county-wide, water-use data base and to document trends in use. The data base will be used to (1) develop water-use projections by surface-water source, by well, by supplier and by aquifer, (2) aid in planning for conjunctive use, and inter-connections of water companies, (3) aid in drought contingency planning, and (4) provide a basis for protecting in-stream uses. The study should demonstrate the utility of a water-use data base to county planners.

APPROACH: Water-use data from 1960 to date will be collected for each surface source and for each well that pumps more than 10,000 gal/d. Data on interbasin transfers and return flow will also be collected. These data will be entered into State Water Use Data System (SWUDS) on the Prime computer. Data on all wells for which use data are collected will be entered into the GWSI file. The county will be divided into grid blocks, and population and land-use data will be collected and assigned to each grid block. Estimates of maximum sustained yield and impacts of present and projected use on streamflow will be assessed. Trends in water use will be plotted.

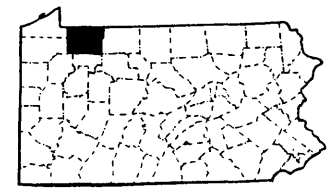
PROGRESS: Data collection is nearly complete and entered. Data has been consolidated from several different sources and is being organized into permanent format.

PLANS: Install MICRO-SWUDS program series on the cooperator's micro computer. Write software to enable two way data transfer between SWUDS and MICRO-SWUDS. Develop software programs to allow water budget analysis retrievals from the MICRO-SWUDS database.

GROUND-WATER QUALITY ASSESSMENT OF WARREN COUNTY, PA (PA157)

LOCATION: Northwestern Pennsylvania

COOPERATOR(S): PaDER, Bureau of Topographic and Geologic Survey; Warren County Commissioners



PERIOD OF PROJECT: July 1984 to December 1988

PROJECT CHIEF: Theodore F. Buckwalter

HEADQUARTERS OFFICE: Pittsburgh, PA

PROBLEM: Ground water is the predominent source for domestic and municipal water supplies for Warren County. Degradation of shallow ground water by industrial wastes and oil and gas development has been documented in selected areas of the county. Information concerning the quality and quantity of the ground-water resources of the county is needed for management and resource development.

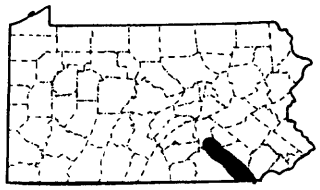
OBJECTIVE: Assess the geohydrologic system in the study area. Estimate at selected sites the areal extent of ground-water degradation resulting from oil and gas development and from disposal of other hazardous substances. Provide data on the physical/chemical character of the contaminants; assess the hydraulic properties of the rock containing the contaminants.

APPROACH: Perform literature review. Conduct well inventory and ground-water quality sampling throughout Warren County to assess hydraulic properties and quality of major aquifers. Install observation wells. Perform aquifer tests and geophysical logging. Design and conduct test drilling program. Prepare report for publication in Pennsylvania Geological Survey Water Resource Report Series.

PROGRESS: About 225 wells and springs inventoried and 125 ground-water samples collected. Water-level monitoring continues at five observation wells. Several aquifer tests were performed on high-capacity, municipal test wells. High concentrations of dissolved methane, ethane, and propane have been found in ground-water samples from domestic water wells and abandoned oil wells. Geophysical logging was performed at seven water wells and three abandoned oil wells.

PLANS: The following work elements will be finished: well and spring inventory, aquifer testing, ground-water sampling, geophysical logging, and water-level monitoring. Data interpretation will continue. The Pennsylvania Geologic Survey will complete the 1:50,000 geologic map including structure contours and fracture traces.

EVALUATION OF AGRICULTURAL BEST MANAGEMENT PRACTICES AND OTHER INNOVATIVE METHODS OF CONTROLLING NUTRIENT DISCHARGES IN THE LOWER SUSQUEHANNA RIVER BASIN (PA158)



LOCATION: Southeastern Pennsylvania

COOPERATOR(S): SRBC

PERIOD OF PROJECT: October 1984 to September 1990

PROJECT CHIEF: David K. Fishel

HEADQUARTERS OFFICE: Harrisburg, PA

PROBLEM: The Pennsylvania Departments of Environmental Resources and Agriculture (PADERA) are developing a nonpoint-source control program for agriculture in the lower Susquehanna River basin. In addition to traditional practices, new practices or alternate schemes will be utilized to limit the nutrients transported from farms. There is no program that evaluates the impact of these practices on water quality in areas underlain by noncarbonate rocks in the lower Susquehanna River basin.

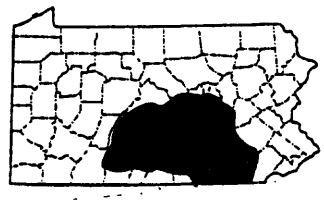
OBJECTIVE: To document the water quality of surface runoff and base flow from small agricultural watersheds and to evalute the effectiveness of agricultural best management practices in controlling nutrient and sediment discharges in basins underlain by noncarbonate rocks.

APPROACH: The variability and trends in surface runoff and base flow quality due to precipitation and farming practices will be documented at two small watersheds underlain by noncarbonate rock 2 years before and 2 years after practice implementation. The effects of the practices on sediment and nutrient discharges will be measured using statistical trend analysis and data may be used to model the effectiveness of the practices using the Chemical Runoff, and Erosion from Agricultural Management Systems (CREAMS) or Hydrologic Simulation Program-Fortran (HSPF) models. Results will be compared to determine the relative influences of physiography, geology, soils, land use, precipitation and installed practices on water quality.

PROGRESS: One year of precipitation, land use, and water quality data has been collected and analyzed for two stations. Lack of precipitation at the York County site resulted in severe damage to crops and low sediment and nutrient concentrations and discharges. High ammonia concentrations have been recorded at the Adams County site throughout the year and may have been responsible for a fish kill downstream from the site. Meetings with the farmers, local conservation districts, and soil conservation offices have been held to explain preliminary data. Management plans for the Adams County site will include terraces and grassy waterways; diversion of barnyard runoff is planned for the York County site.

PLANS: Data collection for the second year of the pre-implementation phase will continue. Management plans for the two sites will be developed and implementation will begin near October 1987. Trends in data for the pre-implementation data will be determined and estimates of reductions of constituent concentrations and discharges necessary for significant improvement to occur will be made.

ASSESSMENT OF NUTRIENT SOURCES IN THE SUSQUEHANNA RIVER BASIN (PA159)



LOCATION: South-central Pennsylvania

COOPERATOR(S): Susquehanna River Basin Commission

PERIOD OF PROJECT: October 1984 to September 1990

PROJECT CHIEF: Lloyd A. Reed

HEADQUARTERS OFFICE: Harrisburg, PA

PROBLEM: The lower Susquehanna River basin has been identified as being the major nutrient contributor to the upper Chesapeake Bay. The nutrients nitrogen and phosphorus, which contribute to algal growth and resultant water-quality degradation, have been related to accelerated eutrophication of the Chesapeake Bay.

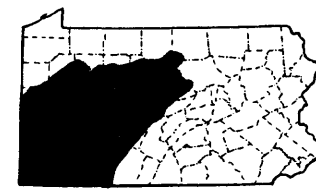
OBJECTIVE: To characterize the nutrient discharge from the Susquehanna River and its major tributaries south of Harrisburg, Pennsylvania to the Chesapeake Bay.

APPROACH: Will determine (1) relative contribution of nutrients and suspended sediment from individual tributaries, (2) seasonal variation in nutrient and suspended sediment discharge, (3) distribution of nutrient discharge between dissolved and particulate phases during storm runoff and base flow, and (4) annual contribution of point-source nutrients to the total discharge.

PROGRESS: Monthly baseflow samples have been collected but required storm samples have not been collected due to prevailing drought conditions.

PLANS: Storm samples will be collected. The USEPA Bay Model will be used and evaluated as to its utility for project use.

WATER-QUALITY EFFECTS OF THE APPLICATION OF SEWAGE SLUDGE AND ALKALINE MATERIAL ON COAL SURFACE MINES (PA160)



LOCATION: Bituminous Coal Fields of Pennsylvania

COOPERATOR(S): PaDER, Bureau of Surface Mine Reclamation

PERIOD OF PROJECT: January 1985 to October 1990

PROJECT CHIEF: David J. Wangsness

HEADQUARTERS OFFICE: Harrisburg, PA

PROBLEM: Information is needed on the water-quality effects associated with the use of urban sewage sludge and alkaline material in the reclamation of surface mines in the bituminous coal fields of Pennsylvania. The possibility of a reduction in acid-mine drainage and the potential for additional water-quality problems, including the migration of metals from the sludge, are of primary interest.

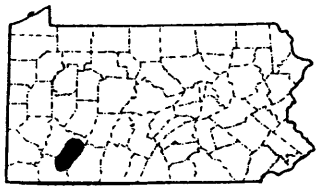
OBJECTIVE: To evaluate the water-quality effects of the application of urban sewage sludge and alkaline material at representative surface coal mines.

APPROACH: Four surface mines that typify the range of hydrogeologic conditions will be selected for study. Each site will be instrumented with weirs, wells, and lysimeters for water-quality and other hydrologic monitoring. The water quality at each site will be monitored 6 to 12 months prior to reclamation. After background data has been collected, the mine sites will be reclaimed with sewage sludge or sludge and alkaline material. Monitoring will continue for 2-2.5 years following reclamation.

PROGRESS: Began collection of post-reclamation water quality and other hydrologic data in the unsaturated zone, ground-water, and surface-water systems at a 30 acre mine in Clarion County. Began collection of background water quality data at nearby mine, which has similar geologic, hydrologic, and geochemical characteristics.

PLANS: Continue to collect water quality and other hydrologic data at the reclaimed and background mines. Background data collection will begin at a second site in Clearfield County contingent on sludge-permit approval and participation of the involved coal company.

HYDROLOGY OF INDIAN CREEK BASIN, FAYETTE AND WESTMORELAND COUNTIES, PENNSYLVANIA (PA161)



LOCATION: Southwestern Pennsylvania

COOPERATOR(S): PaDER, Bureau of Surface Mine Reclamation

PERIOD OF PROJECT: March 1985 to September 1987

PROJECT CHIEF: James I. Sams

HEADQUARTERS OFFICE: Pittsburgh, PA

PROBLEM: Indian Creek is in a water-and coal-rich basin in southwestern Pennsylvania where coal was formerly mined underground, but currently some surface mining is in progress. Acid mine drainage (AMD) from the abandoned underground mines has been a problem for years. Many years ago, a flume was built to intercept the AMD and deliver it to a downstream area, but the reliability of this flume has been questioned. Future mining permits will be requested for large reserves of coal which remain in the basin. There is insufficient hydrologic data available to make proper decisions by the Pennsylvania Department of Environmental Resources (PaDER) to issue the permits. The permit decisions must balance the benefits of mining the coal verses the detrimental effects on the water resources in the basin.

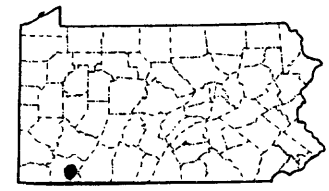
OBJECTIVE: (1) To define the current hydrologic conditions in the Indian Creek basin (baseline pollution level), and (2) to provide background data for evaluating mining regulations and permit requests.

APPROACH: A general basin-wide approach will be used. Selected water-quality characteristics will be studied and a basin water budget will be defined. Five stream-gaging stations with water-quality monitors and automatic sediment samplers will be established to monitor surface-water characteristics. Approximately 23 additional synoptic sites will be established for intermittent surface-water determinations. Observation wells will be monitored to define ground-water characteristics. Two climatic stations will be installed within the basin for recording precipitation amount and intensity. Water samples will be collected periodically at all sites for laboratory analyses.

PROGRESS: Set-up of the water quality monitoring network in the basin has been completed. Twelve months of water-quality data have been collected from four water-quality monitors, three sediment samplers and 28 miscellaneous sites sampled monthly or quarterly. Also two tipping bucket rain gages and four SW stage recorders and one ground-water stage recorder are operating. A biological survey has been completed in the basin by PaDER.

PLANS: Write a data report. Project will be terminated October 1, 1987.

EFFECTS OF STRIP MINING ON THE HYDROLOGY OF A SMALL WATERSHED IN FAYETTE COUNTY, PENNSYLVANIA (PA163)



LOCATION: Southwestern Pennsylvania

COOPERATOR(S): PaDER, Bureau of Surface Mine Reclamation

PERIOD OF PROJECT: July 1985 to September 1988

PROJECT CHIEF: James I. Sams

HEADQUARTERS OFFICE: Pittsburgh, PA

PROBLEM: The PADER Bureau of Mining and Reclamation (BMR) and other regulatory agencies need to know the impacts of surface mining on the hydrologic environment in order to properly evaluate permit applications for surface mining. The PaDER and the U.S. Geological Survey have observed hydrologic changes as a result of surface mining in the Stony Fork basin since 1977 under projects PA080 and PA124. A new surface mine is proposed immediately upstream from one of the continuous monitoring stations presently in operation. Data collection for PA124 will end September 30, 1985. The continuation of the Gibbon Glade site would provide a unique opportunity to determine hydrologic changes caused by strip mining in a small basin.

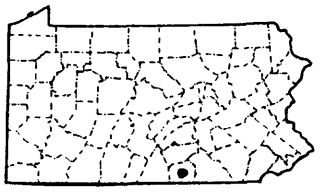
OBJECTIVE: (1) To determine hydrologic changes caused by mining in a previously unmined area. (2) Assess the cumulative impact of mining to the watershed systems. (3) Provide site specific information to PaDER for evaluating future mining permits.

APPROACH: The basic approach will be to continuously record pH, specific conductance, and water temperature and to sample surface- and ground-water quality on a regular basis. The samples will be analyzed for sulfate, aluminum, iron, manganese, and zinc. In addition, samples will be collected twice yearly for selected trace metals. Data will also be collected at a climatic station which will record precipitation intensity and amount and air temperature. The discharge and precipitation data will be used to calibrate and verify a computer model. Pre-mining, mining, and post-mining data will be analyzed statistically (regression analysis).

PROGRESS: Surface mining occurred in previously unmined small basin. Monitoring equipment maintained, stage data collected, sediment samples collected with expectations of being processed for annual report.

PLANS: Continue to collect hydrologic data, and with proper funding prepare watershed model.

GROUND-WATER FLOW SYSTEMS AND WATER QUALITY OF THE GETTYSBURG AREA, PENNSYLVANIA (PA164)



LOCATION: South-Central Pennsylvania

COOPERATOR(S): National Park Service

PERIOD OF PROJECT: September 1985 to September 1987

PROJECT CHIEF: Albert E. Becher

HEADQUARTERS OFFICE: Harrisburg, PA

PROBLEM: Water resources utilized by the National Park Service (NPS) at park sites around Gettysburg, Pennsylvania are vulnerable to contamination from on-site and nearby agricultural activities and possibly from other pollutants coming from surrounding areas. An evaluation of the existing ground-water quality and the potential for contamination is needed and requires an understanding of the ground-water flow system(s) and their relation to surface streams.

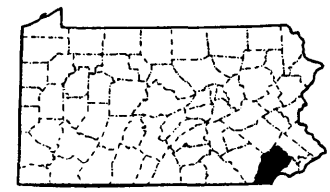
OBJECTIVE: Determine the divides and flow directions of ground-water system(s) encompassing the Gettysburg battlefield and Eisenhower farm area and the relationship between ground and surface water. Evaluate the potential for surface streams and ponds to contaminate the ground water. Determine the concentrations of major constituents and contaminants (nitrogen species, pesticides, other organic pollutants, and trace metals) in ground water and evaluate the extent of contamination.

APPROACH: Establish a network of wells for measuring water levels and collecting samples for chemical analysis. Use information from ground-water levels, reconnaissance, seepage runs, and well points in stream beds to locate losing reaches of streams and to select about 15 key wells from which water will be collected for chemical analysis. An initial sample will be analyzed for major dissolved constituents, nitrogen species and trace metals. Spring and fall samples in 1986 will be analyzed for nitrogen, pesticides and other organic pollutants. Summer samples will be analyzed for nitrogen only. The Park Service will provide a basic well inventory and data on contaminants used in the area.

PROGRESS: A network of 60 wells was established, fall and spring water levels measured, spring and summer samples collected for chemical analysis and six continuous record ground-water level sites installed. A shallow water-table system drains through the local stream drainage basins and is controlled by the differences in bedrock resistance to weathering. A deep system is controlled by openings in specific bedrock layers that are poorly interconnected.

PLANS: Analyze data and prepare final report.

GROUND-WATER FLOW IN THE CARBONATE ROCK OF THE VALLEY CREEK BASIN, CHESTER COUNTY, PENNSYLVANIA (PA165)



LOCATION: Southeastern Pennsylvania

COOPERATOR(S): Chester County Water Resources Authority

PERIOD OF PROJECT: October 1985 to September 1988

PROJECT CHIEF: Ronald A. Sloto

HEADQUARTERS OFFICE: Malvern, PA

PROBLEM: The Valley Creek basin is rapidly changing from an agricultural area to an area of corporate parks, residential subdivisions, and high density condominiums. Sixty-six percent of the Valley Creek basin in underlain by carbonate rocks that are the highest-yielding aquifers in Chester County. The quantity of useable water is threatened by chemical contamination.

OBJECTIVE: To gain a detailed understanding of ground-water flow in the Valley Creek basin to provide a basis for prudent water-management decisions.

APPROACH: Complete suites of geophysical logs will be run at 12 wells. A test well will be drilled south of Warner Quarry to provide geohydrologic data. A three-dimensional finite-difference digital ground-water flow model of the carbonate aquifer system in the Valley Creek basin will be constructed using the U.S. Geological Survey's modular model program.

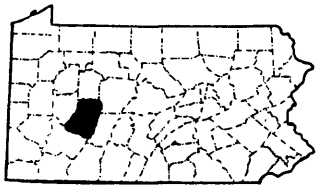
PROGRESS: Data collection network is in place. Geophysical logging was completed at 12 wells. Test well completed to 124 feet. Model grid constructed and preliminary input keyed in.

PLANS: Calibrate ground-water flow model.

HYDROLOGY AND WATER RESOURCES OF INDIANA COUNTY, PENNSYLVANIA
(PA166)

LOCATION: West-central Pennsylvania

COOPERATOR(S): PaDER, Bureau of Topographic and Geologic Survey; Indiana County Commissioners



PERIOD OF PROJECT: May 1986 to September 1989

PROJECT CHIEF: Donald R. Williams

HEADQUARTERS OFFICE: Pittsburgh, PA

PROBLEM: Indiana County, in 1984, produced 12 million tons of bituminous coal, the largest county production in Pennsylvania. Eighty four percent of this production was from underground mines. The impacts of mining on the water resources include acid mine drainage, which affects water quality, and the draining of shallow aquifers by subsurface mining, which affects ground-water and surface-water quantify. Petroleum-production activities have also affected the surface and ground-water quality throughout the county. Some ground-water samples collected from northern Indiana County wells had chloride concentrations greater than 250 mg/L and concentrations of total dissolved solids as high as 1890 mg/L. From 1979 to 1982, Indiana County had the highest number of gas wells drilled annually in the state, averaging 400 wells per year. Because coal mining continues to be active in the county and petroleum production is on the increase, county residents are deeply concerned about further effect of these activities on the water resources.

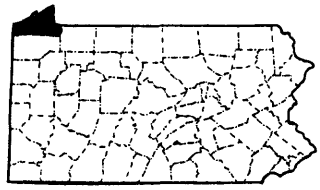
OBJECTIVE: (1) To appraise the water resources of Indiana County, (2) determine the effects of surface and subsurface mining on both the surface- and ground-water quantity and quality, and (3) determine the effects of gas well drilling on the surface- and ground-water quality.

APPROACH: About 400 water wells will be inventoried throughout the county. Of special interest will be the aquifer systems overlying active underground mining and areas where there has been a sharp increase in petroleum exploration. About 20 observation wells will be equipped with continuous water-level recorders in active mining areas, in non-mining areas, and in areas where petroleum production has increased. Aquifer tests will be done on the bedrock aquifers to analyze the variation of hydraulic properties with depth and between areas mined and unmined. Water samples will be collected at about 150 wells to determine ground-water quality. Six stream-gaging stations currently in operation in the county will be a part of the data collection network and three additional stream gages will be constructed. Approximately 25 additional intermittent surface-water sites will be established throughout the county. About 6 mass-sampling water-quality runs will be conducted at all of the surface-water sites during base-flow conditions.

PROGRESS: Approximately 120 wells have been inventoried and continuous water-level recorders were installed on five observation wells. About 40 well samples were collected for laboratory analyses. Twelve springs have been inventoried and sampled for laboratory analyses. Land-lease agreements and water obstruction permits were obtained for the construction of three gaging stations. The gaging stations were constructed and operational by mid September 1986. Land-lease agreements were obtained for two recording precipitation sites. The precip. sites were installed operatinally by October 1, 1986. Approximately 22 additional surface-water sites were located for intermittent sampling and will complement the nine continuous recording streamgaging sites.

PLANS: Approximately 200 wells will be inventoried, 15 additional observation wells will be established, 50 wells will be sampled for lab analyses. Fifty springs will be inventoried and sampled. A low-base flow and high-base flow sampling run will be conducted at all surface-water sites. Two base-flow seepage runs will be conducted simultaneously in the mined and unmined basins. All collected data will be compiled and published in the annual Water Resources Data report.

GROUND-WATER QUALITY OF ERIE COUNTY, PENNSYLVANIA (PA168)



LOCATION: Northwestern Pennsylvania

COOPERATOR(S): Erie County Department of Health

PERIOD OF PROJECT: October 1985 to September 1987

PROJECT CHIEF: David B. Richards

HEADQUARTERS OFFICE: Pittsburgh, PA

PROBLEM: The major water resource for the City of Erie, adjacent Millcreek Township, some adjacent areas, North East, and Union City is surface water. The other portions of Erie County are dependent upon ground water. As a result of industrial and municipal waste disposal sites and petroleum exploration and production, the ground water is locally polluted/contaminated. This is determined by the exceedances of chemical constituents beyond the PaDER and USEPA safe drinking water limits, including: total dissolved solids, lead, chloride, iron, and manganese. Two waste disposal sites have been on the Super Fund list: Lord-Shope and Millcreek. The Erie County Department of Health knows of many other waste disposal sites, but does not know of the impact of these sites on municipal and domestic wells.

OBJECTIVE: (1) Determine ground-water quality pollution/contamination sites; (2) develop a computer tabulation of the chemical constituent data of #1, and a map showing the location of the sites; (3) develop a ground-water resources map where abundant (long-term quantity) fresh ground water is available (assumed to be the buried channels of unconsolidated deposits); and (4) define land use as affecting ground-water quality (landfills and waste disposal sites are assumed included in number 1).

APPROACH: (1) Identify ground water-quality problem areas (2) develop ground-water quality network and store data on computer for publication; (3) delineate buried channel unconsolidated deposits; and (4) determine ground-water flow characteristics.

PROGRESS: The U.S. Geological Survey provided leadership in interviewing candidates for Hydrologist I and II for the Erie County Department of Health (DOH). A Hydrogeologist I was hired and is working under the general supervision and direction of Pittsburgh Subdistrict Chief (PSDC). Major waste disposal sites in the County have been visited by Hydrogeologist I and PSDC.

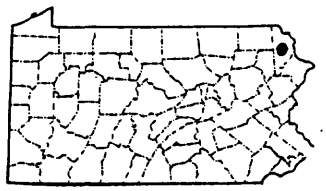
PLANS: Inventory water wells in vicinity of waste disposal sites, collect some samples, and run chemical analyses. Update 'record of wells' table with well records received from Pennsylvania Topographic and Geologic Survey since 1979. Enter chemical results from analyses into computer storage. Identify on maps known ground-water contamination sites where chemical constituents exceed USEPA and PaDER drinking water standards.

WATER-QUALITY ASSESSMENT OF PROMPTON RESERVOIR, WAYNE COUNTY, PENNSYLVANIA (PA169)

LOCATION: Northeast Pennsylvania

COOPERATOR(S): U.S. Army Corps of Engineers, Philadelphia District

PERIOD OF PROJECT: October 1986 to September 1988



PROJECT CHIEF: James L. Barker

HEADQUARTERS OFFICE: Harrisburg, PA

PROBLEM: The Philadelphia District Corps of Engineers (COE) needs baseline water-quality data and projections of water quality for the proposed project modifications of raising the full water-supply pool from elevation 1,125 to 1,180 feet.

OBJECTIVE: To determine the baseline water quality of the impoundment, its inflow and its outflow. To predict the environmental impacts of the raised water level modification on the reservoir limnology and ground-water hydrology.

APPROACH: The major inflow, three sites within the impoundment, and the outflow will be sampled monthly during base flow conditions to observe seasonal variations in chemical, physical, and biological characteristics. Additional sampling of the inflow through five selected storms will provide information on nutrient and suspended-sediment concentrations for estimating loads. Biological analysis will consist of determining Chlorophyll A and B concentrations from monthly samples. The COE's personnel will continue to measure biweekly profiles of temperature, dissolved oxygen, pH, and specific conductance at a minimum of three impoundment sites as well as collect other water-quality data upstream of the reservoir at Aldenville, at the reservoir midpoint off Route 170, and at the dam.

PROGRESS: Initiated sampling weekly for suspended sediment and monthly for base-flow water quality. Storm flow samples have been collected for six storms. Gaging station for continuous discharge record is under construction.

PLANS: Continue base flow and storm flow water quality sampling, collect impoundment water quality samples and calculate loads of suspended sediment and nutrients entering and retained in the impoundment.

RADIUM AND RADON OCCURRENCE IN GROUND WATER OF THE CHICKIES FORMATION, SOUTHEASTERN PENNSYLVANIA (PA170)

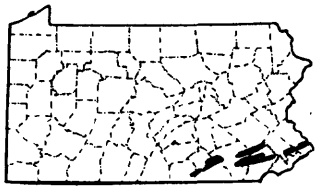
LOCATION: Southeastern Pennsylvania

COOPERATOR(S): PaDER, Bureau of Topographic and Geologic Survey

PERIOD OF PROJECT: October 1986 to September 1988

PROJECT CHIEF: L. DeWayne Cecil

HEADQUARTERS OFFICE: Malvern, PA



PROBLEM: Anomalous concentrations of radium are naturally present in ground water within the Chickies Formation throughout southeastern Pennsylvania. These anomalous radium levels do not appear to be limited to any particular location in the Chickies Formation, and therefore may be related to unusual geochemical conditions within the formation. Data indicate that the radium and radon in solution seem largely confined to the Chickies Formation.

OBJECTIVE: (1) To identify the extent and magnitude of radium and radon anomalies in the Chickies Formation. (2) To identify alternative water supplies in the Chickies for those areas where the maximum contaminant level of radium or radon in drinking water is exceeded. (3) To characterize the geochemical and hydrological environments associated with elevated radium and radon concentrations.

APPROACH: The project is organized into three program elements beginning with the collection of available hydrologic and geochemical data. A field sampling program will be designed and implemented after review of all available data. Data analysis and report writing constitute the final project element.

PROGRESS: Reconaissance sampling of 51 wells for radium and radon concentrations was completed. The data were released as Open File Report 87-232. Radium concentrations above the USEPA limit of 5.0 pCi/L were found in water from 43 percent of the wells sampled.

PLANS: To sample an additional 130 wells, statistically analyze the data and relate it to geology and aquifer geochemistry, and to begin writing the final report.

AQUIFER CHARACTERISTICS OF THE ROCKS OF PENNSYLVANIA (PA171)

LOCATION: Statewide

COOPERATOR(S): PaDER, Bureau of Topographic and Geologic Survey

PERIOD OF PROJECT: January 1987 to September 1989

PROJECT CHIEF: Dennis J. Low

HEADQUARTERS OFFICE: Harrisburg, PA

PROBLEM: Information on the aquifer characteristics of the rocks of Pennsylvania is needed for proper resource development, management, and protection of sensitive ground-water resources. A comprehensive summary of aquifer characteristics, supplemental to the State Geologic Maps and 7½-minute quadrangle maps, would substantially augment the informational needs of State and Federal regulatory agencies, resource planners, public and private water suppliers, industrial users, and hydrogeologic consultants.

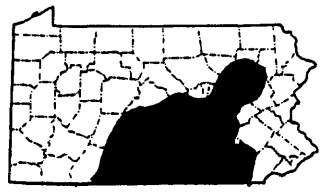
OBJECTIVE: To develop a comprehensive summary of the aquifer characteristics of the rocks of Pennsylvania including information on lithology, topography, and strucure; well-yield; ground-water quality; and ground-water recharge, flow, and discharge.

APPROACH: The comprehensive summary will be developed by: (1) compilation of statewide and regional reports; (2) extrapolation of published detailed investigations; (3) analysis of well-yield and water-quality data from over 5,000 wells, which are continuously updated and stored in GWSI and WATSTORE data bases of the U.S. Geological Survey; (4) analysis of borehole-geophysical data on file with the U.S. Geological Survey; (5) review of aquifer-test data and well-interference problems at selected sites on file with the SRBC and DRBC and other agencies; and (6) review of hydrolgeologic and water-quality data at selected contamination sites on file with PaDER and other agencies.

PROGRESS: Ground Water Site Inventory (GWSI) data base is being updated.

PLANS: Analysis of water quality, pumping, and other aquifer characteristics for possible modeling and additional interpretation on selected sites. Further processing of data base and continued elimination of errors.

SURFACE WATER STATIONS, HARRISBURG SDO (PA201)



LOCATION: South-central Pennsylvania

COOPERATOR(S): Multiple

PERIOD OF PROJECT: Continuous since June 1931

PROJECT CHIEF: Robert A. Hainly

HEADQUARTERS OFFICE: Harrisburg, PA

PROBLEM: Surface-water information is needed for purposes of surveillance, planning, design, hazard warning, and operation and management in water-related fields such as water supply, hydroelectric power, flood control, irrigation, bridge and culvert design, wildlife management, pollution abatement, flood-plain management, and water resources development. To provide this information, an appropriate data base is necessary.

OBJECTIVE: A. To collect surface-water data sufficient to satisfy needs for current-purpose uses, such as (1) assessment of water resources, (2) operation of reservoirs or industries, (3) forecasting, (4) disposal of wastes and pollution controls, (5) discharge data to accompany water-quality measurements, (6) compact and legal requirements, and (7) research or special studies. B. To collect data necessary for analytical studies to define for any location the statistical properties of, and trends in, the occurrence of water in streams, lakes, estuaries, etc., for use in planning and design.

APPROACH: Standard methods of data collection will be used as described in the series "Techniques of Water Resources Investigations of the United States Geological Survey." Partial-record gaging will be used instead of complete-record gaging where it serves the required purpose.

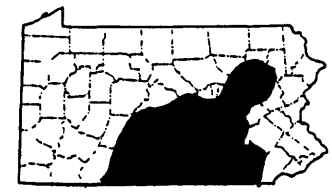
PROGRESS: Hydrologic data were collected at surface-water sites in the lower Susquehanna and upper Potomac River basins. Two continuous-record stations (Fawns Grove and McSherrystown) were added to the network. Presently, operating 82 active sites; 54 continuous record and 28 others.

PLANS: Continue hydrologic data collection at surface-water sites with the Lower Susquehanna and upper Potomac River basins, discontinue one site (Mt. Nebo) and incorporate five new stream gages, 15 new rain gages, and 25 new data-collection platforms into the existing network as they are installed by the Susquehanna flood Forecasting Improvement Program.

GROUND-WATER STATIONS, HARRISBURG SDO (PA202)

LOCATION: South-central Pennsylvania

COOPERATOR(S): PaDER, Bureau of Water Resources Management, Bureau of Topographic and Geologic Survey



PERIOD OF PROJECT: Continuous since January 1931

PROJECT CHIEF: Robert A. Hainly

HEADQUARTERS OFFICE: Harrisburg, PA

PROBLEM: Long-term water level records are needed to evaluate the effects of climatic variations on the recharge to and discharge from the ground-water systems, to provide a data base from which to measure the effects of development, to assist in the prediction of future supplies, and to provide data for management of the resource.

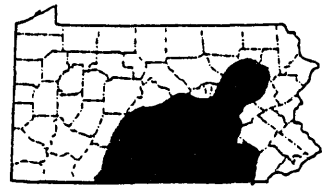
OBJECTIVE: A. To collect water level data sufficient to provide a minimum long-term data base so that the general response of the hydrologic system to natural climatic variations and induced stresses is known and potential problems can be defined early enough to allow proper planning and management. B. To provide a data base against which the short-term records acquired in areal studies can be analyzed. This analysis must (1) provide an assessment of the ground-water resource, (2) allow prediction of future conditions, (3) detect and define pollution and supply problems, and (4) provide the data base necessary for management of the resource.

APPROACH: The diversity of the stratigraphic, lithologic, topographic, and climatic conditions in the lower basin precludes sampling each environment. A network of 18 uniformly distributed wells has therefore been established. Continuous recorders are installed on 17 wells and the remaining well, which cannot accommodate a recorder, is measured weekly. It will be replaced as funds permit by a well on which continuous measurements can be made. All records will be analyzed statistically to determine their predictability, so that a station can then be shifted to a new site. For the present, this office will assume responsibility for reducing and entering in the computer all ground-water level data collected in the district.

PROGRESS: Water-level data were collected on schedule within major stream basins of the lower Susquehanna and Upper Potomac River basins. Presently operating 17 continuous recording sites and 1 other.

PLANS: To continue collecting water-level data within major stream basins of the lower Susquehanna and upper Potomac River basins. The PaDER is proposing the installation of data-collection platforms on six wells for drought-monitoring purposes.

QUALITY WATER STATIONS, HARRISBURG SDO (PA203)



LOCATION: South-central Pennsylvania

COOPERATOR(S): Susquehanna River Basin Commission

PERIOD OF PROJECT: Continuous since August 1949

PROJECT CHIEF: Robert A. Hainly

HEADQUARTERS OFFICE: Harrisburg, PA

PROBLEM: Water-quality data are needed for surveillance, planning, design and management of water resources. Water-quality problems can affect industries, water-treatment facilities, and the individual consumer. To provide the appropriate information, a data base is necessary.

OBJECTIVE: To collect water-quality data sufficient for current uses, such as (1) assessment of water resources, (2) operation of reservoirs, and (3) research or special studies. To collect data necessary for analytical studies to define the statistical properties of spatial and temporal trends in the quality of surface waters - streams, lakes, estuaries - for use in planning and management.

APPROACH: Water samples are collected periodically and analyzed in the U.S. Geological Survey Central Laboratories. At some sites, temperature, dissolved oxygen, pH, and specific conductance are monitored continuously. The operation of the network provides chemical concentrations and loads as required by water planning and managing agencies.

PROGRESS: Continued collection of water-quality samples and recorded water-quality data at stations within the lower Susquehanna basin. Presently monitoring 2 continuous sites and 4 others.

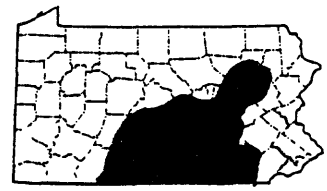
PLANS: To continue the data-collection program. A proposal has been developed to remove one National Stream Quality Accounting Network (NASQAN) station (Newport) and add three new ones (Saxton, Manchester and Tunkhannock).

SEDIMENT STATIONS, HARRISBURG SDO (PA204)

LOCATION: South-central Pennsylvania

COOPERATOR(S): PaDER, Bureau of Water Resources Management

PERIOD OF PROJECT: Continuous since October 1948



PROJECT CHIEF: Robert A. Hainly

HEADQUARTERS OFFICE: Harrisburg, PA

PROBLEM: Suspended sediment is considered the principal pollutant in water. It silts in reservoirs and harbors, contaminates water supplies, adversely affects machinery, and causes fishery problems. On the other hand, sediment is needed to maintain beaches, control algae, and remove toxic chemicals from the water. Sediment data are necessary for erosion studies, reservoir design, dredging scheduling, and drinking-water standards. A network of sediment stations is needed to provide a data base for proper water-resource management.

OBJECTIVE: To collect sediment data sufficient for current uses such as (1) reservoir design, (2) water-quality standards, (3) pollution controls, (4) erosion assessment, (5) water-resources management, (6) dredging, and (7) research or special studies. To collect data necessary for analytical studies to delineate the effects of land use, such as highway construction, mining, and urbanization; to describe the effects of sediment on water chemistry; and to assess spatial and temporal trends.

APPROACH: Suspended-sediment samples are collected and loads calculated by methods described in the series "Techniques of Water Resources Investigations of the United States Geological Survey." Automatic samplers are used at some locations and coal-separation techniques are used to determine effects of coal mining.

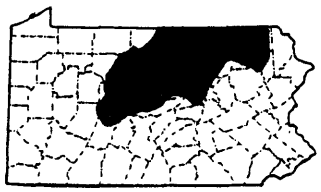
PROGRESS: Sediment data-collection and load computations were continued at one site in the Lower Susquehanna River basin. In addition, two automatic sediment samplers were operated in the Swatara Creek basin for a pre-impoundment study.

PLANS: To continue operation of the long-term continuous-record site. At the time of this update, funding for the pre-impoundment sites was uncertain.

SURFACE WATER STATIONS, WILLIAMSPORT SDO (PA301)

LOCATION: North-central Pennsylvania

COOPERATOR(S): PaDER, Bureau of Water Resources Management; University Area Joint Authority; City of Williamsport; NOAA; U.S. Corps of Engineers



PERIOD OF PROJECT: Continuous since June 1931

PROJECT CHIEF: Robert A. Hainly

HEADQUARTERS OFFICE: Williamsport, PA

PROBLEM: Surface-water information is needed for purposes of surveillance, planning, design, hazard warning, and operation and management in water-related fields such as water supply, hydroelectric power, flood control, irrigation, bridge and culvert design, wildlife management, pollution abatement, flood-plain management, and water resources development. To provide this information, an appropriate data base is necessary.

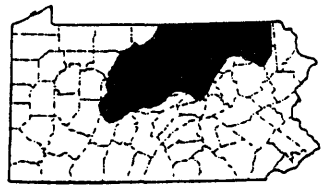
OBJECTIVE: A. To collect surface-water data sufficient to satisfy needs for current-purpose uses, such as (1) assessment of water resources, (2) operation of reservoirs or industries, (3) forecasting, (4) disposal of wastes and pollution controls, (5) discharge data to accompany water-quality measurements, (6) compact and legal requirements, and (7) research or special studies. B. To collect data necessary for analytical studies to define for any location the statistical properties of, and trends in, the occurrence of water in streams, lakes, estuaries, etc., for use in planning and design.

APPROACH: Standard methods of data collection will be used as described in the series, "Techniques of Water Resources Investigations of the United States Geological Survey." Partial-record gaging will be used instead of complete-record gaging where it serves the required purpose.

PROGRESS: Data collection was continued at surface-water stations in the West Branch Susquehanna and Tioga River basins.

PLANS: Data collection will continue. An enhancement of the flood-forecasting system will introduce four new stream gages, 15 new raingages and 25 new data collection platforms to the existing network.

QUALITY WATER STATIONS, WILLIAMSPORT SDO (PA303)



LOCATION: North-central Pennsylvania

COOPERATOR(S): U.S. Army Corps of Engineers

PERIOD OF PROJECT: Continuous since August 1949

PROJECT CHIEF: Robert A. Hainly

HEADQUARTERS OFFICE: Williamsport, PA

PROBLEM: Water-quality data are needed for surveillance, planning, design and management of water resources. Water-quality problems can affect industries, water-treatment facilities, and the individual consumer. To provide the appropriate information, a data base is necessary.

OBJECTIVE: To collect water-quality data sufficient for current uses, such as (1) assessment of water resources, (2) operation of reservoirs, and (3) research or special studies. To collect data necessary for analytical studies to define the statistical properties of spatial and temporal trends in the quality of surface waters - streams, lakes, estuaries - for use in planning and management.

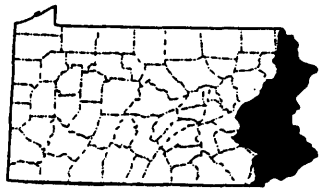
APPROACH: Water samples are collected periodically and analyzed in the U.S. Geological Survey Central Laboratories. At some sites, temperature, dissolved oxygen, pH, and specific conductance are monitored continuously. The operation of the network provides chemical concentrations and loads as required by water planning and managing agencies.

PROGRESS: Water-quality data collection was continued in the West Branch Susquehanna and Tioga River basins. Presently operating seven continuous record sites and one other.

PLANS: Continue water-quality data collection.

SURFACE WATER STATIONS, MALVERN SDO (PA401)

LOCATION: Eastern Pennsylvania



COOPERATOR(S): Multiple

PERIOD OF PROJECT: Continuous since June 1931

PROJECT CHIEF: James R. Kolva

HEADQUARTERS OFFICE: Malvern, PA

PROBLEM: Surface-water information is needed for purposes of surveillance, planning, design, hazard warning, and operation and management in water-related fields such as water supply, hydroelectric power, flood control, irrigation, bridge and culvert design, wildlife management, pollution abatement, flood-plain management, and water resources development. To provide this information, an appropriate data base is necessary.

OBJECTIVE: A. To collect surface-water data sufficient to satisfy needs for current-purpose uses, such as (1) assessment of water resources, (2) operation of reservoirs or industries, (3) forecasting, (4) disposal of wastes and pollution controls, (5) discharge data to accompany water-quality measurements, (6) compact and legal requirements, and (7) research or special studies. B. To collect data necessary for analytical studies to define for any location the statistical properties of, and trends in, the occurrence of water in streams, lakes, estuaries, etc., for use in planning and design.

APPROACH: Standard methods of data collection will be used as described in the series, "Techniques of Water Resources Investigations of the United States Geological Survey." Partial-record gaging will be used instead of complete-record gaging where it serves the required purpose.

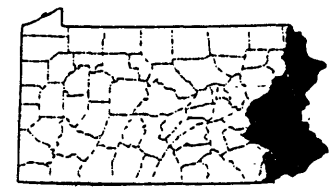
PROGRESS: Hydrologic data for continuous record, reservoir, and partial-record surface-water stations in the Delaware River basin were collected and published. Seven new gages were added to the network and seven additional data-collection platforms were installed. Presently operating 66 continuous recording sites and 98 others.

PLANS: Continue hydrologic data collection at continuous record, reservoir, and partial-record surface-water stations in the Delaware River basin. Construct three new gages. Install data collection platforms on three additional stations. Discontinue 14 crest-stage gages.

GROUND-WATER STATIONS, MALVERN SDO (PA402)

LOCATION: Eastern Pennsylvania

COOPERATOR(S): PaDER, Bureau of Water Resources Management; PaDER, Bureau of Topographic and Geologic Survey; and Chester County Water Resources Authority



PERIOD OF PROJECT: Continuous since January 1931

PROJECT CHIEF: James R. Kolva

HEADQUARTERS OFFICE: Malvern, PA

PROBLEM: Long-term water-level records are needed to evaluate the effects of climatic variations on the recharge to and discharge from the ground-water systems, to provide a data base from which to measure the effects of development, to assist in the prediction of future supplies, and to provide data for management of the resource.

OBJECTIVE: A. To collect water-level data sufficient to provide a minimum long-term data base so that the general response of the hydrologic system to natural climatic variations and induced stresses is known and potential problems can be defined early enough to allow proper planning and management. B. To provide a data base against which the short-term records acquired in areal studies can be analyzed. This analysis must (1) provide an assessment of the ground-water resource, (2) allow prediction of future conditions, (3) detect and define pollution and supply problems, and (4) provide the data base necessary for management of the resource.

APPROACH: The diversity of the stratigraphic, lithologic, topographic, and climatic conditions in the basin preclude sampling each environment. A network of 16 uniformly distributed wells has, therefore, been established. Continuous recorders are installed on 14 wells and the remaining 2 wells, which cannot accommodate recorders, are measured weekly. These latter will be replaced as funds permit by wells on which continuous measurements can be made. All records will be analyzed statistically to determine their predictability, so that a station can then be shifted to a new site.

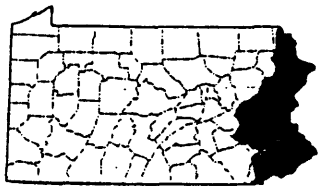
PROGRESS: Water-level data for continuous and monthly observation wells were collected, and data from network wells were published. Presently operating 15 continuous record sites and 2 others.

PLANS: Continue data collection in the Delaware River basin. Publish these data in the annual report. Install data collection platforms on five stations.

QUALITY WATER STATIONS, MALVERN SDO (PA403)

LOCATION: Eastern Pennsylvania

COOPERATOR(S): Delaware River Basin Commission; City of Philadelphia; and Chester County Water Resources Authority



PERIOD OF PROJECT: Continuous since August 1949

PROJECT CHIEF: James R. Kolva

HEADQUARTERS OFFICE: Malvern, PA

PROBLEM: Water-quality data are needed for surveillance, planning, design, and management of water resources. Water-quality problems can affect industries, water-treatment facilities and the individual consumer. To provide the appropriate information, a data base is necessary.

OBJECTIVE: To collect water-quality data sufficient for current uses, such as (1) assessment of water resources, (2) operation of reservoirs, and (3) research or special studies. To collect data necessary for analytical studies to define the statistical properties of spatial and temporal trends in the quality of surface waters-streams, lakes, estuaries - for use in planning and management.

APPROACH: Water samples are collected periodically and analyzed in the U.S. Geological Survey Central Laboratories. At some sites, temperature, dissolved oxygen, pH, and specific conductance are monitored continuously. The operation of the network provides chemical concentrations and loads as required by water planning and managing agencies.

PROGRESS: Hydrologic data for continuous and partial-record stations in the Delaware River basin were collected and published. Eight continuous record stations were established on the Schuylkill River. Data collection platforms were installed on all water-quality monitors except one. Delaware River at Ship John Shoal was discontinued. Presently operating 16 continuous record sites and 58 others.

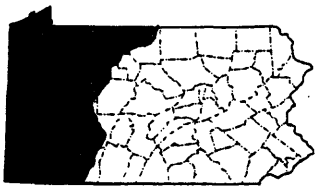
PLANS: Continue hydrologic data collection at continuous and partial-record stations in the Delaware River basin.

SURFACE WATER STATIONS, PITTSBURGH SDO (PA501)

LOCATION: Western Pennsylvania

COOPERATOR(S): New York State Department of Environmental Conservation; PaDER, Bureau of Water Resources Management; Federal Energy Regulatory Commission; and U.S. Army Corps of Engineers

PERIOD OF PROJECT: Continuous since June 1931



PROJECT CHIEF: Joseph B. Lescinsky

HEADQUARTERS OFFICE: Pittsburgh, PA

PROBLEM: Surface-water information is needed for purposes of surveillance, planning, design, hazard warning, and operation and management in water-related fields such as water supply, hydroelectric power, flood control, irrigation, bridge and culvert design, wildlife management, pollution abatement, flood-plain management, and water resources development. To provide this information, an appropriate data base is necessary.

OBJECTIVE: A. To collect surface-water data sufficient to satisfy needs for current-purpose uses, such as (1) assessment of water resources, (2) operation of reservoirs or industries, (3) forecasting, (4) disposal of wastes and pollution controls, (5) discharge data to accompany water-quality measurements, (6) compact and legal requirements, and (7) research or special studies. B. To collect data necessary for analytical studies to define for any location the statistical properties of, and trends in, the occurrence of water in streams, lakes, estuaries, etc., for use in planning and design.

APPROACH: Standard methods of data collection will be used as described in the series, "Techniques of Water Resources Investigations of the United States Geological Survey." Partial-record gaging will be used instead of complete-record gaging where it serves the required purpose.

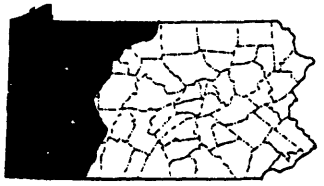
PROGRESS: Hydrologic data for continuous and partial record stations within Ohio and St. Lawrence River basins were collected and published. Presently operating 71 continuous record stations and five others.

PLANS: To continue hydrologic data collection of continuous record and partial record stations within Ohio and St. Lawrence River basins.

GROUND-WATER STATIONS, PITTSBURGH SDO (PA502)

LOCATION: Western Pennsylvania

COOPERATOR(S): PaDER, Bureau of Water Resources Management; and PaDER, Bureau of Topographic and Geologic Survey



PERIOD OF PROJECT: Continuous since January 1931

PROJECT CHIEF: Raymond W. Siwicki

HEADQUARTERS OFFICE: Pittsburgh, PA

PROBLEM: Long-term water-level records are needed to evaluate the effects of climatic variations on the recharge to and discharge from the ground-water systems, to provide a data base from which to measure the effects of development, to assist in the prediction of future supplies, and to provide data for management of the resource.

OBJECTIVE: A. To collect water-level data sufficient to provide a minimum long-term data base so that the general response of the hydrologic system to natural climatic variations and induced stresses is known and potential problems can be defined early enough to allow proper planning and management. B. To provide a data base against which the short-term records acquired in areal studies can be analyzed. This analysis must (1) provide an assessment of the ground-water resource, (2) allow prediction of future conditions, (3) detect and define pollution and supply problems, and (4) provide the data base necessary for management of the resource.

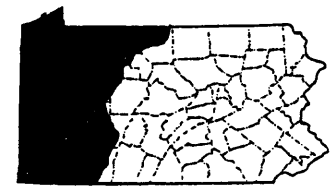
APPROACH: The diversity of the stratigraphic, lithologic, topographic, and climatic conditions in the basin preclude sampling each environment. A network of 22 uniformly distributed wells has, therefore, been established. Continuous recorders are installed on 21 wells, and the remaining well, which cannot accommodate a recorder, is measured weekly. It will be replaced as funds permit by a well on which continuous measurements can be made. All records will be analyzed statistically to determine their predictability, so that a station can then be shifted to a new site.

PROGRESS: Data collected on schedule within major stream basins for the Ohio and St. Lawrence River basins.

PLANS: Data will be collected within major stream basins of the Ohio and St. Lawrence River basins.

QUALITY WATER STATIONS, PITTSBURGH SDO (PA503)

LOCATION: Western Pennsylvania



COOPERATOR(S): None

PERIOD OF PROJECT: Continuous since August 1949

PROJECT CHIEF: Donald R. Williams

HEADQUARTERS OFFICE: Pittsburgh, PA

PROBLEM: Water-quality data are needed for surveillance, planning, design, and management of water resources. Water-quality problems can affect industries, water-treatment facilities, and the individual consumer. To provide the appropriate information, a data base is necessary.

OBJECTIVE: To collect water-quality data sufficient for current uses, such as (1) assessment of water resources, (2) operation of reservoirs, and (3) research or special studies. To collect data necessary for analytical studies to define the statistical properties of spatial and temporal trends in the quality of surface waters-streams, lakes, estuaries - for use in planning and management.

APPROACH: Water samples are collected periodically and analyzed in the U.S. Geological Survey Central Laboratories. At some sites, temperature, dissolved oxygen, pH, and specific conductance are continuously monitored. The operation of the network provides chemical concentrations and loads as required by water planning and managing agencies.

PROGRESS: Continued sample collection at regular stations within the Ohio and St. Lawrence River basins. Presently operating three sites.

PLANS: Sample collection will be continued at regular stations within the Ohio and St. Lawrence River basins. Sample frequency is four times per year.

WATER RESOURCES DIVISION PUBLICATIONS

The Water Resources Division of the U.S. Geological Survey is the Nation's lead agency in the collection of water data and the dissemination of information on water resources. The Division makes water data and information readily and equally available to water managers, policymakers, the scientific community, and the public in formats that meet their needs.

The Geological Survey has published the results of its studies for more than 100 years. The information is multipurpose and, after its initial use, becomes a basis for future resource evaluation and water-management decisions. The Water Resources Division releases its information through several publication series, explained below, and through computerized systems, accessible through NAWDEX (see page 14) and WATSTORE (see page 15).

A description of these publications series, the types of information presented in them and ordering information is given below.

Water Supply Paper--Significant interpretive results of hydrologic investigations that are considered to be of broad interest.

Professional Paper--Comprehensive or topical reports on any earth-science subject of interest to multi-discipline scientific audiences.

Bulletin--Significant interpretive results of earth-science investigations of broad interest, including computer applications.

Circular--Summaries of topical investigations or programs that are of short-term or local interest.

Map series, such as Hydrologic Investigations Atlas--Significant results of hydrologic investigations presented in map format.

Techniques of Water-Resources Investigations Report--Reports on methods and techniques used in collecting, analyzing, and processing hydrologic data for technically oriented audiences.

Geological Survey Yearbook--Significant activities of the Water Resources Division that are summarized each year for general audiences.

Water Resources Investigations Report--Comprehensive or topical interpretive reports, and maps mainly of local or short-term interest, for interdisciplinary audiences.

Open-file book and map reports--Compilations of data and preliminary interpretive reports of limited interest, or reports awaiting formal publication that require interim release.

Water-Data Report--Water year data on streamflow, ground-water levels, and quality of surface and ground-water for each State, Puerto Rico, Virgin Islands, and the Trust Territories.

National Water Conditions--A monthly news release that summarizes the national water situation for water-resources-oriented audiences.

With the exception of the "National Water Conditions," which is a form of news release, all the above publication series are listed in three catalogs--"Publications of the Geological Survey, 1879-1961", "Publications of the Geological Survey, 1962-1970", and "Publications of the Geological Survey, 1971 through 1981"--and in yearly supplements to these catalogs for 1982 through 1986.

As new publications are released, they are announced in a monthly list, "New Publications of the Geological Survey", to which a free subscription is available by writing to the U.S. Geological Survey, 582 National Center, Reston, VA 22092.

Many items of scientific interest are published in technical and scientific journals to make the information readily available to those in related fields of study. Other reports of local interest are published by cooperating State agencies and made available within the State.

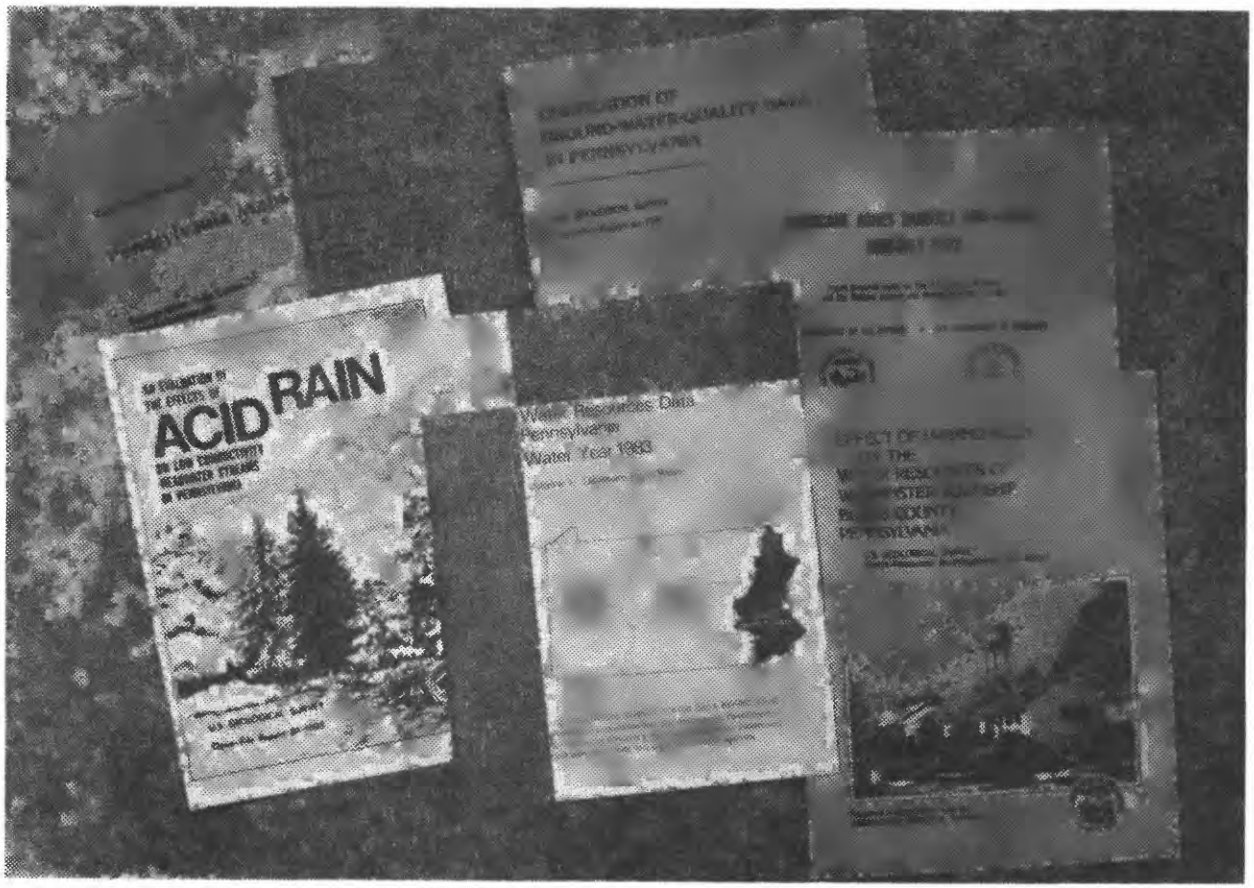
A report,--U.S. Geological Survey Circular 900, "Guide to Obtaining USGS Information",--describes sources of U.S. Geological Survey information and shows in tabular form the types of U.S. Geological Survey products and where they are available.

TO ORDER TEXT PRODUCTS

Professional papers, bulletins, water-supply papers, techniques of water-resources investigations, water-resources investigations reports, circulars, publications of general interest (such as leaflets, pamphlets, booklets), single copies of the Earthquake Information Bulletin, Preliminary Determination of Epicenters, and some miscellaneous reports, including some from the foregoing series that have gone out of print at the Superintendent of Documents, are obtainable by mail from U.S. Geological Survey, Books and Open-File Reports, Federal Center, Building 41, Box 25425, Denver, CO 80225.

Certain U.S. Geological Survey reports, including most of the Water Resource Investigations (WRI) series released before 1982, "Water Resources Data - [State] [Water year] [year]" beginning with the 1975 issues, and many compilations of data, can be purchased only from the National Technical Information Service (NTIS). New U.S. Geological Survey reports that are available only from NTIS are cited in the monthly list, "New Publications of the U.S. Geological Survey." For information on obtaining these reports contact: National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161 (703) 737-4650.

SELECTED LITERATURE ON WATER RESOURCES IN PENNSYLVANIA



Because the number of publications pertaining to water resources in Pennsylvania is large, the publications listed herein were selected to show the types of information available to those interested in or in need of water facts. Many of these publications are available for inspection at the office listed on the front page of this report and at large public and university libraries. The publications are grouped as follows: I. Publications of the U.S. Geological Survey; II. Publications of State agencies prepared in cooperation with the U.S. Geological Survey; and III. Other publications, such as technical journals.

I. Publications of the U.S. Geological Survey

General Information.--The U.S. Geological Survey announces all its publications in a monthly report "New Publications of the Geological Survey." Subscriptions to this monthly listing are available upon request to the U.S. Geological Survey, 582 National Center, Reston, VA 22092. All publications are for sale unless specifically stated otherwise. Prices, which are subject to change, are not included here. Prepayment is required and information on price and availability should be obtained before placing an order. The "U.S. Geological Survey Yearbook" provides a comprehensive description of the Federal Government's largest earth-science agency; copies may be purchased at the address where professional papers are sold. Summaries of research in progress and results of completed investigations are published each fiscal year in the professional paper series "Geological Survey Research". A pamphlet entitled "Geologic and Water-Supply Reports and maps for Pennsylvania and New Jersey," which includes reports of the geology and other water-resources reports, is available upon request to: Map Distribution Section, U.S. Geological Survey, Federal Center, Box 25286, Denver, CO 80225 (303) 236-7477.

Water Resources Information.--A monthly summary of the national water situation is presented in the "Water Resources Review." Records of streamflow, ground-water levels, and quality of water were published for many years as Geological Survey water-supply papers as explained below.

Streamflow records.--Records of daily flows of streams prior to 1971 were published in the Water-Supply Paper series "Surface-Water Supply of the United States," which was released in numbered parts as determined by natural drainage basins. Until 1961, this was an annual series; monthly and yearly summaries of these data were compiled in two reports: "Compilation of Records of Surface Waters of the United States through 1950," and "Compilation of Records of Surface Waters of the United States, October 1950 to September 1960." For the period 1961-1970, 5-year compilations were published. Data for Pennsylvania are published in Parts 1, 3, and 4. Daily streamflow records also were published on a State-boundary basis during the period 1961-74.

Ground-water records.--Ground-water levels and artesian pressures in observation wells prior to 1975 were reported by geographic areas in a 5-year Water-Supply Paper series. Data for Pennsylvania are in "Ground-Water Levels in the United States, Northern States."

Quality-of-water records.--Data on quality of surface water prior to 1971 were published annually in the Water-Supply Paper series "Quality of Surface Waters of the United States," which also was released in numbered parts as determined by natural drainage basins. Data for Pennsylvania are in Parts 1, 3, and 4. For water years 1964-74, these data also were released annually on a State-boundary basis.

Data reports covering the years 1971 through 1974 were published by the Geological Survey and archived by National Technical Information Service, and were retroactively numbered and included in the state water-data report series.

Beginning with the 1975 water year, these series were replaced by a new publication series "U.S. Geological Survey Water-Data Reports." This series combines under one cover streamflow data, water-quality data for surface and ground water, and ground-water level data for each State. For Pennsylvania the title is "Water Resources Data for Pennsylvania--Water Year (date).

Methods for estimating the magnitude and frequency of floods for selected streams are given in the Water-Supply Paper series "Magnitude and Frequency of Floods in the United States," which is composed of reports released in parts by drainage basins; data for Pennsylvania are in Parts 1, 3, and 4. The U.S. Geological Survey also outlines flood-prone areas on topographic maps as part of a nationwide Federal program for managing flood losses. In Pennsylvania, 757 topographic maps have been completed. (See list: "Flood-prone area maps in Pennsylvania.")

P 271. The natural channel of Brandywine Creek, Pa., by M. G. Wolman. 1955.

P 282-F. Drainage basins, channels, and flow characteristics of selected streams in central Pennsylvania, by L. M. Brush, Jr., 1961.

P 381. Water resources of the Delaware River basin, by G. G. Parker, A. G. Hely, W. B. Keighton, F. H. Olmsted, and others. 1964 (1965).

P 417-A. Relation between ground water and surface water in Brandywine Creek basin, Pennsylvania, by F. H. Olmsted and A. G. Hely. 1962.

P 417-B. Some relations between streamflow characteristics and the environment in the Delaware River region, by A. G. Hely and F. H. Olmsted. 1963.

P 473-B. Field investigation of mine waters in the Northern Anthracite field, Pennsylvania, by Ivan Barnes, W. T. Stuart, and D. W. Fisher. 1964.

P 575-C. Geological Survey Research 1967. Contains the following articles, which are not available separately. The construction and use of flow-volume curves, by E. G. Miller. Hydrogeologic significance of calcium-magnesium ratios in ground water from carbonate rocks in the Lancaster quadrangle, southeastern Pennsylvania, by Harold Meisler and A. E. Becher.

P 700-B. Geological Survey Research 1970. Contains the following article, which is not available separately. High-calcium limestone deposits in Lancaster County, southeastern Pennsylvania, by A. E. Becher and Harold Meisler.

P 701-A. Hydrology of two small river basins in Pennsylvania before urbanization, by R. A. Miller, John Troxell, and L. B. Leopold with a section on Observations of stream fauna, by Ruth Patrick and R. R. Grant, Jr. 1971 (1972).

P 750-D. Geological Survey Research 1971. Contains the following article, which is not available separately. Relationship between ground-water levels and quality in shallow observation wells in Muddy Creek basin, southeastern York County, Pa., by D. J. Growitz and O. B. Lloyd, Jr.

P 800-C. Geological Survey Research 1972. Contains the following article, which is not available separately. An evaluation of the use of herbicides to control aquatic weeds in six Pennsylvania recreation lakes, by J. L. Barker.

P 813-I. Summary appraisals of the Nation's ground-water resources-Mid-Atlantic region, by Allen Sinnott and E. M. Cushing. 1978.

P 813-J. Summary appraisals of the Nation's ground-water resources-Great Lakes region, by W. E. Weist, Jr. 1978.

P 924. Hurricane Agnes rainfall and floods, June-July 1972, by J. F. Bailey, J. L. Patterson, and J. L. H. Paulhus. 1975.

P 1191. Storm-induced debris avalanching and related phenomena in the Johnstown area Pennsylvania, with references to other studies in the Appalachians, by J. S. Pomeroy. 1980 (1981).

P 1211. Johnstown-western Pennsylvania storms and floods of July 19-20, 1977, by L. R. Hoxit, R. A. Maddox, and C. F. Chappell, National Oceanic and Atmospheric Administration, and S. A. Brua, U.S. Geological Survey. 1982.

W 106. Water resources of the Philadelphia district, by Florence Bascom. 1904.

W 108. Quality of water in the Susquehanna River drainage basin, by M. O. Leighton, with an introductory chapter on Physiographic features, by G. B. Hollister. 1904.

W 109. Hydrography of the Susquehanna River drainage basin, by J. C. Hoyt and R. H. Anderson. 1905.

W 161. Quality of water in the upper Ohio River basin and at Erie, Pa., by S. J. Lewis, 1906.

W 799. The floods of March 1936--Part 2, Hudson River to Susquehanna River region. 1937 (1938).

W 800. The floods of March 1936--Part 3, Potomac, James and upper Ohio River; with a section on the Weather associated with the floods of March 1936, by Stephen Lichtblau. 1937 (1938).

W 915. Major winter and nonwinter floods in selected basins in New York and Pennsylvania, by W. B. Langbein and others. 1947.

W 1134-B. Floods of July 18, 1942, in north-central Pennsylvania, by W. S. Eisenlohr, Jr., with a section on Descriptive details of the storm and floods, by J. E. Stewart. 1952, p. 59-158.

W 1420. Floods of August-October 1955, New England to North Carolina, by D. B. Bogart, 1960.

W 1473. Study and interpretation of the chemical characteristics of natural water, by J. D. Hem. 1970.

W 1526. Hydraulic and hydrologic aspects of flood-plain planning, by S. W. Wiitala, K. R. Jetter, and A. J. Sommerville. 1961.

W 1532-C. Effects of agricultural conservation practices on the hydrology of Corey Creek basin, Pennsylvania, 1954-60, by B. L. Jones. 1966.

W 1532-E. Hydrology and sedimentation of Corey Creek and Elk Run basins, north-central Pennsylvania, by L. A. Reed. 1971.

W 1532-F. Appraisal of stream sedimentation in the Susquehanna River basin, by K. F. Williams and L. A. Reed. 1972.

W 1532-H. Sediment transport by streams draining into the Delaware Estuary, by L. J. Mansue and A. B. Commings, 1974.

W 1535-P. Chemical composition of atmospheric precipitation in the Northeastern United States, by F. J. Pearson, Jr., and D. W. Fisher. 1971.

W 1539-H. Ground-water resources of Olmsted Air Force Base, Middletown, Pa., by Harold Meisler and S. M. Longwill. 1961.

W 1586-B. Salinity of the Delaware estuary, by Bernard Cohen and L. T. McCarthy, Jr. 1962.

W 1586-G. Fresh-water discharge--salinity relations in the tidal Delaware River, by W. B. Keighton. 1966.

W 1619-W. Chemical quality of surface waters in Pennsylvania, by C. N. Durfor and P. W. Anderson. 1963.

W 1779-B. Variations in the chemical character of the Susquehanna River at Harrisburg, Pa., by P. W. Anderson. 1963.

W 1779-C. Chemical quality of surface water in the West Branch, Susquehanna River basin, Pennsylvania, by E. F. McCarren. 1964.

W 1779-X. Quality of Delaware River water at Trenton, N. J., by L. T. McCarthy, Jr., and W. B. Keighton. 1964.

W 1798-M. Sediment characteristics of five streams near Harrisburg, Pa., before highway construction, by L. A. Reed. 1976.

W 1798-N. Hydrology and sedimentation of Bixler Run basin, central Pennsylvania, by L. A. Reed. 1976.

W 1800. The role of ground water in the national water situation, by C. L. McGuinness. 1963.

W 1809-O. Delaware River water quality, Bristol to Marcus Hook, Pa., August 1949 to December 1963, by W. B. Keighton. 1965.

W 1812. Public water supplies of the 100 largest cities in the United States, 1962, by C. N. Durfor and Edith Becker. 1964.

W 1829. Swatara Creek basin of southeastern Pennsylvania--An evaluation of its hydrologic system, by W. T. Stuart, W. J. Schneider, and J. W. Crooks. 1967.

W 1835. Chemical quality of surface water in the Allegheny River basin, Pennsylvania and New York, by E. F. McCarren. 1967.

W 1871. Water data for metropolitan areas, compiled by W. J. Schneider. 1968.

W 1879-H. Water quality and discharge of streams in the Lehigh River basin, Pennsylvania, by E. F. McCarren and W. B. Keighton. 1969.

W 1899-I. Streamflow from the United States into the Atlantic Ocean during 1931-60, by C. D. Bue. 1970.

W 1990. Annotated bibliography on artificial recharge of ground water, 1955-67, by D. C. Signor, D. J. Growitz, and William Kam. 1970.

W 1990-O. Water quality of streams in the Neshaminy Creek basin, Pennsylvania, by E. F. McCarren. 1972.

W 2020. Subsurface waste disposal by means of wells--A selective annotated bibliography, by D. R. Rima, E. B. Chase, and B. M. Myers. 1971.

W 2035. Geohydrologic reconnaissance of the upper Potomac River basin, by F. W. Trainer and F. A. Watkins, Jr. 1975.

W 2042. Mean annual runoff in the Upper Ohio River basin, 1941-70, and its historical variation, by R. M. Beall. 1978.

W 2054. Effectiveness of sediment-control techniques used during highway construction in central Pennsylvania, by L. A. Reed. 1978.

W 2072. Suspended-sediment discharge, in five streams near Harrisburg, Pennsylvania, before, during, and after highway construction, by L. A. Reed. 1980.

W 2250. National water summary 1983; hydrologic events and issues. 1984.

W 2256-A. Distribution and transport of trace substances in the Schuylkill River basin from Berne to Philadelphia, Pennsylvania, by J. K. Stamer, T. H. Yorke, and G. L. Pederson, 1985. (Supersedes Open-file report 83-265).

W 2256-B. Effects of low-level dams on the distribution of sediment, trace metals, and organic substances in the lower Schuylkill River basin, Pennsylvania, by T. H. Yorke, J. K. Stamer, and G. L. Pederson. 1985.

W 2262. Organochlorine pesticide and polychlorinated biphenyl residues at four trophic levels in the Schuylkill River, Pennsylvania: IN, Selected Papers in the Hydrologic Sciences, by J. L. Barker, 1984.

W 2275. National water summary 1984; hydrologic events, selected water-quality trends, and ground-water resources. 1985.

W 2276. Techniques for estimating streamflow characteristics in the Eastern and Interior coal provinces of the United States, by K. L. Wetzel, and J. M. Bettandorff. 1986.

W 2300. National water summary 1985; hydrologic events and surface-water resources. 1986.

Bulletins

1245-G. Carbonate rocks of Cambrian and Ordovician age in the Lancaster quadrangle, by Harold Meisler and A. E. Becher. 1968.

1331-A. Mississippian stratigraphy of northeastern Pennsylvania, by G. R. Schiner and G. E. Kimmel. 1972.

U.S. Geological Survey Circulars

C-104. Water resources of southeastern Bucks County, Pa., by J. B. Graham, J. W. Mangan and W. E. White, Jr. 1951.

C-174. Water resources of the Lake Erie shore region in Pennsylvania, by J. W. Managan, D. W. Van Tuyl, and W. F. White, Jr. 1952.

C-204. Floods in Youghiogheny and Kiskiminetas River basins, Pennsylvania and Maryland, frequency and magnitude. 1952.

C-257. The use of water in Pennsylvania, 1951, by J. W. Mangan and J. B. Graham, 1953.

C-315. Water resources of the Pittsburgh area, Pennsylvania, by Max Noecker, D. W. Greenman, and N. H. Beamer. 1954.

C-377. Floods of August 1955 in the northeastern States, 1956. (See Water-Supply Paper 1420.)

C-439. Time and travel of water in the Ohio River, Pittsburgh to Cincinnati, by R. E. Steacy. 1961.

C-526. Stream quality in Appalachia as related to coal-mine drainage, 1965, by J. E. Biesecker and J. R. George. 1966.

C-554. Hydrology for urban land planning--A guidebook on the hydrologic effects of urban land use, by L. B. Leopold. 1968.

C-601-A. Water for the cities--The outlook, by W. J. Schneider and A. M. Spieker. 1969 (1970).

C-601-D. Water as an urban resource and nuisance, by H. E. Thomas and W. J. Schneider. 1970.

C-601-E. Sediment problems in urban areas, by H. P. Guy, 1970.

C-601-F. Hydrologic implications of solid-waste disposal, by W. J. Schneider. 1970.

C-601-G. Real-estate lakes, by D. A. Rickert and A. M. Spieker. 1971 (1972).

C-601-H. Role of water in urban planning and management, by W. J. Schneider, D. A. Rickert, and A. M. Spieker. 1973.

C-601-I. Water facts and figures for planners and managers, by J. H. Feth. 1973.

C-601-J. Extent and development of urban flood plains, by W. J. Schneider and J. E. Goddard. 1974.

C-601-K. An introduction to the processes, problems, and management of urban lakes, by L. J. Britton, R. C. Averett, and R. F. Ferreira. 1975. (Circular 601 issued only as separate chapters under the general title "Water in the urban environment.")

C-645. A procedure for evaluating environmental impact, by L. B. Leopold, F. E. Clark, B. B. Hanshaw, and J. R. Balsley. 1971.

C-670. Fluvial-sediment discharge to the ocean from the conterminous United States, by W. F. Curtis, J. K. Culbertson, and E. B. Chase. 1973.

C-685. Dissolved-solids discharge to the oceans from the conterminous United States, by D. K. Leifeste. 1974.

C-686. Large rivers of the United States, by K. T. Iseri and W. B. Langbein, 1974.

C-703. Water demands for expanding energy development, by G. H. Davis and L. A. Wood. 1974.

C-719. The National Stream Quality Accounting Network (NASQAN)--Some questions and answers, by J. F. Ficke and R. O. Hawkinson. 1975.

C-728. Landsliding in Allegheny County, Pa., by R. P. Briggs, J. S. Pomeroy, and W. E. Davies. 1975.

C-745. Water consumption by nuclear powerplants and some hydrological implications, by E. V. Giusti and E. I. Meyer. 1977 (1978).

C-747. Environmental geology, Allegheny County and vicinity, Pennsylvania--Description of a program and its results, by R. P. Briggs. 1977.

C-779. Geologic disposal of high-level radioactive wastes--Earth-science perspectives, by J. D. Bredehoeft, A. W. England, D. B. Stewart, N. J. Trask, and I. J. Winograd, 1978.

C-832. Estimating the costs of landslide damage in the United States, by R. W. Fleming and F. A. Taylor. 1980.

C-900. Guide to obtaining USGS information, by K. Dodd, H. K. Fuller, and P. F. Clarke, 1985. (This circular supersedes C-777).

Journal of Research of the U.S. Geological Survey

Armbruster, J. T., 1976, An infiltration index useful in estimating low flows of drainage basins: v. 4, p. 533-538.

Barker, J. L., 1976, Effects of air injection at Prompton Lake, Wayne County, Pennsylvania: v. 4, no. 1, p. 19-25.

Ritter, J. R., 1974, The effects of the Hurricane Agnes Flood on channel geometry and sediment discharge of selected streams in the Susquehanna River basin, Pennsylvania: v. 2, no. 6, p. 753-761.

WRI 50-74. Stream reconnaissance for nutrients and other water-quality parameters, Greater Pittsburgh region, Pennsylvania, by R. M. Beall. 1975. (PB-241 493/AS)

WRI 6-75. Occurrence of pesticide residues in four streams draining different land-use areas in Pennsylvania, by J. F. Truhlar and L. A. Reed. 1975. (PB-242 770/AS)

WRI 76-51. Technical manual for estimating low-flow frequency characteristics of streams in the Susquehanna River basin, by J. T. Armbruster. 1976. (PB-255 455/AS)

WRI 76-57. Preimpoundment water quality of Raystown Branch Juniata River and six tributary streams, south-central Pennsylvania, by D. R. Williams. 1976. (ADA-027 387)

WRI 76-66. Preliminary results of preimpoundment water-quality studies in the Tioga River basin, Pennsylvania and New York, by J. R. Ward. 1976. (ADA-029 315)

WRI 76-84. Limnological survey of Sacony Creek basin, Berks County, Pennsylvania by J. L. Barker and K. P. Kulp. 1976. (PB-257 270/AS)

WRI 76-111. Sediment discharge from an area of highway construction, Applemans Run basin, Columbia County, Pennsylvania, by D. A. V. Eckhardt. 1976 (1977). (PB-263 616/AS)

WRI 77-12. Flow routing in the Susquehanna River basin: Part I, effects of Raystown Lake on the low-flow frequency characteristics of the Juniata and lower Susquehanna Rivers, Pennsylvania, by J. T. Armbruster. 1977. (PB 268 981/AS)

WRI 77-55. Water-quality study of Tulpehocken Creek, Berks County, Pennsylvania, prior to impoundment of Blue Marsh Lake, by J. L. Barker, 1977. (AD A045 865)

WRI/OF 77-67. Ground-water resources of Chester County, Pennsylvania, by L. J. McGreevy and R. A. Sloto.

WRI 78-12. Regional analysis of the effects of land use on stream-water quality, methodology and application in the Susquehanna River basin, Pennsylvania and New York, by D. J. Lystrom, F. A. Rinella, D. A. Rickert, and Lisa Zimmermann. 1978. (PB-284 185)

WRI 78-35. Sediment discharge from highway construction near Port Carbon, Pennsylvania, by R. E. Helm. 1978. (PB-280 793)

WRI 78-42. Postimpoundment survey of water-quality characteristics of Raystown Lake, Huntingdon and Bedford Counties, Pennsylvania, by D. R. Williams. 1978 (1979). (AOA-061 737)

WRI 78-53. Bacteriological water quality of Tulpehocken Creek basin, Berks and Lebanon Counties, Pennsylvania, by J. L. Barker. 1978 (1979). (ADA-057 485)

WRI 79-3. Regional stochastic generation of streamflows using an arima (1,0,1) process and disaggregation, by J. T. Armbruster, 1979. (PB 300 945/AS)

WRI 79-19. Selected water resources data, Clarion River and Redbank Creek basins, northwestern Pennsylvania --Part 2, by T. F. Buckwalter, C. H. Dodge, and G. R. Schiner. 1979. (PB-80 107 915)

WRI 79-52. Flow routing in the Susquehanna River basin: Part II--Low-flow characteristics of the Susquehanna River between Waverly, New York and Sunbury, Pennsylvania, by D. L. Bingham. 1979. (PB-301 392)

WRI 79-85. Flow routing in the Susquehanna River basin: Part III--Routing reservoir releases in the Tioga and Chemung Rivers system, Pennsylvania, and New York, 1977, by J. T. Armbruster. 1979. (PB-301 393)

WRI 79-88. Nonpoint-source discharges in Pequea Creek basin, Pennsylvania, 1977, by J. R. Ward and D. A. Eckhardt. 1979. (PB-175 656)

WRI 80-02. Development of a digital model of ground-water flow in deeply weathered crystalline rock, Chester County, Pennsylvania, by L. J. McGreevy and R. A. Sloto. 1980 (1981). (PB-81 132 896)

WRI 80-53. Effects of strip mining the abandoned deep Anna S mine on the hydrology of Babb Creek, Tioga County, Pennsylvania, by L. A. Reed, 1980. (PB 81 121 337)

WRI 80-68. The effects of highway construction on sediment discharge into Blockhouse Creek and Steam Valley Run, Pennsylvania, by R. A. Hainly, 1981. (PB-81 202 202)

WRI 81-1. Preimpoundment water quality in the Tioga River basin, Pennsylvania, and New York, by J. R. Ward. 1981. (ADA-101 909)

WRI 81-69. Sedimentation in the East Branch Mahoning Creek, Clearfield and Jefferson Counties, Pennsylvania, June 1979 to June 1980, by K. L. Wetzel.

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WRIR 85-4177.	Determination of Benthic-Invertebrate Indices & Water-Quality Trends of Selected Streams in Chester County, Pennsylvania	MOORE, C. R.	1987
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WRIR 85-4283.	Stream-Water Quality in the West Branch Susquehanna River basin, Pennsylvania: An Appraisal of Areal and Temporal Variability from 1962 to 1982 in NASQAN Accounting Unit -- 020502	HAINLY, R. A.	1988
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WRIR 86-4055.	Simulation of Ground-Water Flow in the Lower Sand Unit of the Potomac-Raritan-Magothy Aquifer System, Philadelphia, Pennsylvania	SLOTO, R. A.	1987
WRIR 86-4164.	Hydrogeology and Ground-Water Quality at a Land Reclamation Site, Neshaminy State Park, Pennsylvania	BLICKWEDEL, R. S.	1987
WRIR 86-4195.	Technique for Estimating Depths of 100-year Floods in Pennsylvania	FLIPPO, H. N.	1988
WRIR 87-4065.	Water Resources of Oley Township, Berks County, Pennsylvania	PAULACHOK, G. N.	1988

WRIR 87-4098.	Effect of Urbanization on the Water Resources of Eastern Chester County, Pennsylvania	SLOTO, R. A.	1987
WRIR 87-4136.	A Feasibility Study to Estimate Minimum Surface-Casing Depths of Oil and Gas Wells to Prevent Ground-Water Contamination in Four Areas of Western Pennsylvania	BUCKWALTER, T. F.	1988
OFR 85-686.	Limnological Data for Selected Streams in Chester County, Pennsylvania, 1969-1980	MOORE, C. R.	1988
OFR 86-140.	Water-Quality Data for Precipitation and Storm Runoff in Pennypack Creek Basin, Philadelphia, Pennsylvania	SPEIGHT, D. W.	1988
OFR 87-217.	Selected Ground-Water Data, Chester County, Pennsylania	SLOTO, R. A.	1988
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Title	Author	PPD
Ground-Water Resources of Delaware County, Pennsylvania	BALMER, W. T.	1988
Ground-Water Resources in and Near the Anthracite Basins of Schuylkill and Adjacent Counties, Pennsylvania	BECHER, A. E.	1987
Ground-Water Resources of Pike County, Pennsylvania	DAVIS, D. K.	1988
Hydrology and Geology of Erie County, Pennsylvania	GALLAHER, J. T.	1987
Hydrogeology, Water Resources, and the Hydrologic Effects of Coal Mining, Greene County, Pennsylvania	STONER, J. D.	1987
Ground-Water Resources of the Berwick-Bloomsburg Danville Area, East-Central, Pennsylvania	WILLIAMS, J. H.	1987

ADDITIONAL INFORMATION

Additional information on U.S. Geological Survey programs in Pennsylvania can be obtained from:

WATER

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USGS-WRD
Federal Bldg., 228 Walnut St.
P.O. Box 1107
Harrisburg, PA 17108
Ph: (717) 782-3468

MAPS

National Cartographic Information Center
U.S. Geological Survey
507 National Center
Room 1-C-107
12201 Sunrise Valley Drive
Reston, VA 22092
Ph: (703) 860-6045

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Geologic Inquiries Group
U.S. Geological Survey
907 National Center
Reston, VA 22092
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U.S. Geological Survey
503 National Center
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Reston, VA 22092
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Several Commonwealth agencies conduct water-resources investigations and present their results in State publications. The Department of Environmental Resources, Bureau of Topographic and Geologic Survey, in addition to the cooperative studies with the U.S. Geological Survey, conducts its own water resource studies and publishes the results in their Water Resource Reports Series. A bibliography of these reports can be obtained by writing:

Pennsylvania Geological Survey
Department of Environmental Resources
P. O. Box 2357
Harrisburg, PA 17120

FLOOD-PRONE-AREA MAPS IN PENNSYLVANIA

Note: Quadrangles completed in 1969 show "approximate areas occasionally flooded." Those completed in the years after 1969 delimit the approximate boundaries of the 100-year flood.

D = Delaware drainage basin
S = Susquehanna drainage basin
P = Potomac drainage basin
O = Ohio drainage basin
L = St. Lawrence drainage basin

Quadrangle	Year Completed		Quadrangle	Year Completed	
Abbotstown	1970	S	Bay View (MD)	1973	D
Accident (MD)	1974	O	Beaver	1974	O
Airville	1973	S	Beaver Center	1973	O
Albion	1973	O,L	Beaver Falls	1974	O
Aldenville	1977	D	Beaver Springs	1974	S
Alexandria	1969	S	Beavertown	1975	S
Alfarata	1981	S	Bedford	1974	S
Aliquippa	1975	O	Bedminster	1974	D
Allensville	1973	S	Beech Creek	1974	S
Allentown East	1973	D	Bellefonte	1974	S
Allentown West	1973	D	Bellegrove (MD)	1972	P
Allenwood	1973	S	Belleville	1974	S
Altoona	1973	S	Bellwood	1977	S
Alum Bank	1982	S	Belvidere (NJ)	1973	D
Ambler	1974	D	Bentley Creek	1973	S
Ambridge	1974	O	Benton	1973	S
Amity	1975	O	Berlin	1982	O
Andersonburg	1973	S	Bernville	1969	D
Antrim	1973	S	Berwick	1972	S
Arendtsville	1973	P,S	Bessemer	1975	O
Artemas (MD)	1974	P	Bethany (W.VA)	1973	O
Asaph	1973	S	Bethel	1973	S
Ashland	1969	S	Beverly (NJ)	1973	D
Ashville	1974	S	Biglerville	1973	S
Auburn	1969	D	Birdsboro	1973	D
Aughwick	1969	S	Black Moshannon	1982	S
Austin	1973	S	Blain	1982	S
Avella	1973	O	Blairs Mills	1973	S
Avilton (MD)	1974	O	Blakeslee	1974	D
Avoca	1973	S	Blandburg	1982	S
Avonmore	1973	O	Bloomsburg	1973	S
Ayers Hill	1982	S	Blossburg	1973	S
			Blue Knob	1974	S
Baden	1974	O	Blue Ridge Summit (MD)	1973	P
Bangor (NJ)	1973	D	Bodines	1973	S
Barbours	1973	S	Bolivar (NY)	1974	O
Barnesboro	1973	S	Boswell	1974	O
Barrville	1982	S	Boyertown	1973	D

Flood-Prone-Area Maps in Pennsylvania (Continued)

Quadrangle	Year Completed	
Braddock	1974	O
Bradford	1974	O
Brandy Camp	1973	O
Bridgeport (NJ)	1973	D
Bridgeville	1975	O
Bristol (NJ)	1972	D
Brookland	1979	S
Brookville	1974	O
Bruceton Mills (W.VA)	1975	O
Brush Valley	1973	O
Buck Hill Falls	1974	D
Buffalo Mills	1982	P,S
Bullis Mills	1972	O
Burgettstown	1973	O
Burnham	1976	S
Burnside	1979	S
Bushkill (NJ)	1973	D
Butler	1973	O
Butler Knob	1969	S
California	1975	O
Callicoon (NY)	1973	D
Cambridge Springs	1974	O
Camden (NJ)	1973	D
Cameron	1973	S
Cammal	1973	S
Campbell (OH)	1974	O
Canonsburg	1975	O
Canton	1974	S
Carbondale	1973	S
Carlisle	1971	S
Carman	1973	O
Carmichaels	1974	O
Carroll	1974	S
Carrolltown	1973	S
Cassville	1974	S
Catasauqua	1973	D
Catawissa	1973	S
Ceder Run	1973	S
Cementon	1973	D
Center Moreland	1969	S
Centerville	1974	O
Central City	1974	O
Centre Hall	1974	S
Chambersburg	1973	P
Cherry Grove	1982	O
Cherry Run (MD)	1971	P
Cherry Springs	1982	S
Chicora	1974	O
Christmans	1974	D
Clarendon	1974	O
Clarion	1974	O
Claysville	1980	O
Clearfield	1974	S
Clear Spring (MD)	1974	P
Clifford	1974	S
Clinton	1977	O
Clymer	1975	O
Coalport	1973	S
Coatesville	1973	D
Cobham	1977	O
Coburn	1973	S
Cochranton	1974	O
Cogan Station	1974	S
Collegeville	1973	D
Colley	1979	S
Columbia East	1973	S
Columbia West	1969	S
Columbus	1974	O
Colver	1974	O
Commodore	1973	O
Conestoga	1973	S
Confluence	1974	O
Conneaut (OH)	1970	L
Conneautville	1973	O
Connellsville	1975	O
Conowingo Dam (MD)	1973	S
Conrad	1973	S
Conyngham	1973	S
Cooksburg	1977	O
Corry	1975	O
Corsica	1980	O
Coudersport	1974	O
Cranberry	1973	O
Crosby	1973	O
Culvers Gap (NJ)	1973	D
Cumberland (MD)	1971	P
Curtisville	1974	O
Curwensville	1974	S
Dalmatia	1973	S
Dalton	1977	S
Damascus (NY)	1974	D
Danville	1973	S

Flood-Prone-Area Maps in Pennsylvania (Continued)

Quadrangle	Year Completed	
Dawson	1973	O
Dayton	1974	O
Delano	1974	D,S
Delta (MD)	1973	S
Dempseytown	1977	O
Dents Run	1973	S
Derrick City	1974	O
Derry	1975	O
Devils Elbow	1982	S
Dickinson	1973	S
Dillsburg	1974	S
Distant	1974	O
Donation	1969	S
Donegal	1973	O
Donora	1973	O
Dover	1973	S
Downingtown	1973	D
Doylesburg	1982	P,S
Doylestown	1974	D
Driftwood	1973	S
DuBois	1974	O
Duncannon	1973	S
Dushore	1979	S
Dutch Mountain	1980	S
Eagles Mere	1974	S
East Brady	1975	O
East Butler	1974	O
East Liverpool No.(OH)	1969	O
East Liverpool So.(OH)	1969	O
Easton (NJ)	1976	D
East Palestine (OH)	1973	O
East Springfield	1973	O,L
East Stroudsburg	1976	D
East Troy	1973	S
Eau Claire	1982	O
Ebensburg	1977	O
Edinboro North	1974	O,L
Edinboro South	1974	O
Edinburg	1974	O
Elderton	1975	O
Eldred	1974	O
Eldred (NY)	1973	D
Elizabethtown	1973	S
Elizabethville	1973	S
Elk Grove	1974	S
Elkland	1977	S
Elliott Park	1981	S
Ellisburg	1982	O
Ellsworth	1975	O
Elverson	1973	D,S
Emlenton	1975	O
Emmitsburg (MD)	1973	P
Emporium	1973	S
Emsworth	1974	O
Ephrata	1977	S
Erie North	1974	L
Erie South	1974	O,L
Ernest	1973	O
Evans City	1975	O
Everett East	1974	S
Everett West	1974	S
Evitts Creek (MD)	1974	P
Factoryville	1976	S
Fairfield	1973	P
Fairview	1973	L
Falls Creek	1970	O
Fannettsburg	1982	P,S
Farrandsville	1974	S
Fawn Grove (MD)	1973	S
Fayette City	1974	O
First Fork	1973	S
Flatbrookville (NJ)	1976	D
Fleetwood	1973	D
Flintstone (MD)	1973	P
Forest City	1973	D,S
Fort Necessity	1982	O
Frankford (NJ)	1973	D
Franklin	1969	O
Franklin Forks	1973	S
Frankstown	1969	S
Fredericksburg	1976	S
Fredonia	1975	O
Freeburg	1969	S
Freeland	1974	S
Freeport	1975	O
Frenchtown (NJ)	1973	D
Friedensburg	1974	D,S
Friendsville	1979	S
Friendsville (MD)	1974	O
Frostburg (MD)	1974	O,P
Fryburg	1981	O
Galeton	1969	S
Galilee	1980	D

Flood-Prone-Area Maps in Pennsylvania (Continued)

Quadrangle	Year Completed	
Gap	1974	S
Garards Fort	1973	O
Geistown	1975	O
Geneva	1974	O
Germantown	1974	D
Gillett	1973	S
Glassport	1973	O
Gleason	1974	S
Glen Richey	1969	S
Glen Rock	1973	S
Glenshaw	1975	O
Glen Union	1974	S
Grand Valley	1979	O
Grantsville (MD)	1974	O
Grantville	1974	S
Great Bend	1972	S
Greencastle	1980	P
Greenfield	1977	O
Greensburg	1973	O
Greenville East	1975	O
Greenville West	1974	O
Grove City	1976	O
Grover	1982	S
Hackett	1975	O
Hadley	1975	O
Hagerstown (MD)	1973	P
Halifax	1969	S
Hallton	1977	O
Hamburg	1969	D
Hammersley Fork	1973	S
Hammett	1980	O,L
Hampton	1970	S
Hancock (MD)	1971	P
Hancock (NY)	1973	D
Hanover	1973	S
Harborcreek	1973	L
Harford	1974	S
Harlansburg	1982	O
Harmonsburg	1974	O
Harrisburg East	1973	S
Harrisburg West	1973	S
Harrison Valley	1974	S
Harveys Lake	1973	S
Hastings	1974	S
Hatboro	1973	D
Hawley	1973	D
Hazel Hurst	1974	O
Hazen	1981	O
Hazleton	1974	D,S
Hellertown	1976	D
Hershey	1975	S
Hilliards	1974	O
Hillsgrove	1974	S
Holbrook	1980	O
Hollidaysburg	1976	S
Honesdale	1973	D
Honey Brook	1974	D,S
Hookstown	1973	O
Hooversville	1974	O
Hop Bottom	1974	S
Hopewell	1974	S
Houtzdale	1973	S
Howard	1974	S
Howard N.W.	1974	S
Hughesville	1972	S
Huntersville	1973	S
Huntingdon	1974	S
Hyndman	1974	P
Ickesburg	1982	S
Indiana	1975	O
Indiantown Gap	1969	S
Iron Springs	1980	P
Irvona	1973	S
Irwin	1974	O
Jackson Center	1982	O
Jackson Summit	1979	S
James City	1982	O
Jenningsville	1979	S
Jersey Mills	1977	S
Jersey Shore	1973	S
Johnstown	1973	O
Julian	1974	S
Karthaus	1982	S
Keating	1973	S
Keating Summit	1973	O,S
Keeneyville	1973	S
Kellettville	1982	O
Kennerdell	1975	O
Kennett Square (DE)	1973	D
Kersey	1974	S
Kingston	1976	S
Kingwood	1977	O

Flood-Prone-Area Maps in Pennsylvania (Continued)

Quadrangle	Year Completed	
Kirkwood	1974	S
Kittanning	1974	O
Klingerstown	1973	S
Knox	1975	O
Knoxville	1976	S
Kutztown	1973	D
Laceyville	1969	S
Lairdsville	1974	S
Lake Como	1979	D
Lake Lynn (WV)	1974	O
Lake Maskenozha (NJ)	1973	D
Lambertville (NJ)	1973	D
Lancaster	1976	S
Landisburg	1973	S
Langhorne	1974	D
Lansdale	1974	D
Lansdowne	1973	D
Laporte	1974	S
Latrobe	1974	O
Laurel Lake	1980	S
Lawton	1979	S
Lebanon	1973	S
Leechburg	1974	O
Lehighton	1971	D
Lemoyne	1969	S
Lenoxville	1977	S
Leola	1973	S
Le Raysville	1972	S
Leroy	1974	S
Lewisburg	1969	S
Lewis Run	1979	O
Lewistown	1974	S
Liberty	1974	S
Ligonier	1973	O
Linden	1973	S
Lineboro (MD)	1974	S
Litchfield	1980	S
Lititz	1973	S
Little Meadows	1980	S
Littlestown (MD)	1973	P
Lock Haven	1974	S
Loganton	1974	S
Long Eddy	1979	D
Lopez	1974	S
Lucinda	1979	O
Ludlow	1974	O
Lumberville (NJ)	1972	D
Luthersburg	1974	O,S
Lykens	1973	S
Lynch	1970	O
Madisonburg	1974	S
Mahaffey	1979	S
Majorsville (W.VA)	1972	O
Malvern	1973	D
Mammoth	1974	O
Manatawny	1974	D
Manchester (MD)	1974	S
Manheim	1982	S
Mansfield	1982	S
Marcus Hook (NJ)	1973	D
Marienville East	1979	O
Marienville West	1979	O
Marion Center	1975	O
Markleton	1981	O
Mars	1974	O
Marshlands	1982	S
Mason-Dixon (MD)	1973	P
Masontown	1974	O
Mather	1975	O
Mayburg	1977	O
McClure	1974	S
McConnellsburg	1971	P,S
McCoysville	1982	S
McGees Mills	1974	O,S
McIntyre	1974	O
McKeesport	1973	O
McSherrystown	1973	S
McVeytown	1974	S
Meadow Grounds	1982	P
Meadville	1974	O
Mechanicsburg	1971	S
Media	1974	D
Mercer	1969	O
Mercersburg	1982	P
Meshoppen	1969	S
Mexico	1974	S
Meyersdale	1974	O
Middleburg	1969	S
Middletown	1969	S
Midland	1975	O
Midway	1975	O
Mifflinburg	1973	S
Mifflintown	1973	S
Mifflinville	1976	S

Flood-Prone-Area Maps in Pennsylvania (Continued)

Quadrangle	Year Completed	
Milford (NJ)	1973	D
Millersburg	1973	S
Millerstown	1973	S
Millerton	1973	S
Mill Hall	1969	S
Millheim	1974	S
Mill Run	1975	O
Millville	1974	S
Milton	1971	S
Minersville	1973	D,S
Monongahela	1973	O
Monroeton	1973	S
Montoursville North	1973	S
Montoursville South	1973	S
Montrose East	1980	S
Montrose West	1980	S
Morgantown	1974	D,S
Morgantown No. (W.VA)	1975	O
Morris	1973	S
Moscow	1973	S
Mosgrove	1974	O
Mount Chestnut	1975	O
Mount Holly Springs	1971	S
Mount Pleasant	1974	O
Mount Pocono	1974	D
Mount Union	1973	S
Muncy	1973	S
Munderf	1977	O
Murdock	1973	O
Murrysville	1974	O
Nanticoke	1973	S
Nanty Glo	1975	O
Narrowsburg (NY)	1973	D
Nauvoo	1982	S
Nazareth	1969	D
Nesquehoning	1971	D
Newark West (DE)	1973	D
New Baltimore	1982	P,S
New Bethlehem	1974	O
Newburg	1971	S
New Castle North	1974	O
New Castle South	1974	O
New Enterprise	1974	S
New Florence	1975	O
Newfoundland	1974	D
New Freedom (MD)	1974	S
New Freeport	1980	O
New Galilee	1975	O
New Holland	1973	S
New Kensington East	1974	O
New Kensington West	1974	O
New Lebanon	1973	O
Newport	1973	S
New Ringgold	1969	D
New Salem	1971	O
Newton Hamilton	1974	S
New Tripoli	1973	D
Newville	1971	S
Norristown	1973	D
Norrisville (MD)	1974	S
Northumberland	1973	S
Norwich	1982	O,S
Noxen	1969	S
Nuremberg	1973	S
Oakdale	1973	O
Oak Forest	1980	O
Ogletown	1982	O,S
Ohiopyle	1974	O
Oil City	1973	O
Oleona	1973	S
Olyphant	1973	S
Orangeville (OH)	1976	O
Orbisonia	1970	S
Orwigsburg	1973	D
Osage (WV)	1974	O
Overton	1974	S
Oxford	1974	D,S
Palmerton	1971	D
Palmyra	1976	S
Parker	1973	O
Parkesburg	1974	D,S
Penfield	1973	S
Pennington (NJ)	1972	D
Perkiomenville	1974	D
Philadelphia	1973	D
Philipsburg	1969	S
Phoenixville	1973	D
Picture Rocks	1974	S
Pillow	1973	S
Pine Grove	1969	S
Pine Grove Mills	1974	S
Pittsburgh East	1973	O
Pittsburgh West	1974	O

Flood-Prone-Area Maps in Pennsylvania (Continued)

Quadrangle	Year Completed	
Pittsfield	1972	O
Pittston	1976	S
Plainfield	1971	S
Plumville	1981	O
Pocono Pines	1974	D
Pohopoco Mt.	1982	D
Polk	1976	O
Pond Eddy (NY)	1974	D
Port Allegany	1974	O
Portersville	1975	O
Port Jervis North (NY)	1973	D
Port Jervis South (NJ)	1973	D
Portland (NJ)	1976	D
Portland Mills	1977	O
Port Matilda	1973	S
Potter Brook	1976	S
Pottersdale	1982	S
Pottstown	1973	D
Pottsville	1973	D
Powell	1974	S
Prospect	1982	O
Prosperity	1980	O
Punxsutawney	1974	O
Quakertown	1973	D
Quarryville	1973	S
Rachelwood	1974	O
Ralston	1974	S
Ramey	1976	S
Ransom	1969	S
Rathbun	1974	S
Reading	1973	D
Red Lion	1973	S
Red Rock	1974	S
Renovo East	1973	S
Renovo West	1973	S
Reynoldsville	1970	O
Richfield	1973	S
Richland	1973	D,S
Rich Valley	1973	S
Ridgway	1973	O
Riegelsville (PA-NJ)	1976	D
Rimersburg	1975	O
Rising Sun (MD)	1973	S
Riverside	1972	S
Roaring Spring	1973	S
Rochester Mills	1974	O
Rockwood	1974	O
Rogersville	1977	O
Roseville	1974	S
Roulette	1972	O
Rowland	1974	D
Roxbury	1982	S
Rural Valley	1974	O
Russell	1976	O
Sabinsville	1974	S
Sabula	1974	O
Safe Harbor	1973	S
Saint Marys	1974	O,S
Saint Thomas	1974	P,S
Salladasburg	1973	S
Saltillo	1974	S
Saltsburg	1973	O
Sandy Lake	1974	O
Sassamansville	1974	D
Saxonburg	1974	O
Saxton	1974	S
Sayre	1969	S
Scandia	1980	O
Scotland	1973	P
Scranton	1973	S
Seven Springs	1974	O
Seven Valleys	1973	S
Shamokin	1973	S
Sharon East	1974	O
Sharon West (OH)	1974	O
Sharpsville	1974	O
Sheffield	1970	O
Shenandoah	1973	D,S
Shermans Dale	1973	S
Shickshinny	1973	S
Shinglehouse	1972	O
Shippensburg	1971	S
Shohola	1974	D
Short Run	1973	S
Shumans	1973	S
Shunk	1974	S
Sigel	1977	O
Sinking Spring	1973	D,S
Sinnemahoning	1973	S
Skytop	1981	D
Slickville	1974	O
Sligo	1975	O
Slippery Rock	1969	O

Flood-Prone-Area Maps in Pennsylvania (Continued)

Quadrangle	Year Completed	
Smethport	1972	O
Smithfield	1975	O
Smithsburg (MD)	1973	P
Smithton	1975	O
Snow Shoe	1974	S
Snow Shoe SE	1974	S
Somerset	1973	O
Sonestown	1974	S
South Connellsville	1974	O
Spring Creek	1979	O
Spring Mills	1974	S
Springville	1973	S
Spruce Creek	1969	S
Spruce Hill	1973	S
Stahlstown	1974	O
Starucca	1977	S
State College	1973	S
Steelton	1974	S
Steubenville E. (W VA)	1974	O
Stillwater	1973	S
Stockton (NJ)	1972	D
Stoystown	1979	O
Strattanville	1980	O
Strausstown	1973	D,S
Strongstown	1981	O
Stroudsburg	1976	D
Sugar Lake	1977	O
Summerville	1974	O
Sunbury	1973	S
Susquehanna	1979	S
Swanville	1974	L
Swatara Hill	1979	S
Sweden Valley	1974	O
Sybertsville	1974	S
Tamaqua	1969	D
Tamarack	1973	S
Taneytown (MD)	1973	P
Telford	1976	D
Temple	1973	D
Templeton	1975	O
Terre Hill	1973	S
Thompson	1982	S
Thornhurst	1973	D
Tidioute	1979	O
Tioga	1969	S
Tionesta	1974	O
Tipton	1977	S
Titusville North	1979	O
Topton	1974	D
Towanda	1972	S
Tower City	1973	S
Tremont	1973	S
Trenton East (NJ)	1972	D
Trenton West (NJ)	1972	D
Trevorton	1974	S
Trout Run	1969	S
Troy	1973	S
Tunkhannock	1977	S
Tyrone	1973	S
Ulster	1969	S
Ulysses	1974	O
Union City	1974	O
Uniontown	1974	O
Unionville	1969	D
Utica	1976	O
Valencia	1974	O
Valier	1974	O
Valley Forge	1973	D
Valley Grove (W.VA)	1972	O
Valley View	1973	S
Vandergrift	1973	O
Vintondale	1975	O
Wagontown	1974	D
Wakefield	1974	S
Walnut Bottom	1974	S
Warren	1974	O
Washington East	1973	O
Washington West	1973	O
Washingtonville	1979	S
Waterford	1974	O
Waterville	1977	S
Wattsburg	1973	O
Waymart	1973	D,S
Waynesboro	1973	P
Waynesburg	1975	O
Weatherly	1973	D
Weedville	1973	S
Weikert	1973	S
Weirton (W.VA)	1973	O
Wellsville	1969	S
Wertzville	1973	S
West Chester	1974	D

Flood-Prone-Area Maps in Pennsylvania (Continued)

Quadrangle	Year Completed	
West Creek	1974	S
West Grove	1974	D
West Hickory	1974	O
West Middletown	1979	O
Westover	1969	S
West Sunbury	1973	O
West York	1973	S
Wharton	1973	S
White Haven	1973	D,S
White Mills	1973	D
White Pine	1982	S
Whitesburg	1974	O
Wilkes-Barre West	1974	S
Williamsburg	1969	S
Williamson	1973	P
Williamsport	1974	S
Williamsport SE	1982	S
Wilmington No. (DE)	1973	D
Wilpen	1974	O
Windber	1974	O
Wind Gap	1973	D
Windham	1980	S
Wind Ridge	1980	O
Wittenberg	1979	O,P
Womelsdorf	1973	D,S
Woodbury (NJ)	1973	D
Worthington	1973	O
Wyalusing	1973	S
York	1973	S
York Haven	1969	S
Youngsville	1972	O
Young Womans Creek	1974	S
Zelienople	1975	S