

WATER RESOURCES DIVISION
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I N T H E 1 9 8 0 ' S

A SUMMARY OF ACTIVITIES AND PROGRAMS
OF THE U.S. GEOLOGICAL SURVEY'S
WATER RESOURCES DIVISION

U.S. Geological Survey Circular 893

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By Edith B. Chase, John E. Moore, and David A. Rickert

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UNITED STATES DEPARTMENT OF THE INTERIOR

JAMES G. WATT, Secretary

GEOLOGICAL SURVEY

Dallas L. Peck, Director



1983

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WATER RESOURCES DIVISION IN THE 1980's

A Summary of Activities and Programs of the U. S. Geological Survey's Water Resources Division

By Edith B. Chase, John E. Moore, and David A. Rickert

ABSTRACT

The Water Resources Division of the U.S. Geological Survey has the principal responsibility within the Federal government for providing hydrologic information and appraising the Nation's water resources. The Geological Survey is unique among government organizations because it has neither regulatory nor developmental authority—its sole product is information that is made available equally to all interested parties.

This report describes the Water Resources Division's mission, organization, source of funds, and major programs. Three types of programs are described: *long-term programs*, which include the Federal-State cooperative program, coordination of Federal water-data acquisition, assistance to other Federal agencies, the national research program, the national water-data exchange, the water resources scientific information center, the national water-use information program, hydrologic-data collection, and international hydrology activities; *topical programs*, which include hazardous waste hydrology, coal and oil-shale hydrology, regional aquifer system analyses, acid rain, volcano hazards, and national water-resources conditions; and *technical-assistance programs*. Emphasis is on programs that will contribute to identifying, mitigating, or solving nationwide water-resources problems in the 1980's. A discussion of how the data and information are disseminated and a selected list of references complete the report.

INTRODUCTION

Effective management of water resources requires an understanding of the Nation's hydrologic system and the factors that determine the availability and quality of the water. The hydrologic system does not function according to political boundaries, and thus it is necessary for hydrologic information to be collected, analyzed, summarized, and made readily available to decisionmakers at all levels—national, regional, State, and local.

Within the Federal government, the Water Resources Division of the U.S. Geological Survey has the principal responsibility for appraising water resources and for providing hydrologic information. It is the Nation's major scientific water organization, and its sole product is water information—it has neither regulatory nor developmental authority. Virtually all the information produced is multipurpose, and, after its immediate need, the information becomes a vital part of future resource evaluation and water-management decisions.

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.

The Division provides extensive support to other Federal agencies and, through its Federal-State Cooperative Program, to State and local agencies. This cooperative program provides the bulk of water information used by the Federal government for a variety of purposes. The Division also coordinates the water-data acquisition activities of all Federal agencies. The combination of these activities together with input from advisory committees enables the Geological Survey to keep abreast of water-information needs at all levels of government and the private sector and to develop programs responsive to those needs.

The programs of the Division are financed by direct appropriations from the Congress, cost-sharing arrangements with State and local governments, and reimbursable agreements with other Federal agencies. These financial arrangements reflect the broad interest among all governmental sectors in seeking to resolve water-resources problems and also reflect the prominent role that the Geological Survey plays in assisting in finding solutions to those problems.

This report summarizes the Division's programs that are expected to have major value in contributing to solutions of nationwide water-resources problems in the 1980's. A brief description of the Division's mission, organization, and source of funds is given as background to the specific programs. Specific results and accomplishments of the various programs, and additional information on the U.S. Geological Survey and the Water Resources Division, can be found in the publications listed in the "Selected References" section. No attempt was made to cite references in the program discussions because it was felt that the reader would benefit more from searching the "Selected References" section after becoming acquainted with the various activities of the Water Resources Division. Many of the illustrations in this report are reproduced from U.S. Geological Survey exhibit panels. Information about those exhibit panels can be obtained from the Exhibits Committee, U.S. Geological Survey, 790 National Center, Reston, VA 22092. Previous reports that summarize past Division programs are those by Gilbert and Buchanan (1981, 1982), Hackett (1966), and McGuinness (1964).

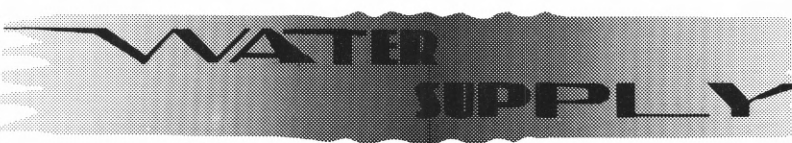
MAJOR WATER ISSUES OF THE 1980's

Some of the Nation's major water issues of the 1980's are highlighted below. The information derived from the programs of the Water Resources Division that are explained in this report will help decisionmakers to understand the magnitude of the issue, to determine water-policy options, and to select or implement the soundest course of action.

- **Water availability and competition for water**—Population growth, especially in the Sunbelt States, national goals to expand agricultural production and energy-resource development, and water rights of the State and Federal governments, Indian tribes, and private individuals have increased competition for available water supplies. Principal uses competing for water are—
 - Crop irrigation
 - Energy production (other than hydroelectric)
 - Mineral-resources development
 - Municipal, domestic, and industrial uses
 - Instream-flow maintenance for hydroelectric power, fish, wildlife, and recreation.
- **Water-quality degradation**—Water availability cannot be separated from water quality because the usability of existing supplies depends on the quality. In some areas, degradation of surface and ground water is due to—
 - Nonpoint-source pollution, such as runoff from agricultural and urban areas
 - Toxic wastes as a result of numerous chemical compounds now in use
 - Saltwater intrusion as a result of ground-water use
 - Acid rain, which is thought to be responsible for the acidification of surface water.
- **Management of water and land resources**—Managers and decisionmakers need to understand that the hydrologic system does not conform to political boundaries and that the development of water resources in one State can affect the availability and use of water in other States. Hydrologic information in understandable form can help those who evaluate policy options to determine the effects of prior decisions and to guide future decisions.

OFFSTREAM WATER USES

Thermoelectric Power
Industry
Irrigation
Public Supply
Rural



INSTREAM WATER USES

Hydroelectric Power
Fish and Wildlife
Recreation
Navigation

INCREASING DEMANDS FOR OUR FINITE WATER SUPPLY

MISSION OF THE WATER RESOURCES DIVISION

The mission of the Water Resources Division, which supports the mission of the Geological Survey and the U.S. Department of the Interior, is to provide the hydrologic information needed for managing the Nation's water resources. To accomplish its mission, the Water Resources Division 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.
- Conducts interpretive water-resource appraisals to describe the consequences of alternative plans for developing land and water resources.
- Conducts basic and problem-oriented research in hydraulics, hydrology, and related fields.
- Develops information on water-related natural hazards such as floods, landslides, volcanoes, mudflows, and land subsidence.
- Coordinates the activities of all Federal agencies in the acquisition of water data.
- Disseminates data and findings through reports, maps, and other forms of public release.
- Provides scientific and technical assistance in the hydrologic fields 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.

Authority for carrying out the Division's mission derives from legislation of 1879, which created the Geological Survey; and legislation of 1888 and 1894, which provided for gaging the 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 Geological Survey and its Water Resources Division by the Department.

ORGANIZATION

The Geological Survey was established in 1879 as part of the U.S. Department of the Interior. Administratively, the Geological Survey reports to the Assistant Secretary for Energy and Minerals (see organization chart on page 6). The Headquarters of the Geological Survey is in Reston, Virginia, about 25 miles west of Washington, D.C.

The Water Resources Division is one of three program Divisions within the Geological Survey. Its functions are carried out at two levels—Headquarters and field (see organization chart on page 7). The Headquarters level is responsible for overall direction of the Division, and consists of the Chief Hydrologist; the Associate Chief Hydrologist; the offices of the three Assistant Chief Hydrologists—for Operations, Scientific Publications and Data Management, and Research and Technical Coordination; and the Office of Water Data Coordination. Also included at the Headquarters level are the office of the Deputy Assistant Chief Hydrologist for Research, the three Branches (Surface Water, Ground Water, and Quality of Water), the Office of Hazardous Waste Hydrology, the Program Office, and the Office of International Hydrology.

General direction of the Division's field program is through four Regional Hydrologists, each of whom is located at a regional center—Reston, Virginia (Northeastern Region); Atlanta, Georgia (Southeastern Region); Lakewood (Denver), Colorado (Central Region); and Menlo Park, California (Western Region). These Regional Hydrologists represent the Chief Hydrologist and the Director of the U.S. Geological Survey in negotiations and dealing with other organizations and committees. They also oversee the programs of the Division's 43 District offices, which carry out the water-resources investigations and data-collection programs of the Division.

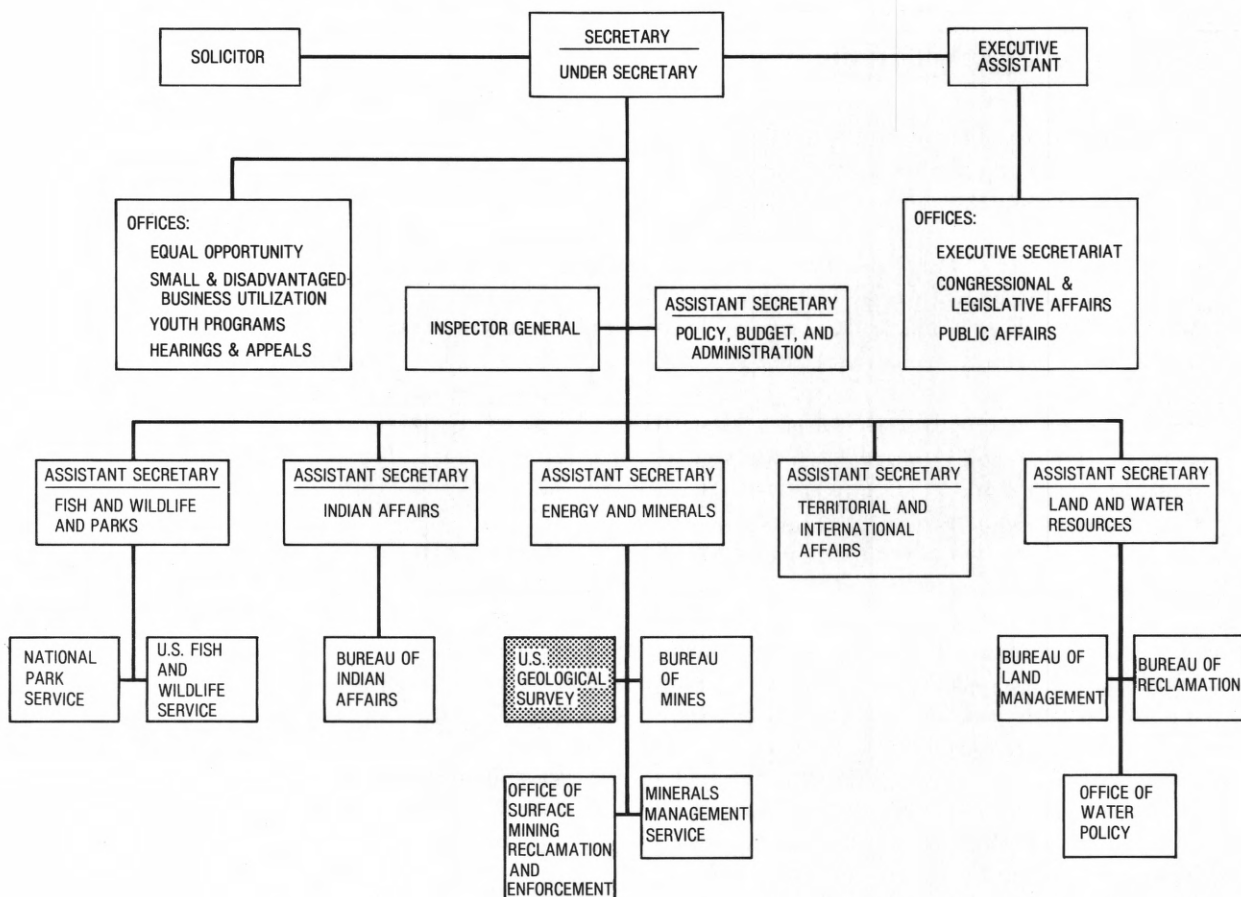
The Division's National Research Program (NRP) is responsible for determining new methods for hydrologic-data collection and analysis, and providing new concepts in the understanding of hydrologic processes. Research staffs are located at the regional centers for the Northeastern, Central, and Western Regions, and, for the Southeastern Region, at the Gulf Coast Hydrosience Center in Bay St. Louis, Mississippi. In each region, the activities of the research program are overseen by a Regional Research Hydrologist who reports to the Deputy Assistant Chief Hydrologist for Research and Technical Coordination at Headquarters.

Each District office is under the guidance of a District Chief who is responsible for planning, programing, and implementing the data-collection activities and hydrologic studies within the District. Many of the Districts' activities are funded by a joint-funding program, whereby the Geological Survey matches funds with tax-supported State and local agencies on a 50-50 basis. Each District typically has one or more subdistrict and field offices that report to the District Chief. Three multi-State Districts also have offices that coordinate programs within each State and report to the District office.

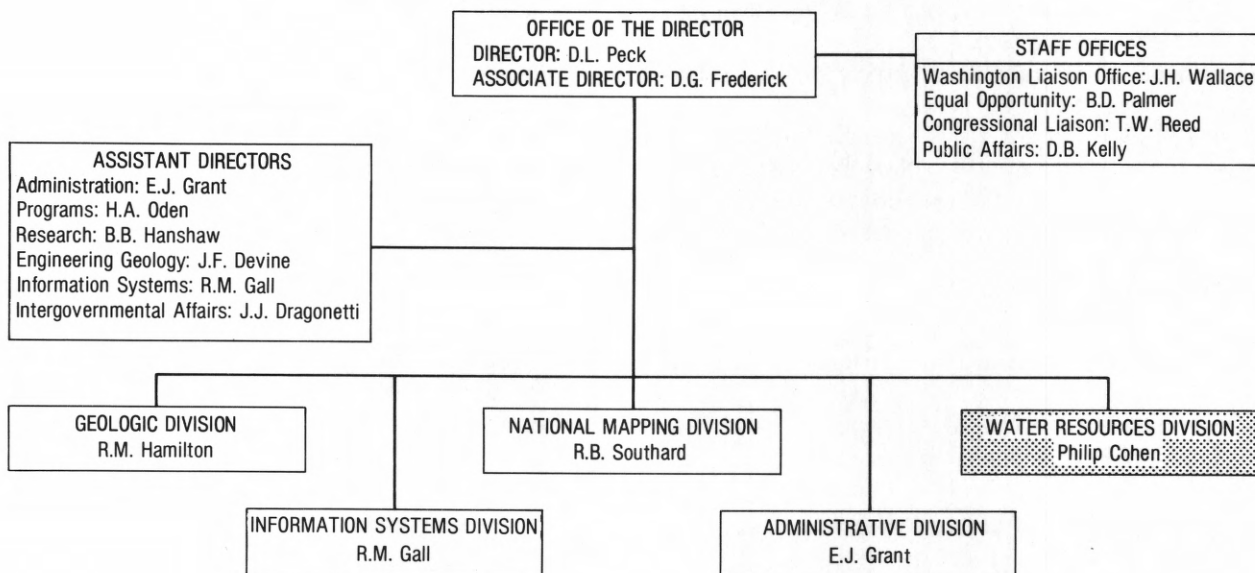
The Division's field organization enables the Geological Survey to have close contact with State and local agencies, allows the accumulation of detailed experience and knowledge of regional and local hydrologic conditions, provides an early-warning system for the detection of emerging water problems, and reduces travel costs for conducting investigations and operating data-collection networks.

A more detailed description of the functions of each component of the Division is given on the following pages. Location of the Division's offices is shown on the map on page 7. A listing of key Headquarters personnel and a directory of the field organization are given at the end of the report.

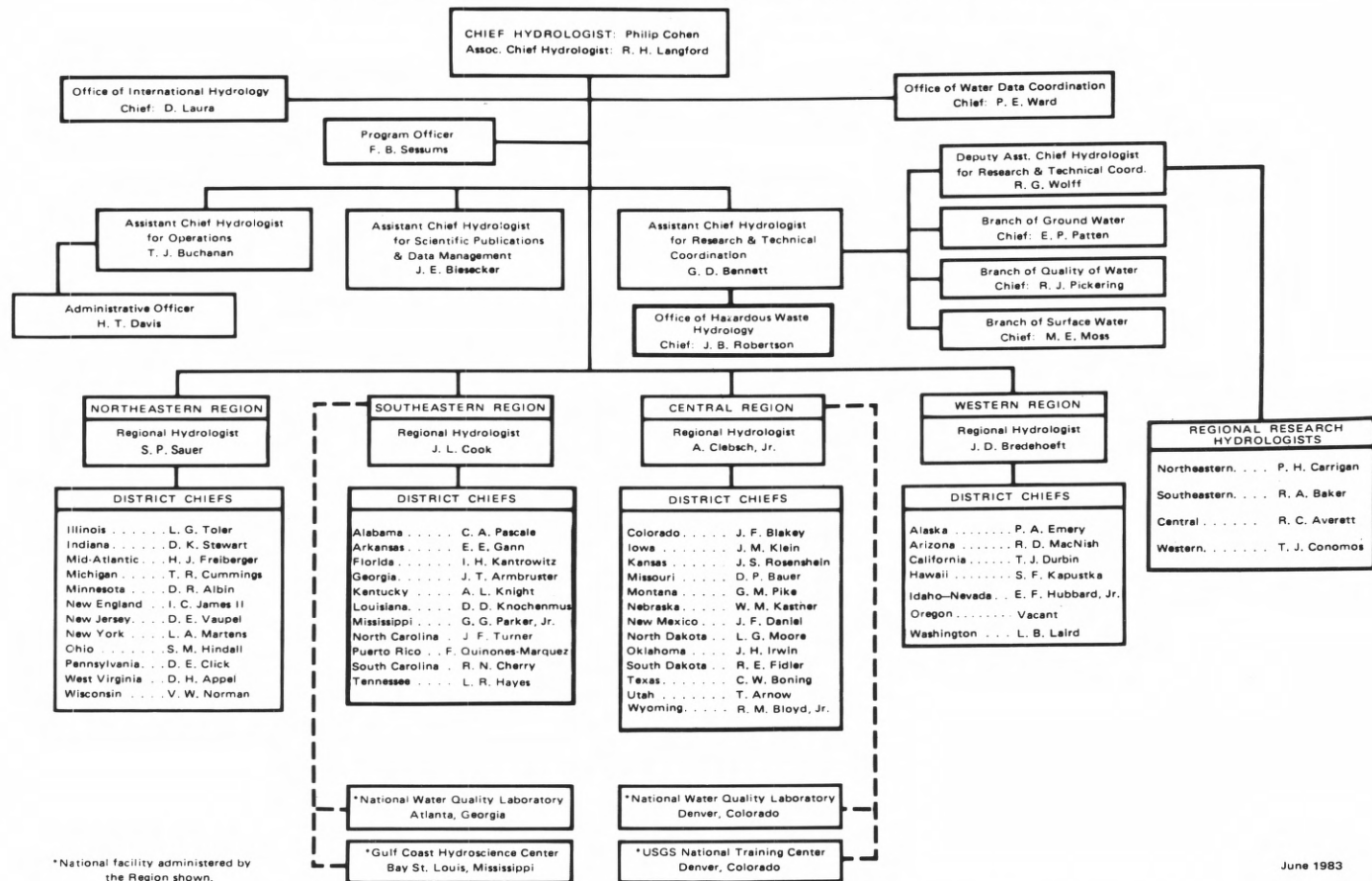
ORGANIZATION OF THE U.S. DEPARTMENT OF THE INTERIOR



ORGANIZATION OF THE GEOLOGICAL SURVEY

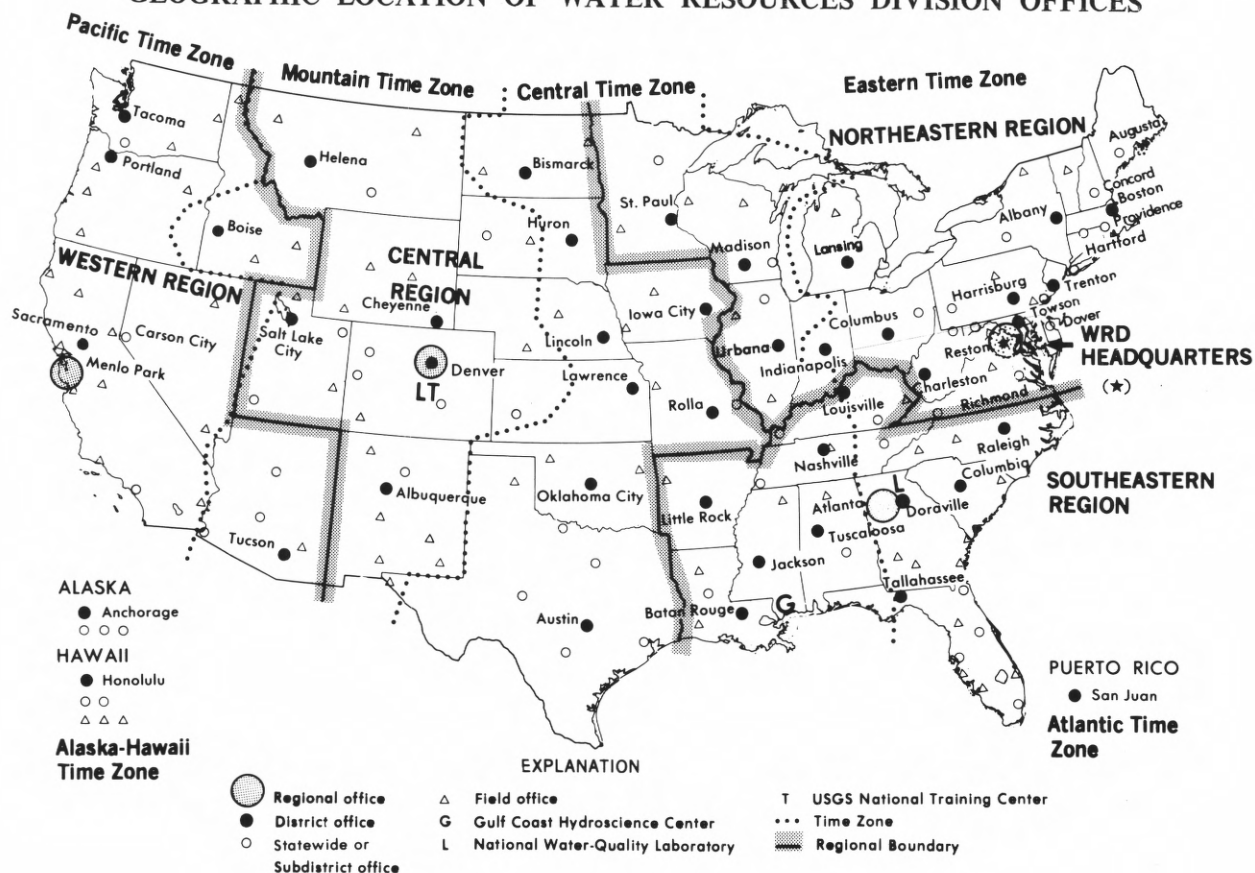


WATER RESOURCES DIVISION ORGANIZATION CHART



June 1983

GEOGRAPHIC LOCATION OF WATER RESOURCES DIVISION OFFICES



Headquarters Organization

Chief Hydrologist and **Associate Chief Hydrologist** are responsible for overall direction of the Division. All Division personnel ultimately report to these officials. Long-range planning, program and budget development, water-data coordination activities, and international hydrology activities are directly under the Office of the Chief Hydrologist.

Program Officer serves as the Division focus for congressional budgets.

Chief, Office of Water Data Coordination, carries out the coordination and network planning functions assigned to the Department of the Interior by the Office of Management and Budget. The Office of Water Data Coordination (OWDC) provides staff assistance to the (Federal) Interagency Advisory Committee on Water Data and the (non-Federal) Advisory Committee on Water Data for Public Use. In addition, OWDC maintains a computerized file of information on water-data acquisition activities of all Federal agencies; many State and local agencies voluntarily contribute information to this file.

Chief, Office of International Hydrology, represents the Water Resources Division in the Geological Survey's program of international cooperation in the earth sciences.

Assistant Chief Hydrologist for Operations assists the Chief Hydrologist in the establishment of policy on budgetary, accounting, personnel, program status, and technical service activities, and provides administrative and technical services to field offices. The Division Administrative Officer reports directly to the Assistant Chief Hydrologist for Operations.

Assistant Chief Hydrologist for Scientific Publications and Data Management assists the Chief Hydrologist in (1) the development of policy and programs related to the production and dissemination of scientific and general-interest publications, and the acquisition of information on the Nation's use of water; (2) the development of methods and procedures for processing, storing, retrieving, and disseminating water data collected by the Division's field organization, and in managing the computerized distributed information system and the National Water-Data Storage and Retrieval System (WATSTORE); and (3) the management and operation of programs such as the National Water-Data Exchange (NAWDEX) and the Water Resources Scientific Information Center (WRSIC), which assist users in determining the availability of water data and related information from the Federal government, programs that assist in technology transfer, and programs that are related to compliance with the National Environmental Policy Act (NEPA).

Assistant Chief Hydrologist for Research and Technical Coordination assists the Chief Hydrologist in the development of national programs of research and water investigations and provides technical guidance to the Division's operating programs. Within this organizational unit is the Deputy Assistant Chief Hydrologist for Research and Technical Coordination who is responsible for the Division's National Research Program; the Branch of Surface Water, which is the Division's technical group responsible for leadership in the development of surface-water technology; the Branch of Ground Water, which is responsible for technical leadership in the ground-water discipline; and the Branch of Quality of Water, which is responsible for leadership in developing technology in water chemistry, sediment, and aquatic biology. The Branches provide technical guidance to Headquarters as well as to field operations. Coordinators of technical programs such as Hazardous Waste Hydrology and Coal and Oil-Shale Hydrology also report to the Assistant Chief Hydrologist for Research and Technical Coordination.

Field Organization

Regional Hydrologists have line authority from the Chief Hydrologist and are responsible for the Districts within their regional structure. They are responsible for the direction and planning of regional programs and operation functions on a day-by-day basis, and serving as the Division and Bureau representative within the region. The Regional Hydrologist's immediate staff consists of an Assistant Regional Hydrologist, a regional administrative officer, a program officer, a computer specialist, a reports adviser, and specialists in the disciplines of surface water, ground water, and quality of water. These regional specialists work closely with equivalent personnel at Headquarters. The Central and Southeastern Regional Hydrologists also are responsible for the national water-quality laboratory within their region, and the Regional Hydrologist for the Central Region also is responsible for the National Training Center.

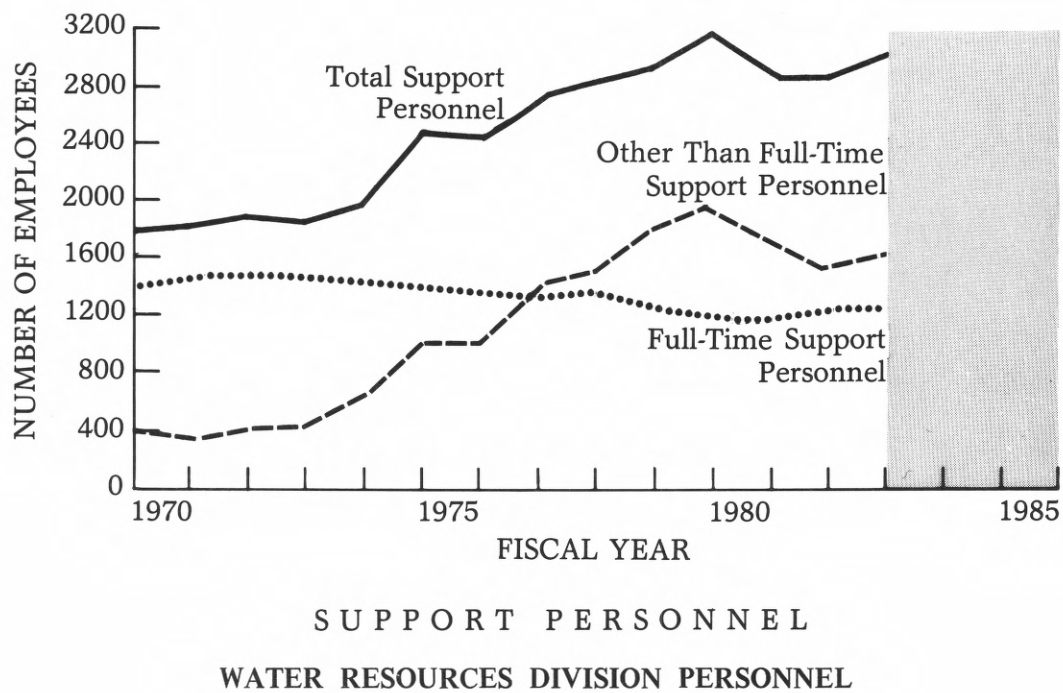
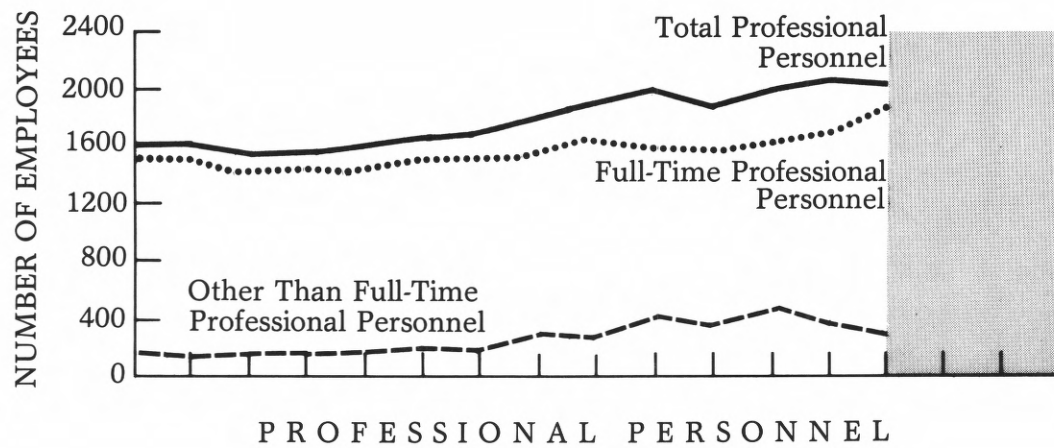
Regional Research Hydrologists are located at the Regional Offices (with the exception of the Southeastern Region Research Hydrologist who is located in Bay St. Louis, Mississippi), but report directly to the Headquarters-based Deputy Assistant Chief Hydrologist for Research and Technical Coordination. The Regional Research Hydrologists provide technical and administrative guidance to research activities in the regions, and participate in the planning of the National Research Program.

District Chiefs report to the Regional Hydrologists and are responsible for the planning, direction, and execution of data-collection and hydrologic studies in the District. Support for these activities is provided by both Headquarters and Regional Offices. The District Chief maintains a staff of professional and technical personnel who conduct hydrologic studies and data-collection activities.

PERSONNEL

The Water Resources Division has a scientific staff with expertise in many phases of water and water-related activities. The scientific staff is supported by field, office, and laboratory personnel. The number of permanent full-time employees has remained nearly constant over the last decade although the program funding has tripled. The table below shows authorized employment levels and the illustration on the facing page shows total professional and support personnel for years 1970 to 1983.

<i>Fiscal year</i>	<i>Authorized employment levels, 1970–83</i>		
	<i>Full time</i>	<i>Other than full time</i>	<i>Total</i>
1970	2,888	476	3,364
1971	2,949	476	3,425
1972	2,874	542	3,416
1973	2,873	545	3,418
1974	2,866	790	3,656
1975	2,895	580	3,475
1976	2,920	707	3,627
1977	2,842	1,150	3,992
1978	2,884	1,253	4,137
1979	2,787	1,369	4,156
1980	2,837	1,391	4,228
1981	2,803	1,286	4,089
1982	2,981	1,328	4,309
1983	2,951	1,166	4,117



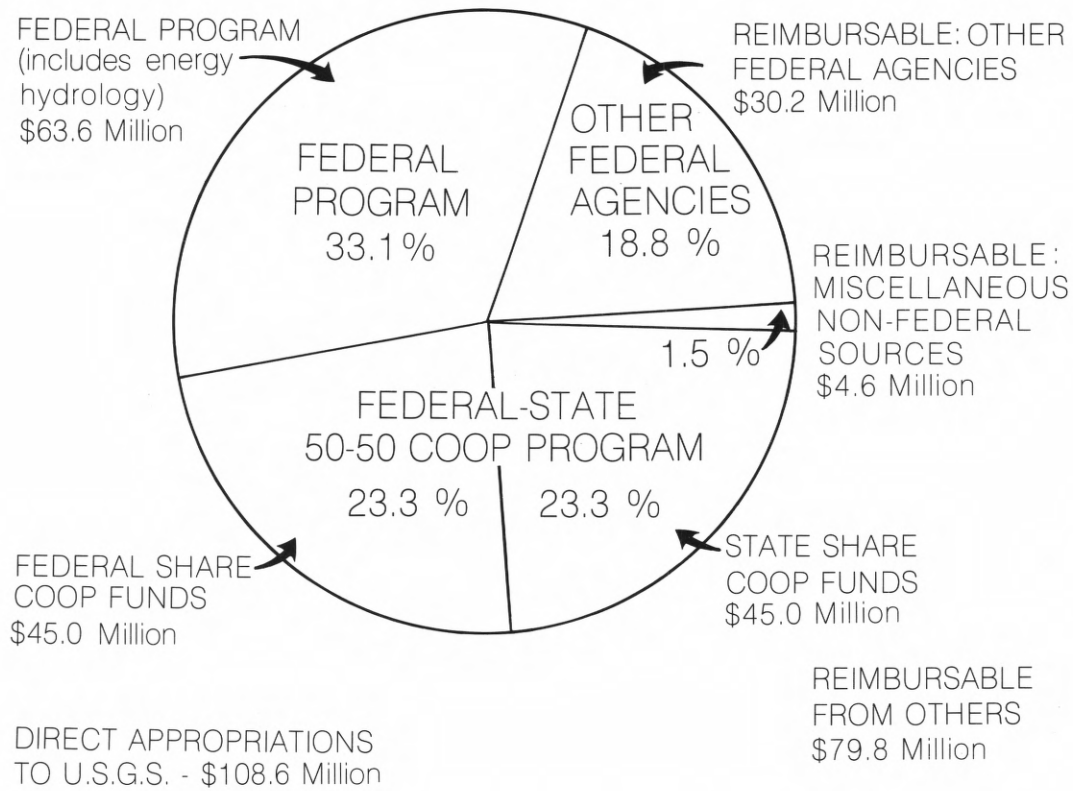
BUDGET AND SOURCE OF FUNDS

Funds to support the work performed by the Water Resources Division are derived from three principal sources.

- **Federal Program**—Funds for the Federal Program are appropriated by the Congress, and are specifically identified in the annual Geological Survey budget. These funds are used to support research, data collection, high-priority topical programs including energy-related programs, the coordination of all Federal programs related to collection of water data, and internal support services. In fiscal year 1982, this funding was \$63.6 million; the estimated funding for fiscal year 1983 is \$67.2 million (see table on page 15).
- **Federal-State Cooperative Program**—Federal funds are appropriated by the Congress and used to match those furnished by State and other tax-supported agencies on a 50-50 basis. These funds are used for a variety of hydrologic data-collection activities and water-resources investigations in which the Water Resources Division represents the national responsibilities and the cooperating agencies represent State and local interests. In fiscal year 1982, these joint funds amounted to \$90.0 million; the estimated funding for fiscal year 1983 is \$92.3.
- **Other Federal Agencies (OFA) Program**—In this program, the funds are transferred to the Geological Survey as reimbursement for work performed at the request of another Federal agency. In fiscal year 1982, this funding amounted to \$30.2 million; and for fiscal year 1983, the estimated funding is \$32.9 million.

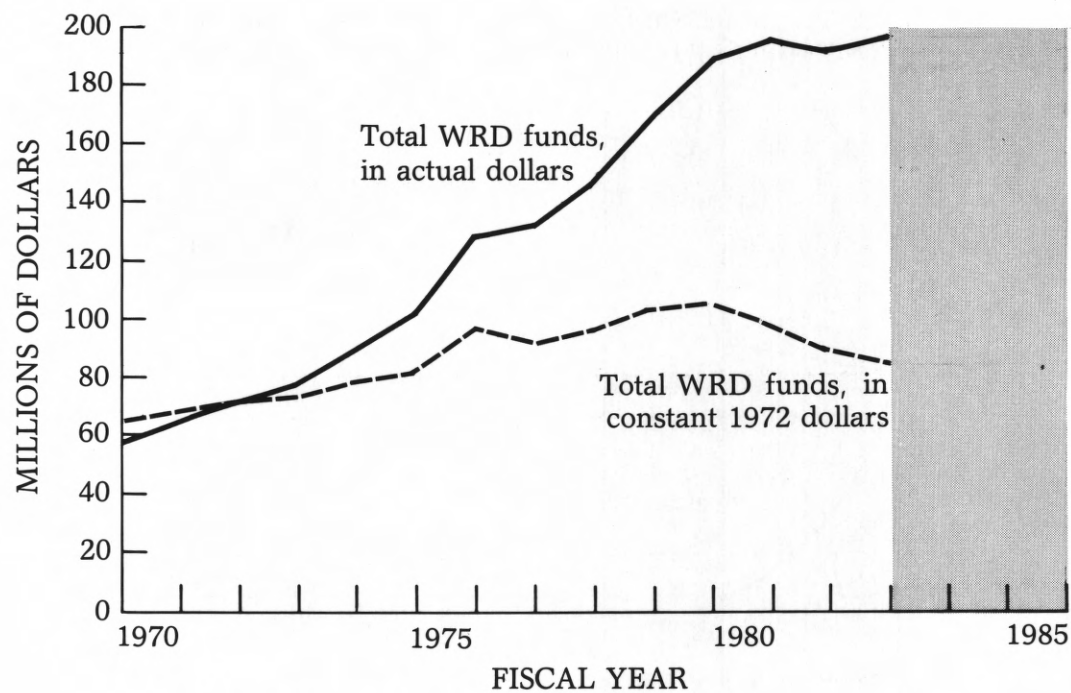
Another source of the Division's funding is unmatched reimbursable funds from State and local government agencies and Federal Energy Regulatory Commission licensees. In fiscal year 1982, these funds amounted to \$4.6 million; the estimated funding for fiscal year 1983 is \$1.5 million.

The total Division budget for fiscal year 1982 was \$188.4 million (see illustration on facing page). From 1970 to 1982, the Division's budget increased threefold; however, much of this increase was due to inflation. Based on constant 1972 dollars, the actual increase amounted to much less, as shown on page 14.



FY 1982 TOTAL \$188.4 MILLION

WATER RESOURCES DIVISION FUNDING, FISCAL YEAR 1982



FUNDING TRENDS: FISCAL YEARS 1970—1983

FUNDING SUPPORT FOR THE WATER RESOURCES DIVISION FOR FISCAL YEARS 1970—1983, BY SOURCE OF FUNDS

[In thousands of dollars]

Fiscal year	Reimbursable funds			Total	Direct appropriation to USGS	Grand total
	State and local share of joint funding	Miscellaneous non-Federal sources	Other Federal agencies			
1970.....	\$17,280	\$559	\$10,183	\$23,022	\$31,585	\$59,607
1971.....	19,464	571	11,468	31,503	34,581	66,084
1972.....	21,294	679	11,905	33,878	37,446	71,324
1973.....	22,736	664	14,518	37,918	40,185	78,103
1974.....	25,820	721	16,378	42,919	45,433	88,352
1975.....	28,546	901	18,570	48,017	53,420	101,437
1976.....	29,735	940	24,629	55,304	57,176	112,480
Transition quarter ¹	7,672	260	6,868	14,800	15,916	30,716
1977.....	34,761	1,331	26,862	62,954	68,555	131,509
1978.....	36,457	1,429	29,641	67,527	78,487	146,014
1979.....	40,156	1,673	29,922	71,751	96,847	168,598
1980.....	43,126	1,778	31,224	76,128	108,742	184,870
1981.....	45,159	2,024	31,375	78,558	115,458	194,016
1982.....	45,012	4,622	30,187	79,821	108,637	188,458
1983 (estimate). . .	48,164	1,535	32,915	82,614	111,388	194,002

¹ In 1976, the beginning of the fiscal year changed from July 1 to October 1. Funds were appropriated to cover this transition quarter.

**DIRECT CONGRESSIONAL APPROPRIATIONS FOR THE WATER
RESOURCES DIVISION FOR FISCAL YEARS 1981–1983**

[In thousands of dollars]

Program	1981	1982	1983 (estimated)
FEDERAL PROGRAM	\$72,702	\$63,625	\$67,224
Data Collection and Analysis	16,633	14,833	15,427
Basic Data Collection	8,893	8,758	9,984
National Water Quality Networks	6,534	5,717	5,443
River Quality Assessments	1,206	358	.....
Energy Programs	22,652	15,525	14,822
Coal Hydrology	12,435	7,564	6,807
Nuclear Energy Hydrology—Low-Level Waste	2,385	2,183	2,252
Nuclear Energy Hydrology—High-Level Waste	4,518	4,490	4,492
Oil-Shale Hydrology	3,314	1,288	1,271
Other Federal Program Elements	33,417	33,267	36,975
National Water-Data Exchange	1,288	1,257	1,210
Regional Aquifer Systems Analyses	15,816	14,872	14,248
Water-Data Coordination	913	898	869
Core-Program Hydrologic Research	6,036	5,996	5,814
Improved Instrumentation	2,026	1,944	1,847
National Water-Resources Conditions	353	337	321
Ground-Water Recharge	1,409	.....	.....
Subsurface Waste Storage	1,475	1,461	1,413
Flood-Hazard Analysis	457	460	452
Toxic Wastes—Ground-Water Contamination . . . .	.....	958	4,317
Acid Rain . . . . .	.....	1,485	2,393
Supporting Services	3,644	3,599	3,491
Water Resources Scientific Information Center . . .	.....	.....	600
FEDERAL-STATE COOPERATIVE PROGRAM	42,756	45,012	44,164
Water Use	3,464	3,334	3,182
Coal Hydrology	3,176	3,137	3,053
Data Collection and Analysis, Areal Appraisals and Special Studies	36,116	38,541	37,929
TOTAL	\$115,458	\$108,637	\$111,388

PROGRAMS

Program development in the Water Resources Division is an evolving activity. Existing programs are reviewed regularly and future needs for water-data and hydrologic investigations are projected. Water problems and data needs frequently are brought to the attention of the Division by State and local agencies and the public; thus, program development also is a grassroots effort. As data needs and water-related problems change, the programs are modified accordingly.

The programs of the Water Resources Division are of three major types—(a) data collection and dissemination, (b) problem-oriented water-resources appraisals, and (c) research. Budgetary documents classify the Division's activities according to source of funds, such as direct congressional appropriations (Federal Program), joint or shared funds (Federal-State Cooperative Program), and assistance to other Federal agencies (OFA Program). Although this classification is helpful for budgetary and general discussion purposes, most of the programs are so interrelated that they are difficult to explain exclusively by source of funds or type of activity. For example, theories arising from research are the foundation of data collection and problem-oriented water-resources appraisals, and data collection is a major component of all water-resources appraisals and most of the research studies.

In this report, the Division's activities are discussed under three headings—long-term programs, topical programs, and technical-assistance programs. In reading the program descriptions, the reader should keep in mind that all Division programs cross scientific and budgetary boundaries.

Long-Term Programs—The long-term programs include the Federal-State cooperative program; coordination of Federal water-data acquisition; assistance to other Federal agencies; the National Research Program; the National Water-Data Exchange; the Water Resources Scientific Information Center; the National Water-Use Information Program; the hydrologic data-collection program, including the national stream quality accounting network and the national bench-mark program; and the international hydrology program. These programs are fundamental to the Division's mission and they provide the data and research needed for the topical programs.

Topical Programs—Topical programs are designed to provide critically needed information on issues of major and immediate concern to the Nation. The programs include hazardous waste hydrology, including high- and low-level nuclear and toxic-chemical wastes; coal and oil-shale hydrology; regional aquifer systems analysis; acid rain; volcano hazards; and water-resources conditions.

Technical-Assistance Programs—Technical-assistance programs include the instrumentation program, the national water-quality laboratories, and the national training center. These programs, which are internal to the Division (in contrast to the other programs discussed in this report that deal with other agencies and the public), contribute significantly to the success of the Division's mission.

Data, investigations, knowledge and understanding are essential to manage the Nation's

WATER RESOURCES

NATIONAL WATER DATA COLLECTION AND INFORMATION SYSTEMS

The U.S. Geological Survey has made a major commitment to upgrade instrumentation for hydrologic data collection during the 1980's.

AREAL INVESTIGATIONS, PROBLEM APPRAISALS, AND RESEARCH, such as:

- Regional aquifer systems analysis
- Toxic wastes and ground water contamination
- Flood hazards analysis
- Cooperative water quality investigations
- Cooperative special hydrologic studies
- National water summary
- Basic research
- Improved instrumentation
- Ground water recharge
- Subsurface waste storage
- Cold regions hydrologic research
- Acid precipitation
- River quality assessment

U. S. Geological Survey

WATER RESOURCES

RESPONSIBILITIES

The USGS collects, analyzes and interprets facts pertaining to the source, quantity, quality, distribution, movement and use of the Nation's underground and surface water.

These data are compiled, published, and made available in various formats.

STUDIES ARE MADE IN COOPERATION WITH LOCAL AND STATE AGENCIES, AND OTHER FEDERAL AGENCIES.

LIFE ON EARTH DEPENDS ON WATER

Source: U.S. Geological Survey exhibit panel W-159-A,B.

WATER RESOURCES DIVISION PROGRAMS

Federal-State Cooperative Program

The Federal-State Cooperative Program is a unique partnership for water-resources investigations. Authority for this program is derived from the legislation of 1879, which established the Geological Survey. The first cooperative program began in 1895 in Kansas. The Federal appropriations bill for fiscal year 1929 established the 50-50 cost-sharing principle. Every appropriations bill since then has recognized this 50-50 principle. These funds are used for a variety of hydrologic data-collection activities and water-resources investigations in which the Water Resources Division represents the national responsibilities and the cooperating agencies represent State and local interests. Much of the hydrologic information needed for planning, developing, and managing the Nation's water resources is derived from this program, which comprises about 45 percent of the overall activities of the Water Resources Division. Selection of investigations is a mutual effort between the Division and the cooperators, and results in a balanced program that recognizes needs, priorities, and resources of both parties.

Purpose:

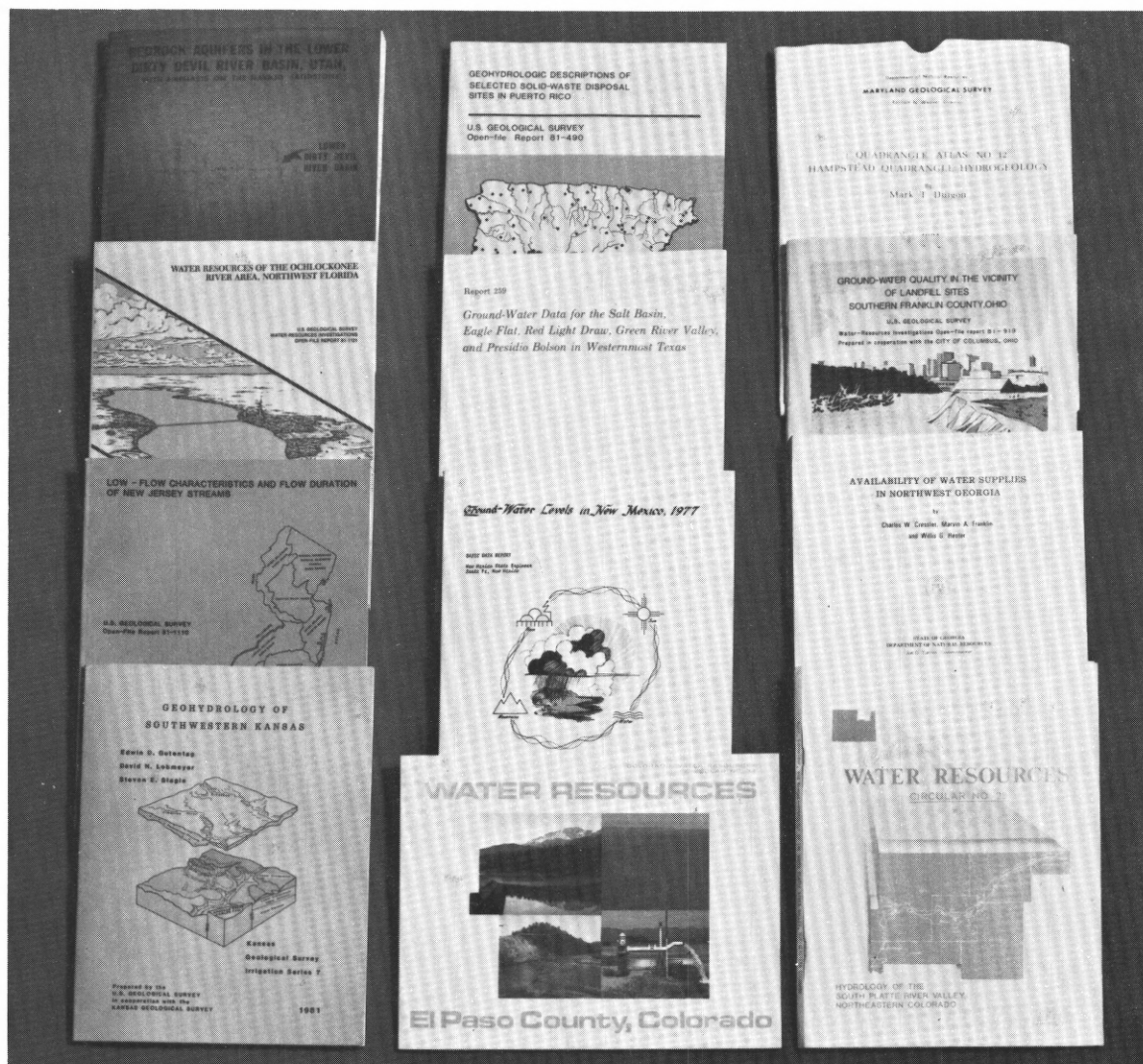
- Determine the quantity and quality of surface and ground water and the use of the water.
- Define and evaluate the extent and availability of water resources of drainage basins, counties, States, and water-resources regions.
- Conduct special hydrologic and research studies on current water issues such as coal hydrology, droughts and floods, waste disposal, mineral and energy development, urban hydrology, and river quality.

Activities:

- More than 830 hydrologic investigations are being conducted by the Water Resources Division in the 50 States, Puerto Rico, and the Trust Territories in fiscal year 1983.
- Work is undertaken at the request of cooperators and is performed mostly by personnel of the Water Resources Division. Activities also are coordinated with other Federal agencies.
- Approximately 700 joint-funding agreements are in effect involving more than 800 cooperators at State, regional, and local levels.

Accomplishments:

- Joint-funding agreements with cooperators to perform studies of mutual benefit result in a balanced program that recognizes the need, priorities, and resources of both sides.
- The program generally provides the background for virtually all new scientific endeavors, partly because it serves as an early-warning system for the detection of emerging water problems.
- Pooling of labor and talent has increased the capability for recruiting, training, and mobility of personnel, and improved support activities such as research and laboratories.
- The cost-sharing principle has doubled the activities that could be afforded by each party. Without this program, many essential water-resources studies would have been impossible or would have required expenditures far greater than the actual costs.
- Some of the many scientific advancements from the program —
 - The hydrology of the Piceance Creek basin, Colorado, was simulated by a computer model to evaluate effects of oil-shale development on the area's water resources.
 - Water resources of the Cook Inlet Hydrologic Unit (drainage basin), Alaska, were studied for land-use planning, waste disposal, and development of public water supplies.
 - The Edward Limestone aquifer, Texas, was studied to determine the need for legislation to deal with the protection of aquifers that are the only source of public water supplies.
 - Beaver Creek, Kentucky, was a prototype study to evaluate the effects of surface mining on the environment.
 - A ground-water study of Indianapolis, Indiana, evaluated the availability of public water supplies and the need for the Highland Reservoir.
- The program increased responsiveness to grassroots real-world needs and emergency situations such as the eruption of Mount St. Helens in 1980.
- Uniform management provides common standards and uniformly reliable products.
- The program assures that availability of impartial hydrologic information for all users—other Federal agencies, State legislatures, courts, water-management districts, State engineers and city administrators, and the public.
- Many publications are produced as part of the Federal-State Cooperative Program. Examples of these publications are shown in the illustration on the facing page.



PUBLICATIONS PREPARED BY THE U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, IN COOPERATION WITH STATE AND LOCAL AGENCIES

In this program, some of the publications are published by the U.S. Geological Survey and others are published by State and local agencies.

Coordination of Federal Water-Data Acquisition

The U.S. Department of the Interior, through the Office of Water Data Coordination (OWDC), is responsible for coordinating the water-data acquisition activities of all agencies of the Federal government. This responsibility was delegated by Office of Management and Budget Circular A-67 in 1964.

Purpose:

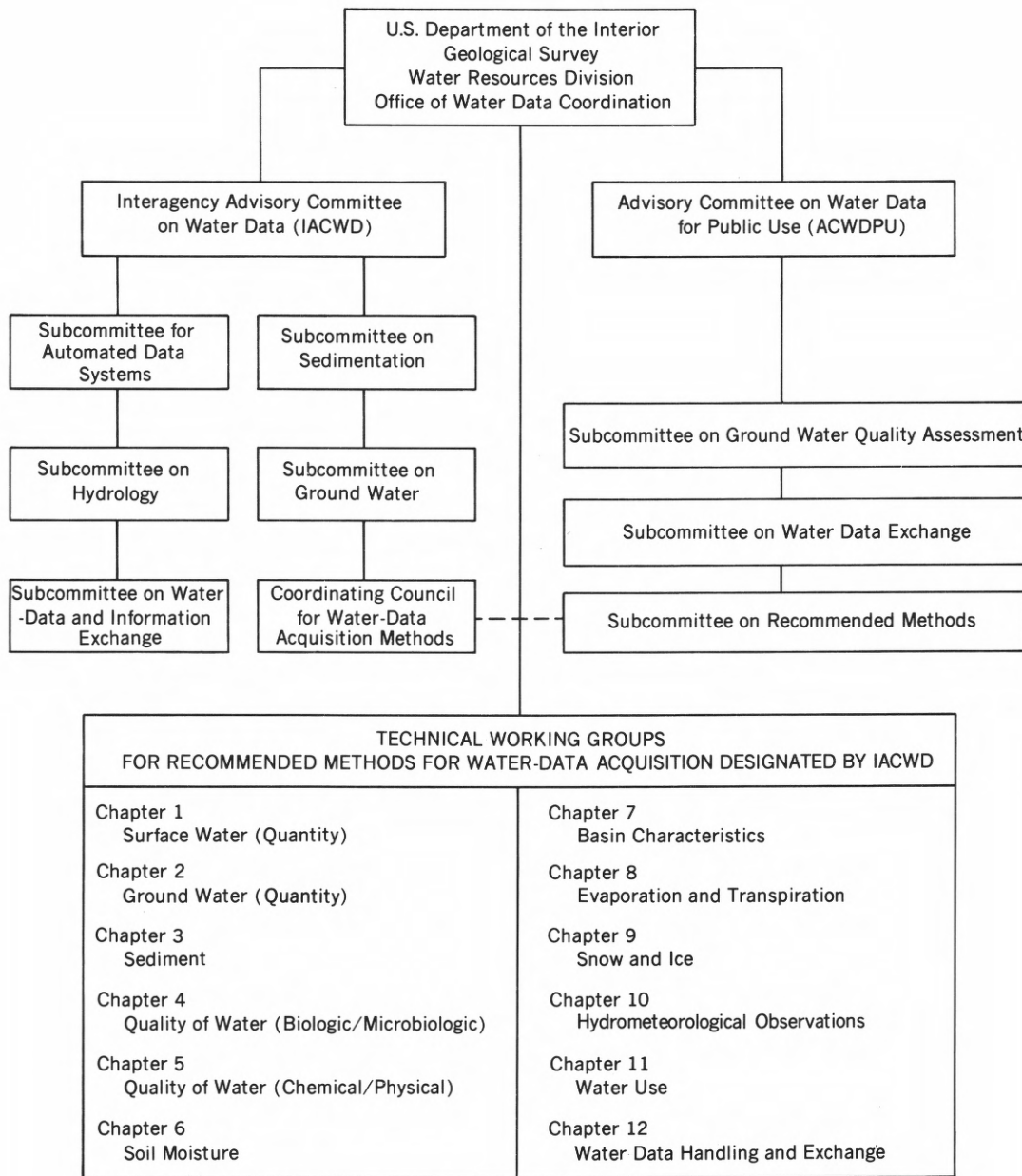
- Assure effective management of Federal programs to meet requirements for water-resources information.
- Catalog information on water data and on planned and existing Federal programs for acquiring water data.
- Coordinate the planning, design, and documentation of water-data networks and information.

Activities:

- Two major committees meet annually to advise the Secretary of the Interior on water-data acquisition; they are the Interagency Advisory Committee on Water Data, consisting of 34 Federal agencies, and the Advisory Committee on Water Data for Public Use, consisting of 27 members who represent State and local agencies, technical societies, universities, and private enterprises. The OWDC provides staff assistance to the two advisory committees. (See organization chart on facing page.)
- Coordinate the preparation of the annual Federal plan for water-data acquisition.
- Implement the recommendations of the advisory committees.

Accomplishments:

- In response to recommendations from the two advisory committees, the OWDC helped implement the following Water Resources Division programs—
 - National Water-Use Information Program
 - National Stream Quality Accounting Network
 - National Water-Data Exchange
 - River Quality Assessment Program
- A 12-chapter loose-leaf manual, “The National Handbook of Recommended Methods for Water Data Acquisition,” was implemented and about 10,000 copies of the manual have been distributed worldwide. This manual is kept current by technical working groups staffed by representatives of the Geological Survey and other Federal agencies. The subjects of the 12 technical working groups and the manual are shown in the chart on the facing page.
- The catalog of information on water-data acquisition activities is now available through the National Water-Data Exchange (see page 26). Information in the catalog is obtained from 185 Federal liaison officials and 460 voluntary participants at State and local levels.
- Summary tables from the catalog of information on water data are published annually.
- A Hydrologic Unit Map of the United States and a Hydrologic Unit Map for each of the States were published.



**OFFICE OF WATER-DATA COORDINATION ADVISORY COMMITTEES,
SUBCOMMITTEES, AND WORKING GROUPS ON RECOMMENDED METHODS**

Assistance to Other Federal Agencies

The U.S. Geological Survey frequently is requested by other Federal agencies to assist them by supplying hydrologic information or expertise pertinent to specific needs of those agencies. The agency requesting the work reimburses the Water Resources Division for its services. Many of the agencies, such as the National Weather Service, have a long-term relationship with the Geological Survey, whereas other agencies, such as the Office of Surface Mining, have recently established contacts with the Geological Survey. General assistance also is provided by the Division to other Federal agencies to assure compliance with environmental laws and regulations as required by the National Environmental Policy Act of 1969 (NEPA).

Purpose:

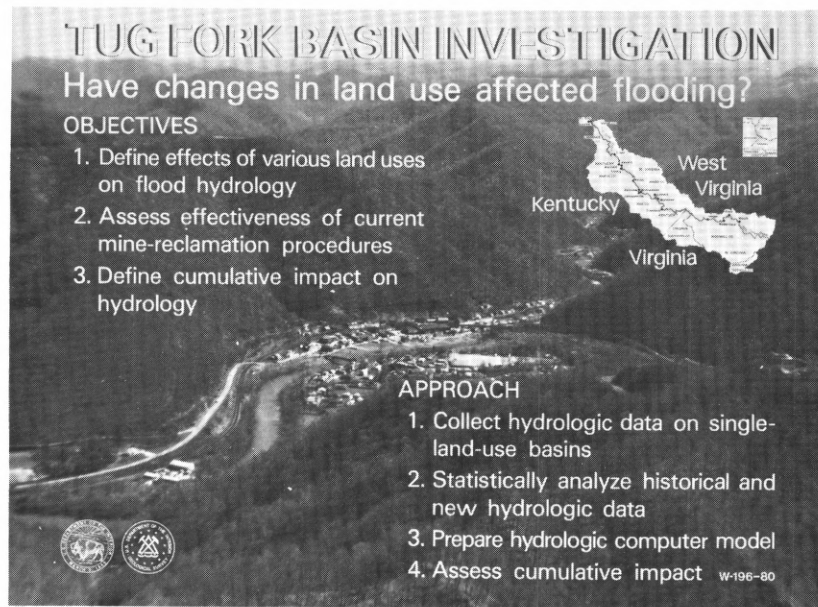
- Provide hydrologic expertise and information needed by other Federal agencies to assist them in accomplishing their missions. This support includes assistance in the preparation of environmental impact statements and related documents as a cooperating agency, and the review and comment on such documents prepared by other Federal agencies as required by the National Environmental Policy Act.

Activities:

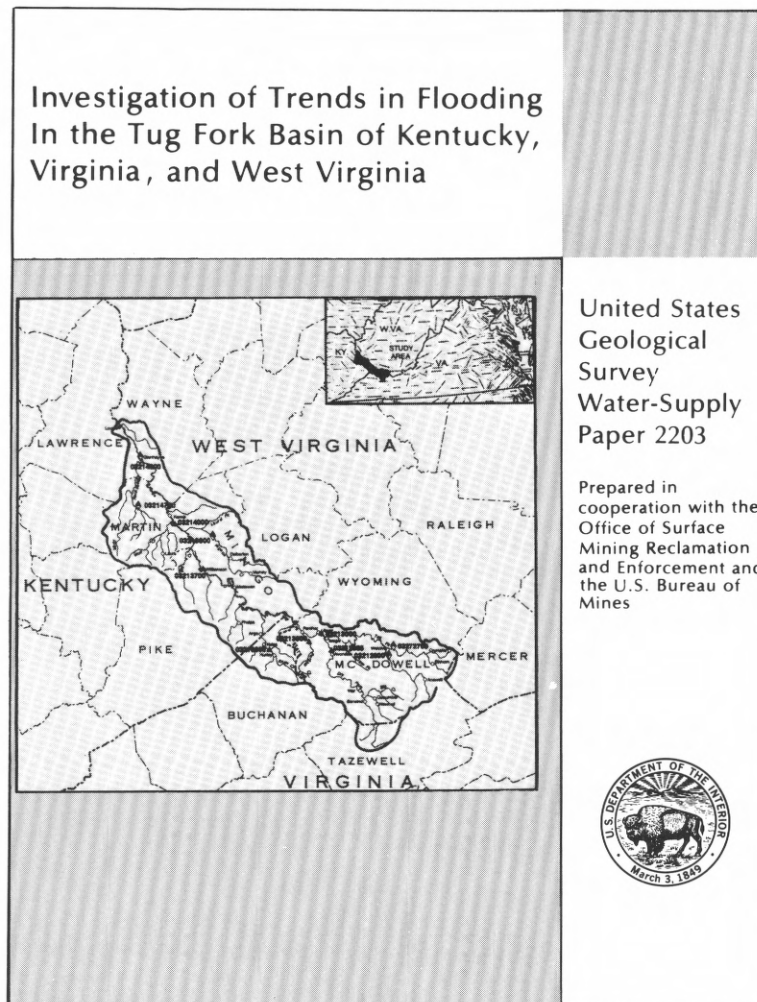
- Activities of this program depend on the information requests of the other Federal agency. Examples of the type of hydrologic assistance requested of the Water Resources Division by other Federal agencies are as follows:
 - **Department of the Interior**
 - *Bureau of Land Management*—collect hydrologic data, investigate availability of water on public lands, determine hydrologic effects of surface mining, and provide hydrologic impact statements for regional coal-leasing environmental impact statements.
 - *Bureau of Mines*—collect hydrologic data and investigate hydrologic aspects of abandoned coal mines.
 - *Bureau of Reclamation*—collect hydrologic data and investigate ground-water resources, land subsidence, and sites of proposed reservoirs.
 - *Fish and Wildlife Service*—collect hydrologic data; study ground-water recharge, availability of water for fish hatcheries, and relation of ground water to lakes; and evaluate instream flow.
 - *National Park Service*—collect hydrologic data, appraise water resources of National Parks and Monuments, and study flood hazards, forest geomorphology, and ground water of campground areas.
 - *Bureau of Indian Affairs*—collect hydrologic data and appraise water resources, including the investigation of present and potential water supplies on reservations.
 - *Office of Surface Mining*—supply hydrologic data and information needs required by the Surface Mining Control and Reclamation Act (SMCRA) of 1977 and provide assistance in developing impact statements required by SMCRA.
 - **Department of Agriculture**—investigate hydrology of small watersheds by studying sediment deposits, stream discharge, and quality of water.
 - **Department of Defense**
 - *Corps of Engineers*—collect hydrologic data, and investigate tidal flows in estuaries, subsidence, streamflow, ground water, sedimentation, and water quality.
 - *Military bases*—conduct studies related to toxic waste, ground-water contamination, and water supply.
 - **Department of Energy**—study hydrologic conditions and effects on the hydrologic environment of underground nuclear-explosion test sites, and of existing and potential nuclear waste disposal sites; conduct research on the interaction between radioactive materials and various geohydrologic environments.
 - **Nuclear Regulatory Commission**—review interpretations of hydrologic condition at sites being evaluated for potential high-level radioactive waste repositories.
 - **Department of Housing and Urban Development**—delineate flood plains, flood profiles, and flood frequencies for flood-insurance programs.
 - **Department of Commerce** (*National Weather Service, National Oceanographic and Atmospheric Administration*)—compile and disseminate flow and stage data from about 2,600 Water Resources Division gaging-stations for use by the National Weather Service for its river and flood-forecasting systems.
 - **Environmental Protection Agency (EPA)**—conduct studies related to energy research and development, municipal waste-disposal sites, relationship of ground water to lakes; collect water-quality information, and provide hydrologic assistance for toxic-waste cleanup actions under the Resource Conservation and Recovery Act (RCRA) and Superfund (ERCLA-Comprehensive Environmental Response, Compensation, and Liability Act) programs.

Accomplishments:

- A number of reports describing the hydrology of eastern and western coal areas have been published. These reports are the result of studies done at the request of the Bureau of Land Management, the Bureau of Mines, and the Office of Surface Mining to determine the location, quantity, and quality of available water, the effects of surface mining on hydrologic processes, and to describe new techniques for evaluating mining impacts, including statistical and modeling approaches. The Tug Fork Basin investigation (see illustration on the facing page) is an example of the assistance given by the Water Resources Division to other Federal agencies.
- Implemented Memorandums of Understanding (MOU) with the Environmental Protection Agency regarding related programs of the Survey and EPA including coordination of information on hydrologic plans, and technology transfer of data and information.
- Established MOU with the Office of Surface Mining for the Water Resources Division to provide hydrologic assistance in the review of mine plans and related activities.
- Participated in "Superfund" activities with the EPA, Corps of Engineers, States, and some local agencies concerning cleanup of hazardous-waste disposal sites.
- Prepared a series of hydrologic and geologic reports for the National Park Service for National Parks and National Monuments.
- Assisted the Department of the Army at the Rocky Mountain Arsenal.
- Reviewed environmental impact statements submitted by other agencies and provided comments for Department of the Interior's review.
- Provided assistance to bureaus and agencies in the environmental assessment and preparation of environmental impact statements in areas of hydrologic and geologic expertise.



Source: U.S. Geological Survey exhibit panel W-196-80.



**TUG FORK BASIN INVESTIGATION IS AN EXAMPLE
OF THE U.S. GEOLOGICAL SURVEY'S ASSISTANCE
TO OTHER FEDERAL AGENCIES**

National Research Program

The National Research Program focuses on increasing understanding of the fundamental hydrologic processes of the Nation's ground- and surface-water systems. Knowledge and techniques derived from the Division's research effort are directed at solving current water-resources problems and anticipating, and thus preventing, future water problems. Results of all research projects are made available to other programs of the Water Resources Division and to the scientific community worldwide.

Purpose:

- Improve knowledge of the fundamental processes that affect or control the movement of water and chemical constituents through hydrologic systems.
- Develop an understanding of the effects of human activities on the hydrologic system.

Activities:

- Research is being done in six major fields of study:
 - Surface-water hydrology
 - Ground-water hydrology
 - Water chemistry
 - Geochemistry
 - Sediment transport and geomorphology
 - Ecology
- About 250 researchers are involved in 140 projects. Examples of these research projects are nuclide migration in saturated and unsaturated environments, hydrology of lakes, water quality and human health, stream ecology and hydrology, solute transport in saturated and unsaturated environments, bedload movement in streams, humic acids in streams, oil-shale leachate migration, wetland hydrology and ecology, geothermal energy resources, development of ground-water flow models, and measurements, predictions, and effects of the movement of glaciers.

Accomplishments:

More than 150 reports and abstracts that cover a broad scientific spectrum were published in fiscal year 1982. Highlights of the research effort include:

- Development of hydrologic models that describe urban storm-sewer flow, transient open-channel flow, and one-dimensional flow in the Potomac River
- Development of a mathematical model that predicts the retreat rate of the terminus of the Columbia Glacier and estimates the time distribution of resulting iceberg discharge (see illustration on facing page).
- Greater insight into chemical processes that affect oxidation, precipitation, and organic complexes of iron and manganese.
- Conducted a detailed survey of the distribution, species composition, and productivity of phytoplankton and zooplankton in San Francisco Bay.
- Improved the method-of-characteristics model to simulate solute transport.
- Completed a comprehensive analysis of major and trace elements in deep granitic ground water which suggests that crystalline rock can undergo significant geochemical reactions with water at great depth.
- Linear programming and ground-water pollution management has led to a new concentration response method to preserve ground-water quality while waste is being injected.
- A one-dimensional model for transport of non-trace quantities of solutes affected by equilibrium-controlled ion exchange reactions was completed.
- Completed studies that showed a significant correlation between mineral content of drinking water and health; low death rates characterized areas with high magnesium content in drinking water and high death rates were correlated with water low in magnesium content.
- A new computer program was written to facilitate calculation of mass balance models in ground water
- Studies were completed which found that the decomposition of organic matter is the dominant diagenetic reaction in sediments of the tidal Potomac River.
- Completed a quantitative assessment of the low-temperature geothermal resources of the Western United States.
- Determined processes that regulate the growth of phytoplankton in the fresh, tidal Potomac River.
- Conducted critical review of recent toxicological and ecological research on the responses of certain flora and fauna to trace metals.
- Better understanding of numerical simulation of hydrodynamic processes in rivers, estuaries, and embayments was achieved with a system that can process and interpret vertical-velocity and flow-profile data, and synthesize time-dependent, unsteady-flow discharge hydrographs.



Source: Rasmussen and Meier, 1982.

COLUMBIA GLACIER, ALASKA

Arrows show direction of flow. Main ice stream is indicated by longer arrows and dots at 2-km intervals along the longitudinal coordinate system.

National Water-Data Exchange

The National Water-Data Exchange (NAWDEX) is the outgrowth of the recommendations made by the two advisory committees to the Secretary of the Interior to improve access to all federally acquired water data.

Purpose:

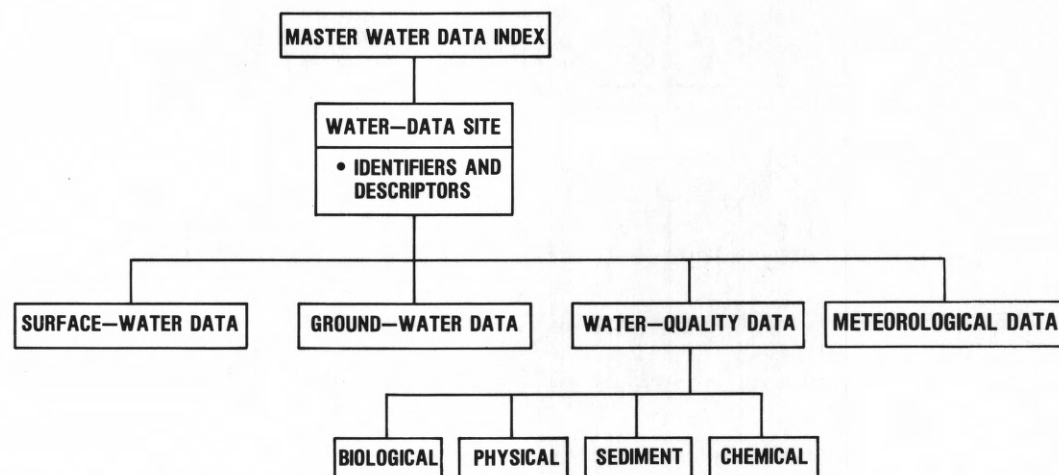
- Expand the availability of water data to all those who need and use water data, improve the exchange of such data, and serve as a focal point for obtaining the data.

Activities:

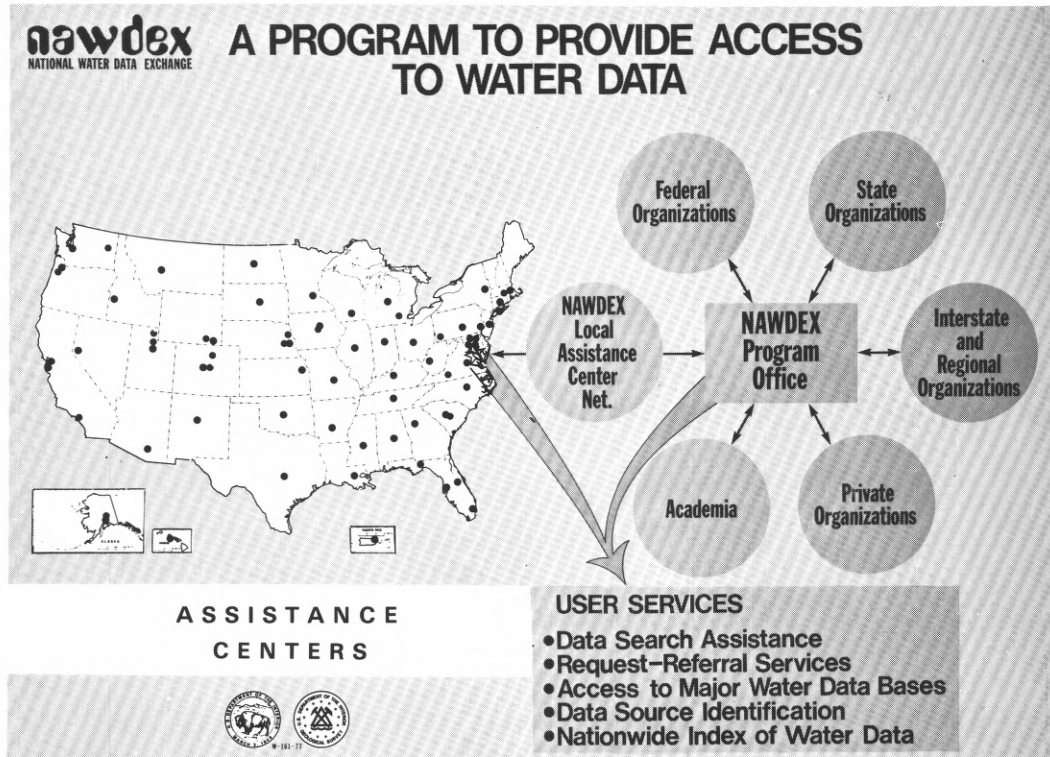
- Operate a national water-data indexing program.
- Maintain a national user-service program that includes a nationwide network of assistance centers and liaison with water-oriented organizations.
- Provide support to the Office of Water Data Coordination (OWDC) water-data cataloging requirements. (See page 20 for description of OWDC.)

Accomplishments:

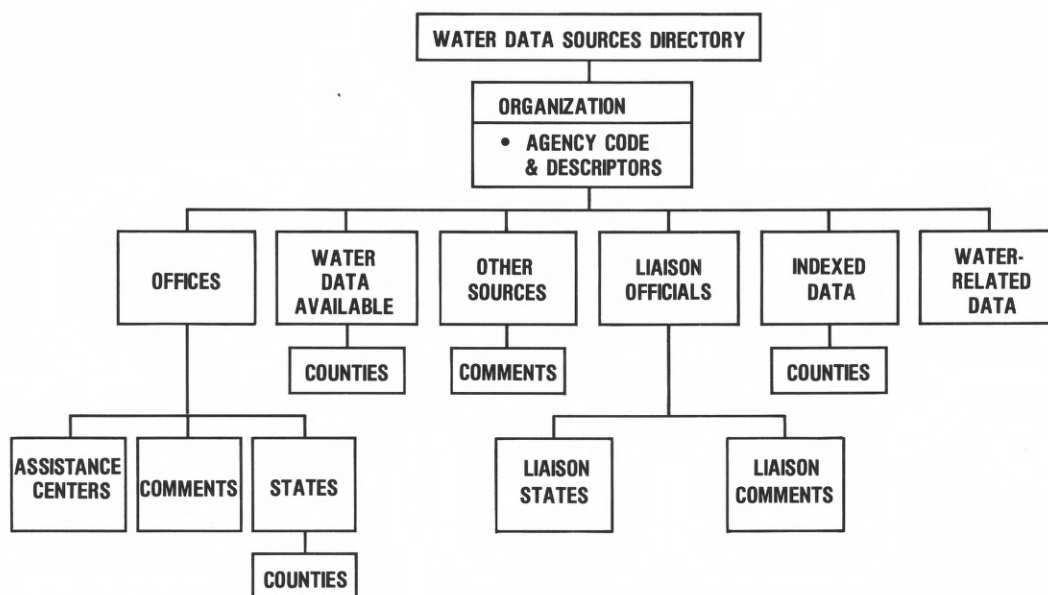
- Increased membership to nearly 250 Federal, State, and local government, academic, and private water-oriented organizations.
- Established a national network of 75 assistance centers in 45 States and Puerto Rico, as of April 1983. These centers processed 85,000 requests for hydrologic information during fiscal year 1981 and nearly 100,000 requests during fiscal year 1982. (See illustration on facing page.)
- Designed and maintains the *Master Water Data Index* of data-collection sites. (See illustration below.) The index now includes over 450,000 sites operated by more than 450 organizations.
- Designed and maintains a *Water-Data Sources Directory*, which identifies organizations that are sources of water and water-related data and locations within these organizations from which data may be obtained. (See illustration on facing page.)
- Coordinates direct access to two major water-data bases: STORET, of the Environmental Protection Agency, and WATSTORE, of the Geological Survey. (See page 30 for description of WATSTORE.)



Source: Perry and Williams, 1982.



Source: U.S. Geological Survey exhibit panel W-161-77.



Source: Edwards, 1982.

Water Resources Scientific Information Center

The Water Resources Scientific Information Center (WRSIC) was created in 1966 and placed in the Department of the Interior on the advice and consent of the Committee on Water Resources Research of the former Federal Council for Science and Technology and the Office of Science and Technology in the Executive Office of the President. The objective of WRSIC was "to make available information and reports on projects completed, in progress, or planned under the provisions ***" of the Water Resources Research Act of 1964 (Public Law 88-379, as amended). WRSIC initially was located in the Office of Water Resources Research (later known as the Office of Water Research and Technology). In August 1982, the Secretary of the Interior transferred WRSIC to the U.S. Geological Survey's Water Resources Division, where it would complement the Division's long-standing program of disseminating water information to the public. WRSIC will work closely with NAWDEX, and plans are being made to provide bibliographic services through NAWDEX in the future.

Purpose:

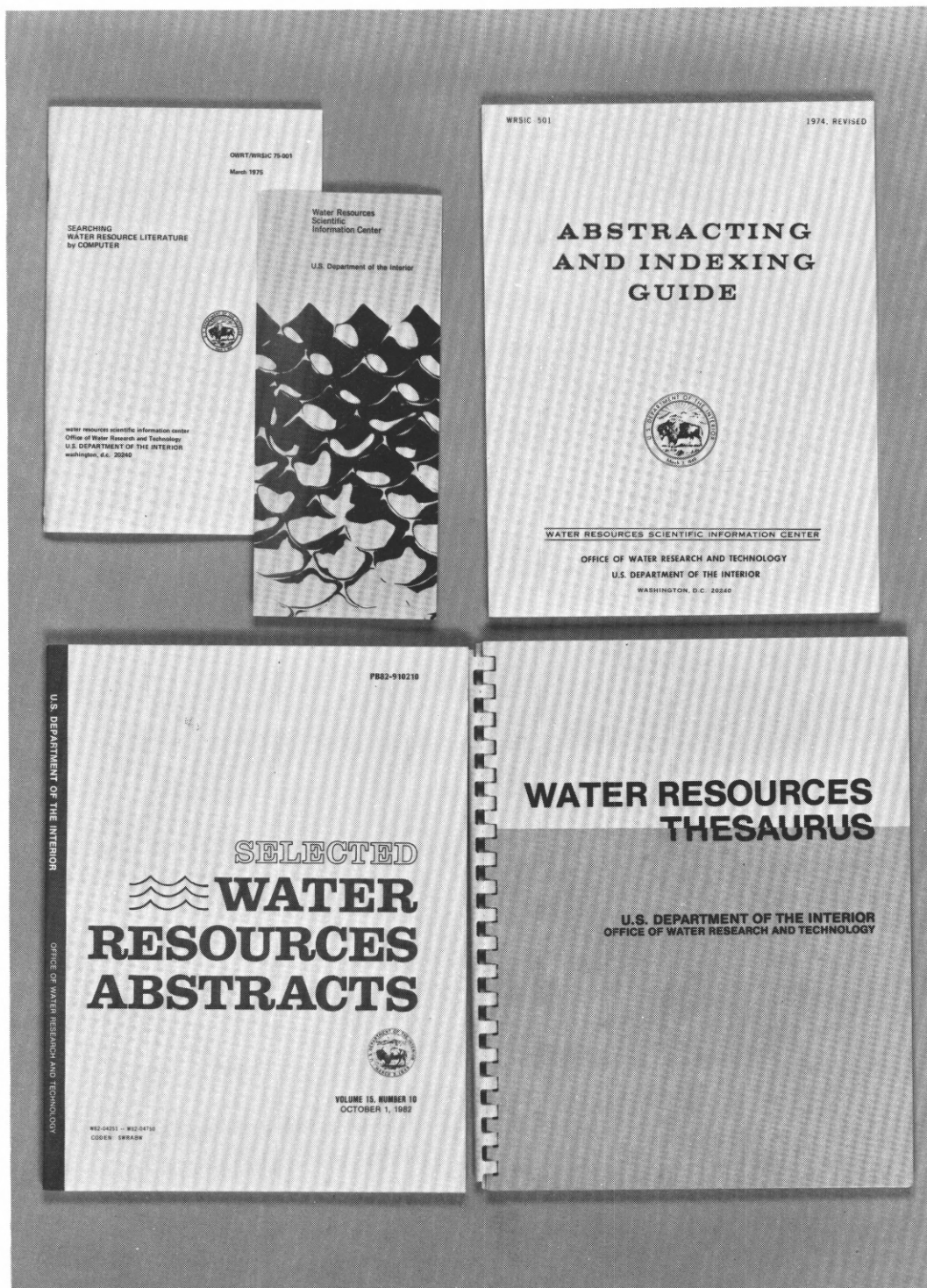
- Increase the availability and knowledge of water-related scientific and technical information by abstracting water-resource publications, and making this information promptly and readily available to the water-resources community and the public through publications and computerized bibliographic-information services. (See illustration on facing page.)

Activities:

- Abstract, index, and classify water-resources literature published worldwide.
- Publish "Selected Water Resources Abstracts" monthly.
- Maintain a comprehensive worldwide computerized bibliographic information base.
- Maintain a research-in-progress information base.
- Provide custom searches of the bibliographic information base for Federal agencies.
- Maintain the "Water Resources Thesaurus."

Accomplishments:

- Established a computerized bibliographic-information base that contained more than 165,000 abstracts as of 1982.
- Established an abstract-exchange program with major Federal water agencies, State water-resources research institutes, and some foreign governments.
- Updated and published revised editions of the "Water Resources Thesaurus."
- Arranged for bibliographic information base to be made available through commercial on-line services from Lockheed's DIALOG system and the Systems Development Corporation's ORBIT system.



PUBLICATIONS OF WATER RESOURCES SCIENTIFIC INFORMATION
CENTER

National Water-Data Storage and Retrieval System

The National Water-Data Storage and Retrieval System (WATSTORE) was begun by the Geological Survey in 1971 to improve access to the vast amount of water data collected by the Water Resources Division. Data from this system form 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 of radioactive-waste storage on water supplies.

Purpose:

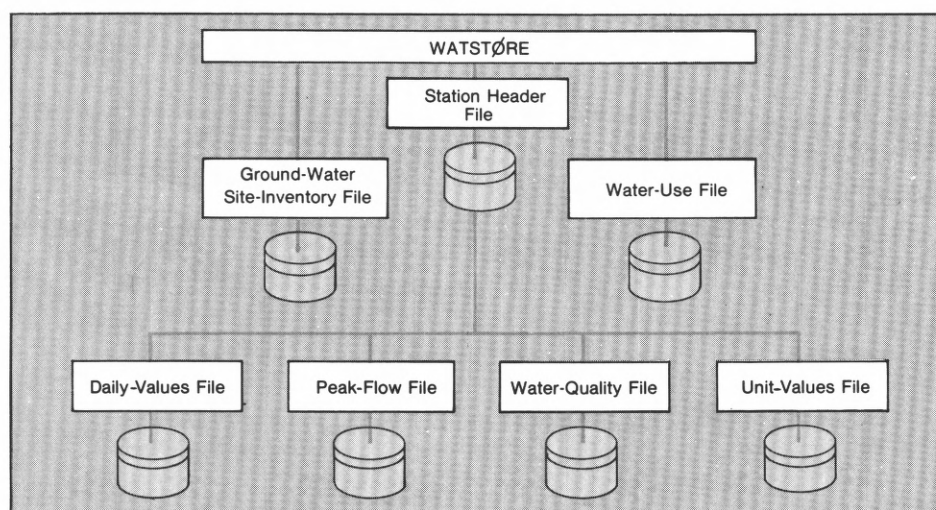
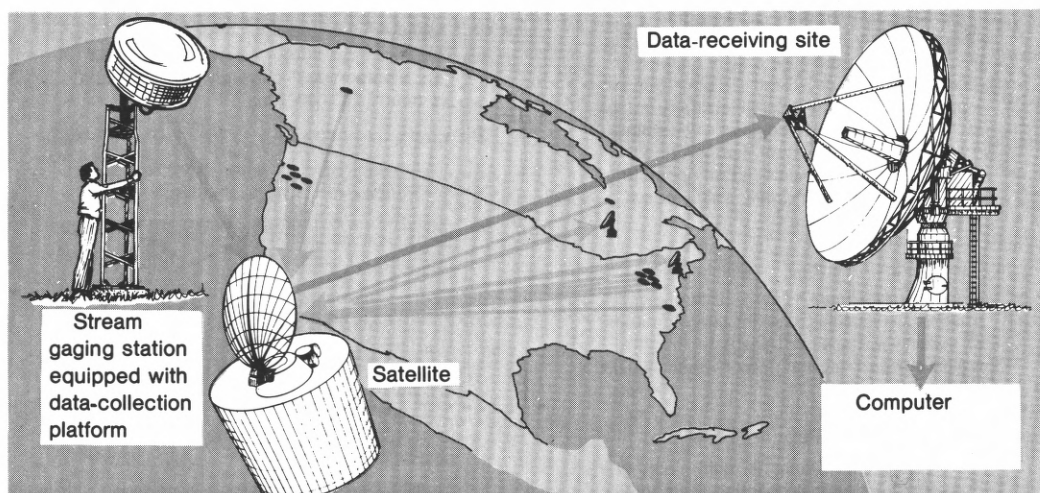
- Provide computerized water data to the water-data community and maintains the national water resources data base.

Activities:

- Maintain several computer files (see illustration on facing page) in which data are grouped and stored by common characteristics and data-collection frequencies. These files include—
 - Surface-water, quality-of-water, and ground-water data measured on a daily or continuous basis.
 - Annual peak (maximum) streamflow (discharge) and gage height (stage) values for surface-water stations.
 - Chemical-quality analyses for surface and ground water.
 - Water characteristics that are measured more frequently than daily.
 - Geologic and inventory data for ground-water sites.
 - Water-use information for 12 categories of use.
- Improve the dissemination of water data to water managers and planners.

Accomplishments:

- WATSTORE and the Environmental Protection Agency's Storage and Retrieval System (STORET) have been interfaced. Data are transferred monthly from WATSTORE to STORET.
- WATSTORE files contain—
 - 200 million daily observations of streamflow, reservoir contents, water temperature, stream sediment, and ground-water level data.
 - 2 million chemical, physical, biological, and radiochemical analyses from surface and ground water.
 - hydrologic and geologic data on 700,000 inventoried wells.
- Data are now stored and retrieved at thousands of locations that are part of a nationwide telecommunications network.
- About 350 satellite data-collection platforms are being operated to provide hydrologic data to users on a real-time or hourly basis.
- Information is being supplied to requestors of data in formats appropriate to their needs. For example, computer-printed tables and graphs, statistical analyses, digital plots, and magnetic tape.
- WATSTORE is a major data base that contributes summary information to the National Water-Data Exchange (see page 26).



Source: U.S. Geological Survey, 1981b.

NATIONAL WATER-DATA STORAGE AND RETRIEVAL SYSTEM

National Water-Use Information Program

The National Water-Use Information Program was started in response to the need for a single source for uniform information on water use. The program, which began in 1978, is part of the Geological Survey's Federal-State Cooperative Program and is designed to meet the mutual needs of State and Federal governments. (See illustration on facing page.) The data derived by this program complement the Geological Survey's long-term data on water availability and quality.

Purpose:

- Determine nationwide how much—
 - fresh and saline surface and ground water is *withdrawn*
 - water is *used*
 - water is *consumed* during use
 - water is *returned* for further use.
- Determine what changes in water quality are associated with the various categories of use.

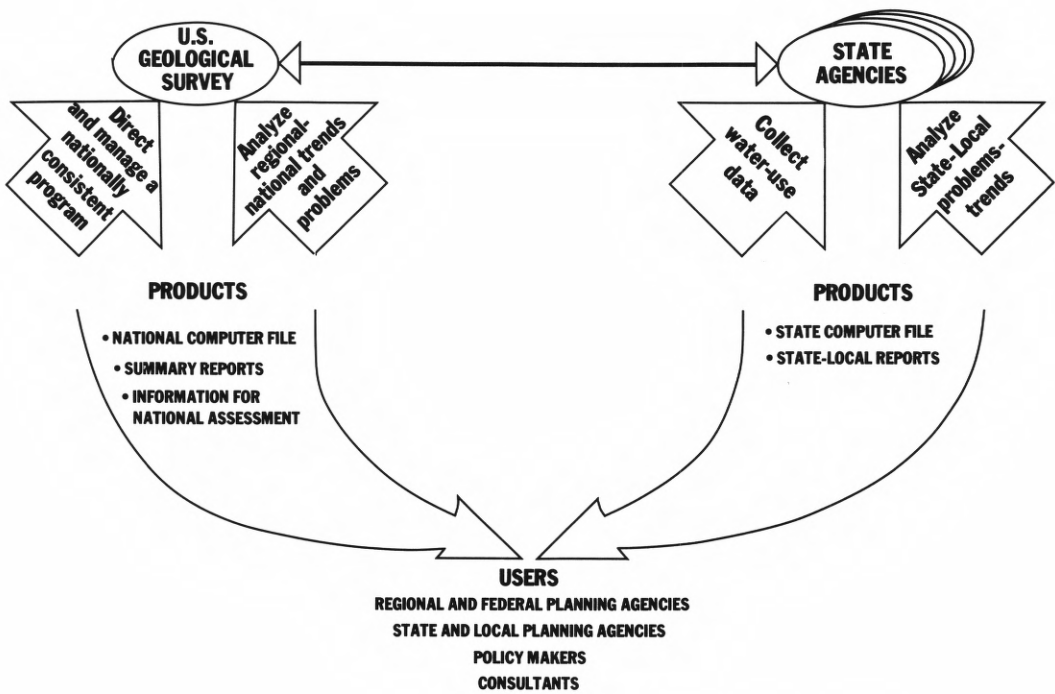
Activities:

- Assist the States in the collection and compilation of water-use data.
- Develop a computerized data storage and retrieval system.
- Devise new methods and techniques to improve and standardize the collection and analysis of water-use information.
- Make the water-use information readily available and understandable.

Accomplishments:

- Program has been established in 47 States, but at varying levels of completeness.
- The computerized National Water-Use Data System is in operation at the Federal level, and data are available through WATSTORE (see page 30) and NAWDEX (see page 26).
- Software programs for the State Water-Use Data System have been completed, and several States have implemented the system.
- Data are being compiled for 12 categories of water use:

Agriculture: <ul style="list-style-type: none"> ◦ Irrigation (1) ◦ Nonirrigation (2) ◦ Commercial (3) ◦ Domestic (4) 	Power generation: <ul style="list-style-type: none"> ◦ Fossil Fuel (5) ◦ Geothermal (6) ◦ Hydroelectric (7) ◦ Nuclear (8) 	<ul style="list-style-type: none"> ◦ Industrial (9) ◦ Mining (10) ◦ Public supply (11) ◦ Sewage treatment (12)
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- Information is being released in publications of the U.S. Geological Survey and State agencies.
- The report "Estimated use of water in the United States in 1980" was published.



NATIONAL WATER-USE INFORMATION PROGRAM

Hydrologic Data-Collection Program

The Hydrologic Data-Collection Program is the Water Resources Division's basic program for collecting and analyzing data on the Nation's surface and ground water. These data are used to support the needs of Federal, State, and local governments. Data-collection stations are maintained at selected locations to provide standardized records on stream discharge (flow) and stage (height), reservoir and lake storage, ground-water levels, well and spring discharge, and the quality of surface and ground water. The program is funded in several ways, as shown in the table below.

Purpose:

- Provide the hydrologic data needed to support the obligations and concerns of the Federal government (Geological Survey and other Federal agencies).
- Provide the hydrologic data needed to respond to the mutual needs and concerns of State, local, and Federal agencies regarding management, development, regulation, conservation, and environmental protection of the Nation's water (*see* Federal-State Cooperative Program).

Activities:

- Collect data required by court decree, treaty, or compact.
- Provide data needed to support activities of other Federal agencies.
- Provide data needed to support national programs, such as energy studies.
- Operate stations to collect data on the quantity and quality of surface and ground water at local and State levels, with emphasis on collecting data in water-deficient areas, urban complexes, small watersheds, and areas of energy-resources development.
- Monitor quantity and quality of water to detect trends in stream quality (*see* National Stream Quality Accounting Network (NASQAN), page 36).
- Monitor hydrologic characteristics at sites relatively unaffected by human activities (*see* National Hydrologic Bench-Mark Program, page 36).

Accomplishments:

- Provides the basic data for water-resources appraisals, environmental impact statements, and energy-related studies, and, in establishing the baseline conditions of the Nation's water, has become the foundation for solving emerging water issues.
- Data are now available through two computerized systems—the National Water-Data Storage and Retrieval System (*see* page 30) and the National Water-Data Exchange (*see* page 26).
- Data are published annually for each State, Puerto Rico, and the Trust Territories. Special appendixes, such as data for coal-producing areas, are published as needed.

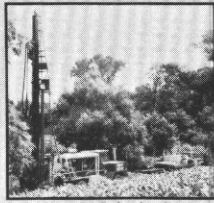
NUMBER OF DATA-COLLECTION SITES, BY SOURCE OF FUNDS, FY 1982

[Numbers have been rounded]

Type of data-collection station	Number of stations, by source of funds			Total number of stations
	Federal Program	Federal-State Cooperative Program	Other Federal Agency Program	
Basic data-collection stations:				
Surface-water quantity:				
Continuous	600	5,300	2,400	8,300
Intermittent	100	7,000	400	7,500
Surface-water quality.	200	7,500	1,200	8,900
Lake and reservoir contents	200	500	200	900
Sediment.	600	1,800	400	2,800
Ground-water levels.	5,500	14,000	7,200	26,700
Ground-water quality.	250	7,100	.....	7,350
Monitoring networks:				
NASQAN	500	.....	.....	500
Bench mark	50	.....	.....	50
Total	8,000	43,200	11,800	63,000

COLLECTING HYDROLOGIC DATA

With the use of Specialized Equipment and Techniques The Water Resources Division of The U. S. Geological Survey determines the Availability and Quality of the Nation's Water Resources.



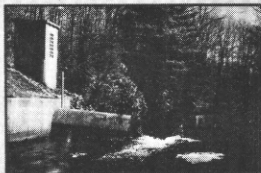
Drilling Rig for Sub-Surface Investigations



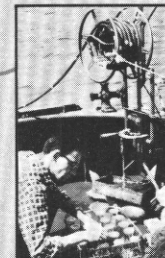
Stage Rainfall Recorder



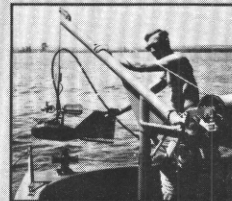
Pumping Test on Small Well



Streamgaging Station With Artificial Control Structure



Water Sampling With Pump Sampler



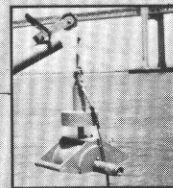
Velocity Measurement and Water Sampling



Stream Discharge Determined by Wading Measurement



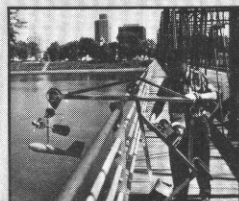
Digital Water Level Recorder



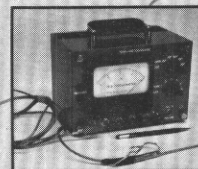
Bottom Material Sampler



Special Purpose Hydrometeorological Station



Measuring River Discharge Using Bridge Equipment



Thermistor Thermometer



Field Chemistry

Source: U.S. Geological Survey exhibit panel W-98.

WATER RESOURCES DIVISION HYDROLOGIC DATA-COLLECTION PROGRAM

Hydrologic Data-Collection Program—Continued

The Geological Survey operates two special-purpose programs to monitor surface-water quality—the National Stream Quality Accounting Network (NASQAN) and the National Hydrologic Bench-Mark Program. These programs are designed to answer the questions, “What is the quality of water in the major river systems of the United States?” and “Is the quality changing?” Neither of these networks is designed to determine why the water quality might be changing. However, research is underway to improve knowledge of the processes that influence the natural and changing quality of water.

National Stream Quality Accounting Network

Purpose:

- Provide an assessment of stream quality for use in national and regional water-quality planning and management.

Activities:

- Monitor a comprehensive set of physical and chemical characteristics of surface water at stations throughout the country to detect changes in stream quality and to determine long-term trends (see illustration on facing page).

Accomplishments:

- Established more than 500 NASQAN stations on the Nation’s major rivers. These stations are located at or near the downstream end of hydrologic accounting units or at representative sites along coastal areas and the Great Lakes.
- Within NASQAN are a Radiochemical Surveillance Network of 52 sampling sites, and a Tritium Network, which monitors tritium concentrations at 14 streamflow and 16 atmospheric precipitation sampling sites.
- Published data and information for a wide variety of users.
- Published river quality assessment reports on several areas.
- Published topical reports based on NASQAN data and focusing on a particular aspect of water quality.
- Initiated research projects to conduct trend analysis.

National Hydrologic Bench-Mark Program

Purpose:

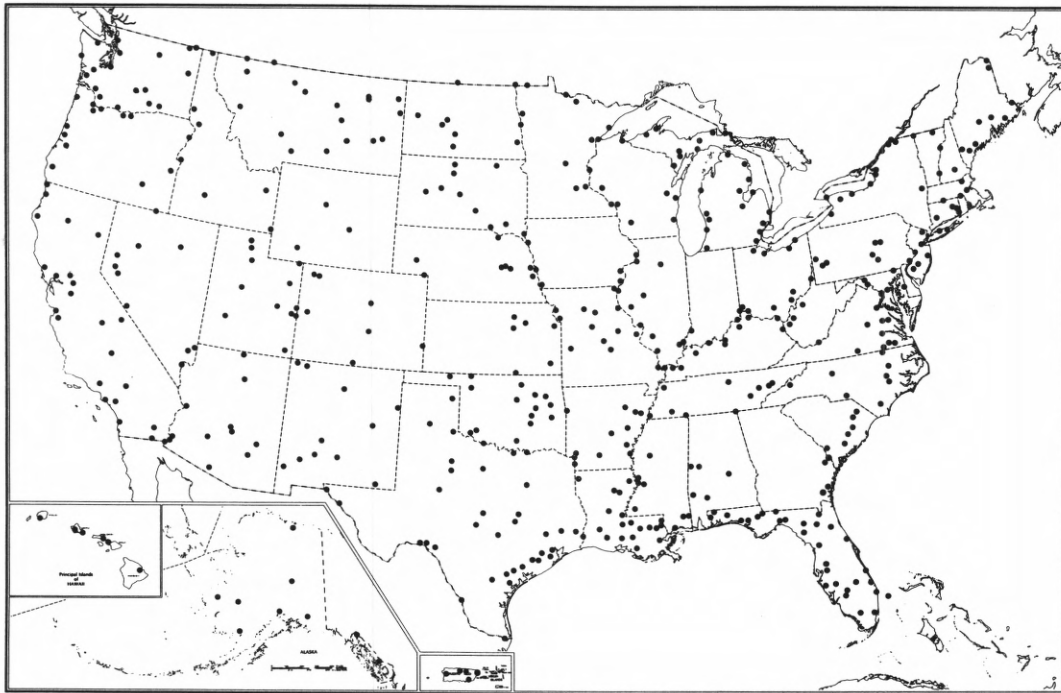
- Provide consistent hydrologic data (including water quality and related factors) in representative undeveloped watersheds nationwide and provide analyses on a continuing basis to compare and contrast conditions observed in basins more obviously affected by man.

Activities:

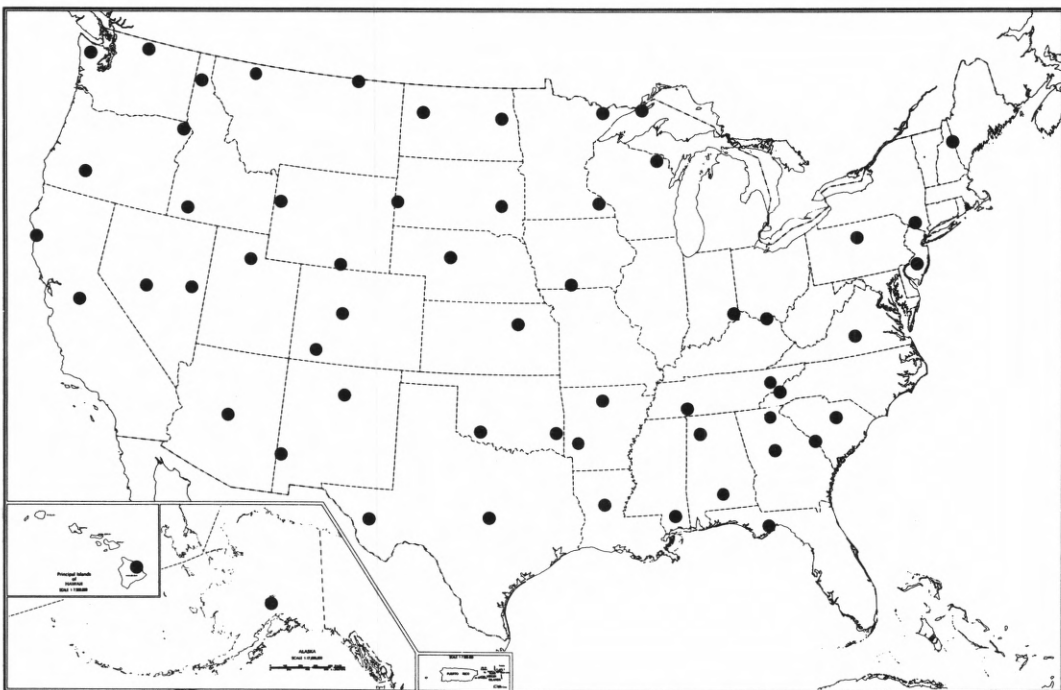
- Monitor streamflow and physical and chemical characteristics at selected “natural” sites throughout the country (see illustration on facing page).
- Provide summary, analysis, and interpretation of the data.

Accomplishments:

- Established 58 monitoring stations.
- Data from the program were used in a search for evidence of effects of acid precipitation on stream waters.
- Reports have been published that describe the environment and the natural water quality of the watersheds; these data were then compared with the quality of major streams that drain the same regions, but which have been “influenced” by man. Studies are underway to summarize all streamflow quantity and quality data and to analyze trends in quantity and quality characteristics.



NATIONAL STREAM QUALITY ACCOUNTING NETWORK (NASQAN)



NATIONAL HYDROLOGIC BENCH-MARK PROGRAM

**LOCATION OF STATIONS IN THE NATIONAL STREAM QUALITY
ACCOUNTING NETWORK AND THE NATIONAL HYDROLOGIC
BENCH-MARK PROGRAM**

International Hydrology Program

Activities related to foreign governments and international organizations are planned and directed by the Office of International Hydrology (OIH).

Purpose:

- Represent the Water Resources Division in the Geological Survey's program of international cooperation in the earth sciences.

Activities:

- Represent the United States in international water programs, such as those associated with United Nations (UN), United Nations Educational, Scientific, and Cultural Organization (UNESCO), World Meteorological Organization (WMO), and Food and Agricultural Organization of the United Nations (FAO).
- Provide personnel and expertise for international water-resources investigations.
- Provide for training and exchange of foreign nationals in hydrologic fields.
- Monitor foreign methodology and research in hydrology for potential application to domestic programs.

Accomplishments:

- Coordinated the Geological Survey's hydrologic assistance programs, including major projects in Saudi Arabia, Jordan, Venezuela, China, and several other countries.
- Provided training for foreign scientists and technicians.
- Arranged visits for scientists and administrators from foreign countries.
- Coordinated the cooperative exchange of technical experts in surface-water hydrology and sedimentation.
- Chief Hydrologist of the Geological Survey serves as Chairman of the United States delegation to UNESCO's Inter-Governmental Council for the International Hydrologic Program.
- Had lead role in establishing an exchange program of hydrologic information between the United States and China (see illustration on facing page).



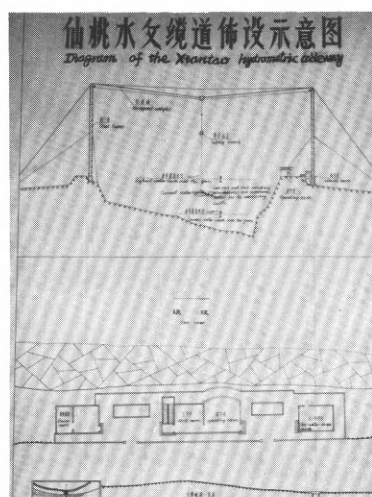
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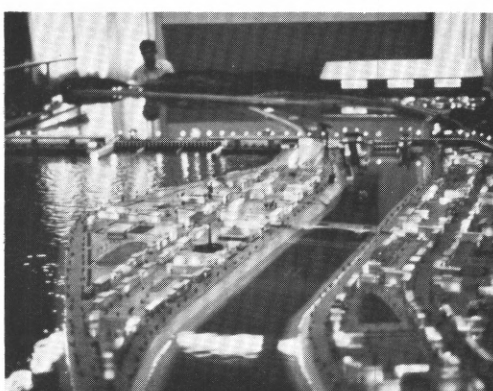
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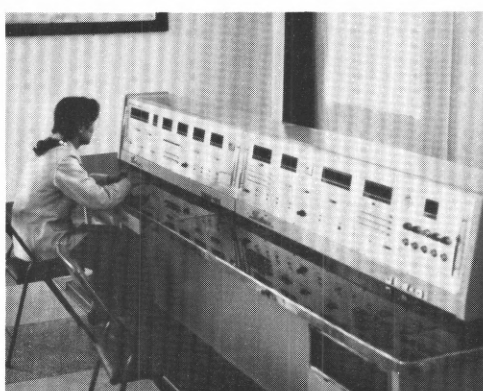
C



D



E



F

A. Demonstration of boat-mounted stream discharge equipment at the Marco Polo hydrologic station on Yong Ding He River. B. Visit to Jiangwan Experimental Runoff Hydrometric Station near Hangzhou. C. Bubble gage and telemetry system for the Yangtze River at Hankow. D. Diagram of cableway and site plan for the hydro-metric station at Xian Tao on the Han Jiang River. E. Model of the Gezhouba Dam under construction on the Yangtze River at Yichang. F. Console for reception of telemetered hydrologic data at the Jiangdu Key Water Conservancy Project near Yangzhou.

**U.S. GEOLOGICAL SURVEY TRIP TO PEOPLE'S REPUBLIC OF CHINA,
MAY-JUNE 1982**

Hazardous-Waste Hydrology Program

The transport of all types of waste through the environment is controlled by the same geologic, hydrologic, and geochemical conditions. In recognition of this fact, the Division in July 1981 established the Office of Hazardous-Waste Hydrology to coordinate research and investigations related to the disposal of all types of hazardous radioactive and toxic-chemical (nonradioactive) waste. The new office will improve the Division's effectiveness in providing the technical information needed to alleviate a critical threat to public health and safety.

The Hazardous-Waste Hydrology Program has four objectives:

- Provide scientific knowledge to evaluate the safety of hazardous-waste disposal and to alleviate existing or potential contamination problems.
- Develop an interdisciplinary team of scientists to conduct research, to provide consultative expertise for use of other Federal agencies, and to develop technical solutions for disposal and contamination problems.
- Provide baseline data on the extent of ground-water contamination.
- Develop procedures and guidelines for identifying and selecting suitable waste-disposal sites.

The three components of the program—high-level nuclear wastes, low-level nuclear wastes, and toxic-chemical wastes/ground-water contamination are described separately on the following pages. A table that compares several characteristics of nuclear wastes and toxic-chemical wastes is shown on the facing page.

**COMPARISON OF SOME CHARACTERISTICS OF NUCLEAR WASTES TO THOSE OF
TOXIC-CHEMICAL WASTES**

[Estimated volumes and other data are based primarily on information from the documents listed at the foot of
this table.]

Characteristics	Nuclear wastes	Toxic chemical wastes (liquids and solids)
Estimated volumes on hand, 1980.	70 million cubic yards, uranium mill tailings. 2 million cubic yards, all other nuclear waste.	6 billion cubic yards.
Estimated yearly volume generated, 1980.	1.5 million cubic yards, uranium mill tailings. 300,000 cubic yards, all other nuclear wastes.	50 to 500 million cubic yards.
Number of known disposal or storage sites.	42 uranium mill tailings sites 20 other major waste sites. Does not include nuclear-power reactors (70) where spent fuel is temporarily stored.	7,000 to 100,000. Does not include municipal landfills and septic tanks.
Estimated area underlain by ground water contaminated beyond potable use.	10 to 30 square miles.	1,000 to 10,000 square miles.
Residential populations affected by condemned groundwater supplies.	None known.	More than 2 million.
Composition of the wastes.	Fairly well known.	Extremely variable; largely unknown.
Principal sources of wastes.	Relatively few industrial and institutional activities; well known and regulated.	All sectors of public and industrial activities; poorly known and controlled.

Gass, T. E., 1980, *To What Extent is Ground Water Contaminated?*, *Water Well Journal*, November 1980, p. 26-27.

Landa, Edward, 1980, *Isolation of Uranium Mill Tailings and Their Component Radionuclides from the Biosphere—Some Earth-Science Perspectives*: U.S. Geological Survey Circular 814, 31 p.

Pishdazdar, H. and Moghissi, A. A., 1980, *Hazardous Waste Sites in the United States: Nuclear and Chemical Waste Management*, v. 1, nos. 3 and 4, p. 161-309.

U.S. Council on Environmental Quality, 1981, *Contamination of Ground Water by Toxic Organic Chemicals*: 85 p.

U.S. Department of Energy, 1981, *Low-Level Radioactive Waste Policy Act Report—Response to Public Law 96-573*: DOE/NE-0015, 57 p.

—1981, *Spent Fuel and Radioactive Waste Inventories and Projections as of December 31, 1980*: DOE/NE-0017, 279 p.

U.S. Environmental Protection Agency, 1980, *Ground-Water Protection: a Water Quality Management Report*, 36 p.

Source: U.S. Geological Survey, 1982c, table 1.

Hazardous-Waste Hydrology Program

High-Level Nuclear Wastes

High-level nuclear wastes, which result from chemical processing of irradiated nuclear fuels, pose some of the most severe potential health hazards and complex technical problems. The Geological Survey conducted geohydrologic studies related to a variety of nuclear facilities and activities for many years through its former Office of Radiohydrology. Its program for identifying environments potentially suitable for repository sites was an outgrowth of a plan developed jointly with the U.S. Department of Energy, which has the responsibility for selecting, building, and operating the repositories. The Geological Survey's effort is aimed at assisting in solving the Nation's dilemma in selecting suitable sites for the storage of high-level radioactive waste.

Purpose:

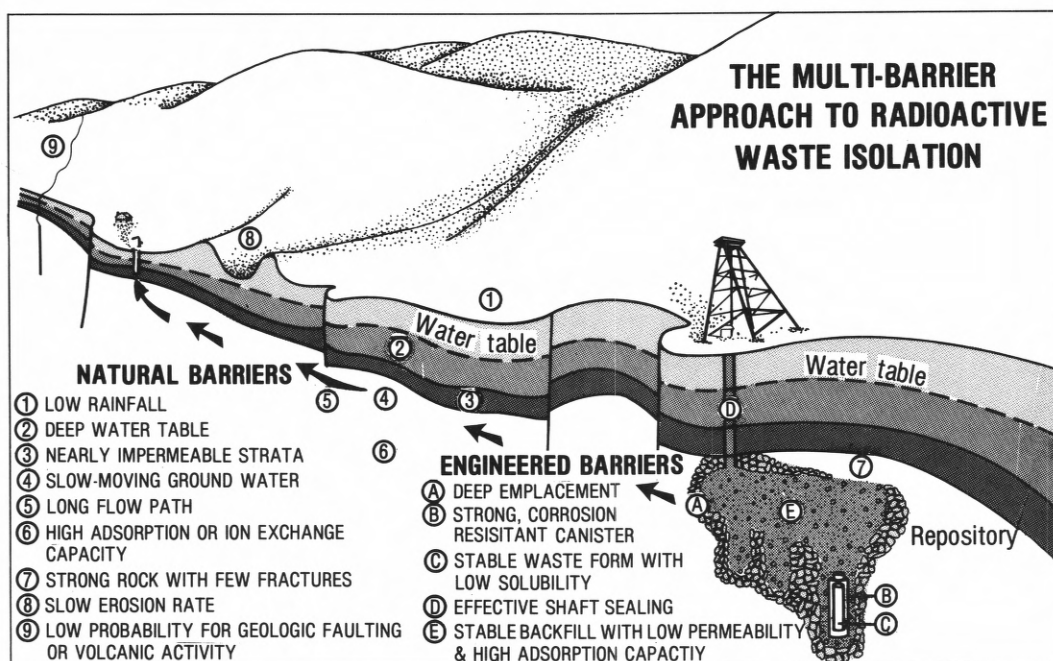
- Provide information from field and laboratory studies to identify and confirm alternative environments that will embody multiple natural barriers to the migration of waste from repository sites. (See illustration on facing page.)

Activities:

- Assist the U.S. Department of Energy in establishing repository-site selection criteria and selecting potential sites.
- Assist the Nuclear Regulatory Commission in developing regulations and in licensing repository sites.
- Conduct program of research on—
 - Geochemistry of plutonium and related isotopes in ground water.
 - Flow of fluids and radionuclides through porous and fractured materials.
 - Thermomechanical properties of rocks.
 - Development of methods to characterize hydrologic, geologic, and chemical properties of rock masses.
 - Characterization of long-term geologic processes and events that could disrupt potential repository sites.
- Screen large areas of the Nation to identify areas having favorable characteristics for locating potential waste-repository sites.

Accomplishments:

- Constructed facility in Colorado for testing and evaluating stress-measuring instruments to be used in determining mechanical properties of selected rocks.
- Conducted hydrologic investigations at the Nevada Test Site to define the rate and directions of ground-water movement.
- Developed the concept of waste disposal in arid unsaturated zones which has been adopted by the Department of Energy.
- Developed and implemented procedures for screening large regions of the country for areas having geohydrologic characteristics potentially suitable for waste-repository sites.
- Instrumental in selecting the Yucca Mountain location at the Nevada Test Site as a principal candidate site for a high-level waste repository.
- Played principal role in selecting and characterizing the Waste Isolation Pilot Program site in New Mexico for disposal of military waste in bedded salt deposits.



Source: Modified from U.S. Geological Survey exhibit panel W-195-80.

MULTIPLE NATURAL BARRIERS TO THE MIGRATION OF WASTE FROM REPOSITORY SITES

Hazardous-Waste Hydrology Program

Low-Level Nuclear Wastes

Low-level nuclear wastes result from a variety of activities, including university research programs, medical treatment, and electrical power generation. The radioactivity of low-level wastes is considerably less than that of high-level nuclear wastes associated with nuclear fuel. Thus, the standards for waste-repository sites are not as stringent as those for high-level nuclear wastes, but determining the selection of effective sites requires considerable study, particularly in the earth sciences.

Purpose:

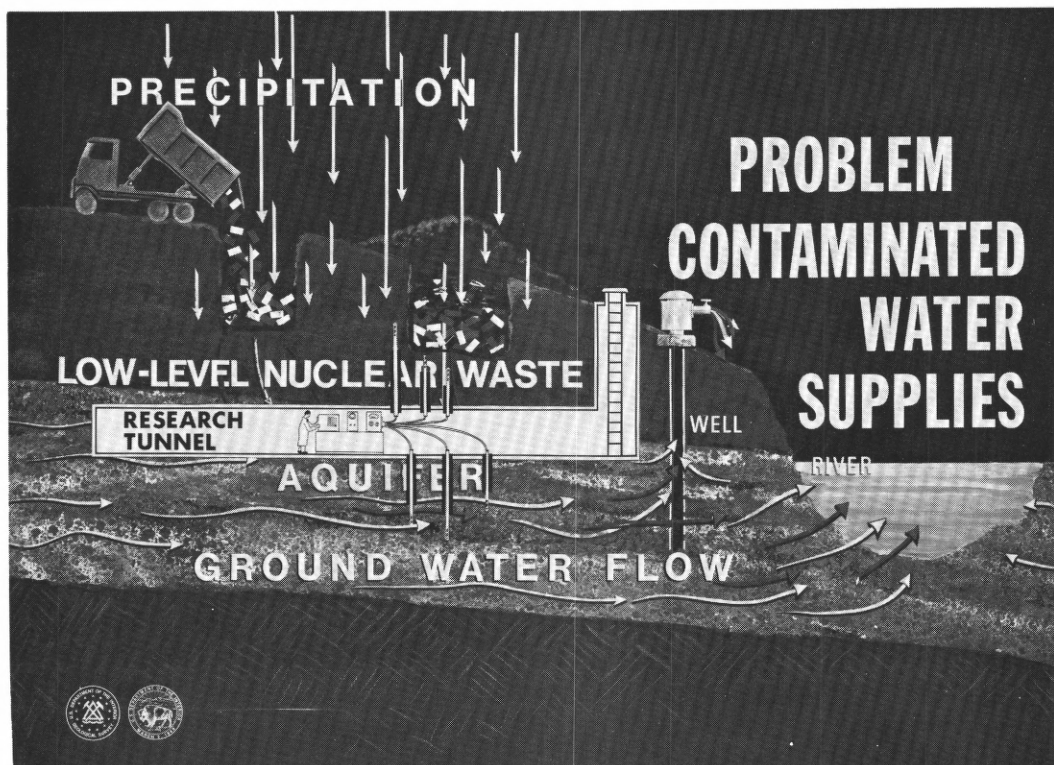
- Develop hydrologic guidelines that can be used to select and develop future sites for burial of low-level nuclear wastes, and to monitor and manage existing sites.

Activities:

- Conduct research and field investigations into processes controlling leaching and migration of radionuclides from existing shallow land-disposal sites.
- Develop techniques and guidelines for the selection and design of future sites and for determining remedial measures to be used at existing sites where site performance does not appear to be satisfactory.
- Assist other Federal and State agencies in developing and implementing effective low-level waste-management programs.

Accomplishments:

- Detailed field investigations were completed at six existing commercial low-level waste burial sites in New York, South Carolina, Kentucky, Illinois, and Nevada.
- Studies also were conducted at U.S. Department of Energy waste-disposal sites in Idaho, Tennessee, and Illinois.
- The usefulness of complex computer models to simulate movement of radionuclides in ground water was clearly demonstrated at the Idaho National Engineering Laboratory and documented in several reports.
- The major geologic and hydrologic problems associated with existing disposal sites for low-level wastes have been identified and described in reports.



Source: U.S. Geological Survey exhibit panel W-166-81.

RESEARCH EXPERIMENTS IN LOW-LEVEL NUCLEAR WASTE DISPOSAL

Hazardous-Waste Hydrology Program

Toxic-Chemical Wastes/Ground-Water Contamination

Public concern about nuclear wastes has been evident for years. Only recently has the public become concerned about the disposal of toxic-chemical wastes because of the increasing evidence of ground-water contamination. (See table on page 41 for comparison of estimated volumes of toxic wastes and nuclear wastes.)

Purpose:

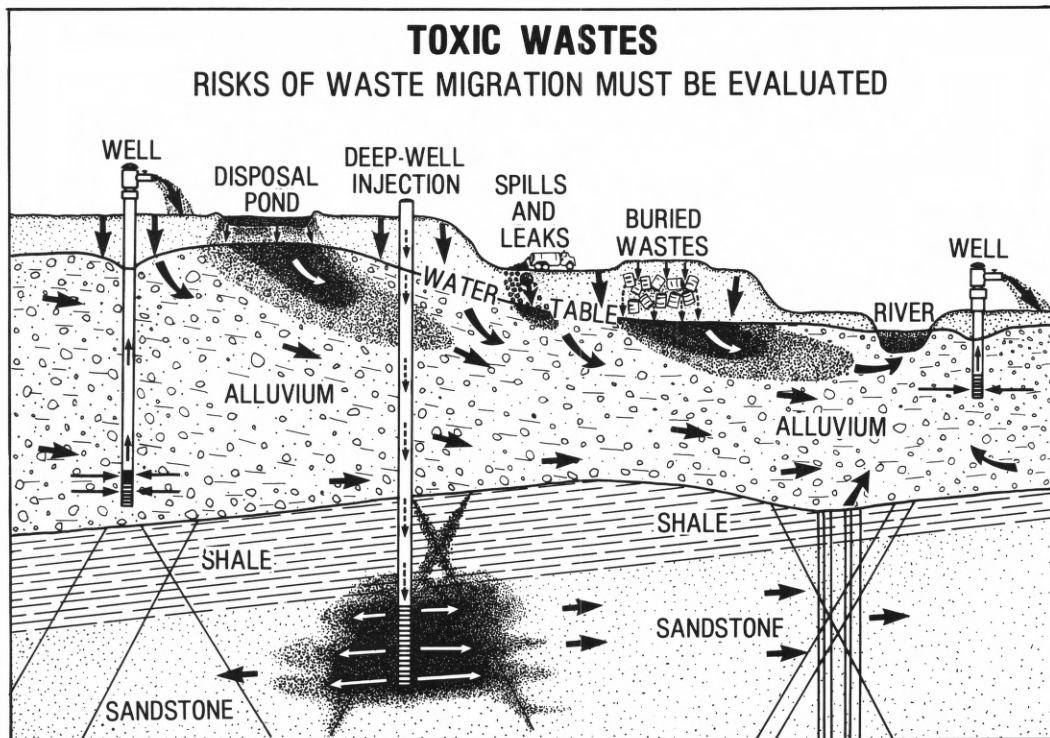
- Provide the scientific knowledge to improve the technology of land burial of toxic-chemical wastes and the procedures for alleviating conditions at those disposal sites that pose a threat to public health and safety. (See illustration on facing page.)

Activities:

- Conduct regional and national appraisals of ground-water quality.
- Conduct intensive interdisciplinary field research of selected disposal sites to characterize the most important earth-science processes affecting the fate of contaminants.
- Assist other Federal and State agencies in developing regulations and standards for managing disposal of hazardous waste.
- Conduct fundamental research into surface chemistry, biochemistry, and other chemical factors controlling the mobility and fate of organic substances in ground water.

Accomplishments:

- The Toxic Waste/Ground-Water Contamination Program began in 1982 and its efforts have been concentrated on developing new research studies in the behavior and fate of contaminants in ground water.
- Two ground-water contamination sites, one each in Florida and Minnesota, have been selected for intensive interdisciplinary field research on physical, chemical, and biological factors affecting the fate of organic contaminants in ground water.
- Projects were initiated in aqueous organic chemistry, biotransformation reaction in ground water, and other water-quality effects of microbes in ground water.
- Four appraisals of ground-water quality were completed in Kentucky, Wisconsin, Idaho, and Nevada. Four additional appraisals were started in Oregon, Montana, Wyoming, and Pennsylvania.



Source: Modified from U.S. Geological Survey exhibit panel W-211-81.

HAZARDOUS-WASTE STORAGE AND GROUND-WATER CONTAMINATION

Coal Hydrology Program

The Surface Mining Control and Reclamation Act of 1977, Public Law 95-87, increased the need for hydrologic information in coal-producing areas of the Nation on Federal and private lands. The Water Resources Division's Coal Hydrology Program is designed to help the appropriate Federal and State regulatory agencies plan and manage mining and reclamation operations. The Division also is providing hydrologic support for the Interior Department's program to lease Federal coal lands.

Purpose:

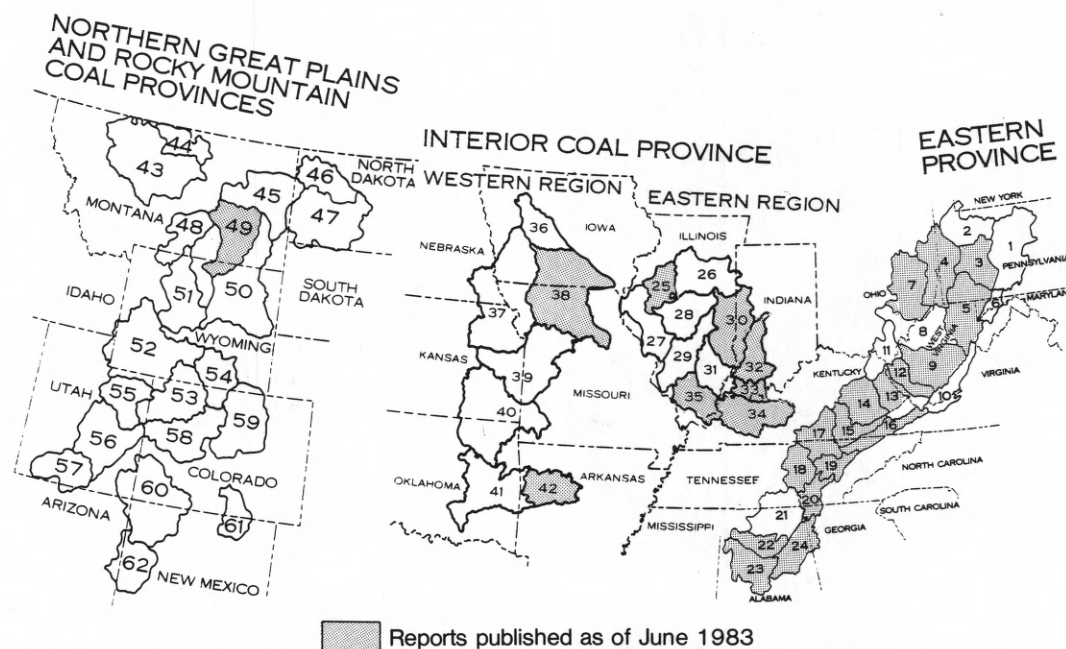
- Provide the water data and hydrologic information needed to evaluate the effects of mining and reclamation on streams and aquifers (see illustration on facing page) to aid in the leasing of Federal lands and permitting of coal mining nationwide.

Activities:

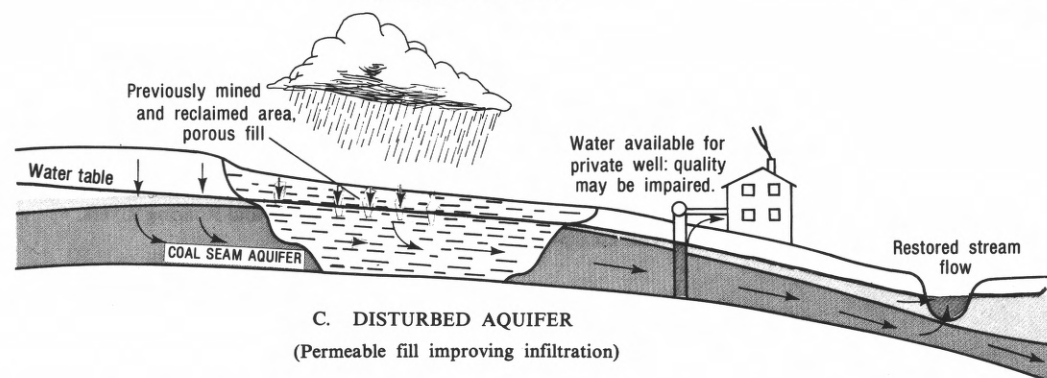
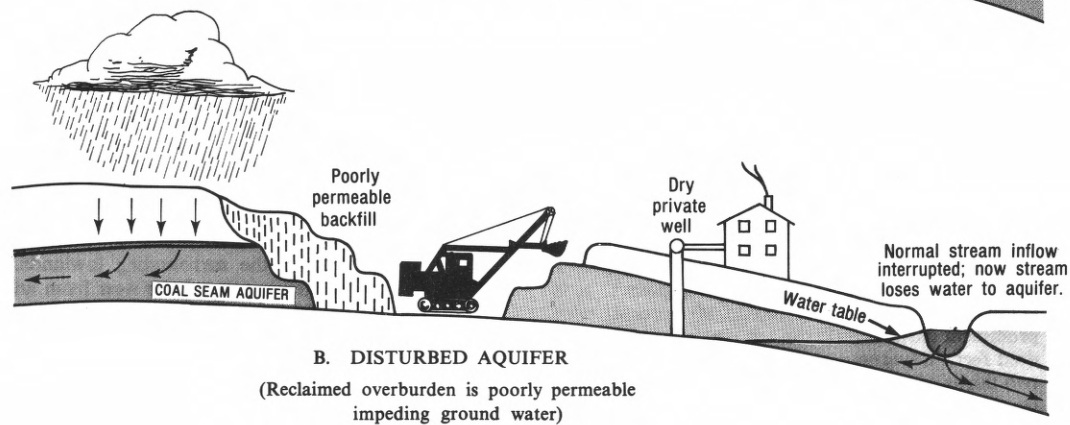
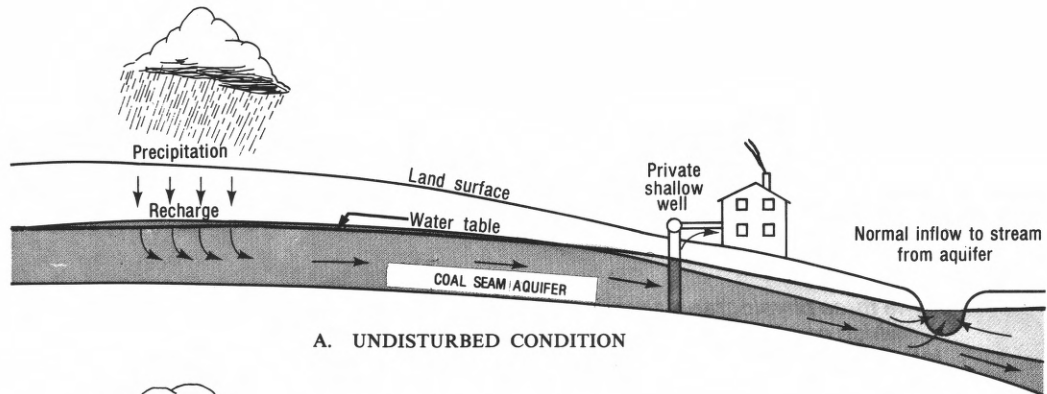
- Acquire and disseminate hydrologic information on existing and potential coal-mining areas.
- Upgrade hydrologic data networks and implement hydrologic studies in major coal areas.
- Improve techniques for interpreting hydrologic data and develop mathematical models for predicting effects of mining and reclamation.

Accomplishments:

- Published water-data indexes for the major coal provinces.
- A series of 62 reports that summarize pertinent hydrologic data in the Nation's principal coal areas has been planned. Twenty-six of these reports have been published as of June 1983. (See map below.)
- Expanded hydrologic data-collection networks for improved definition and characterization of regional hydrology.
- Developed predictive basin models to simulate the effects of various mining and land-use changes on the hydrologic system in several States.



LOCATION OF COAL PROVINCES AND AREAS FOR WHICH REPORTS
WILL BE PUBLISHED



Source: Harkins and others, 1981.

POSSIBLE EFFECTS OF SURFACE MINING ON AQUIFERS

Oil-Shale Hydrology Program

Water is a critical component to the development of oil-shale resources. The Water Resources Division is involved in defining available water supplies in oil-shale areas and in determining the effects of oil-shale development on water resources.

Purpose:

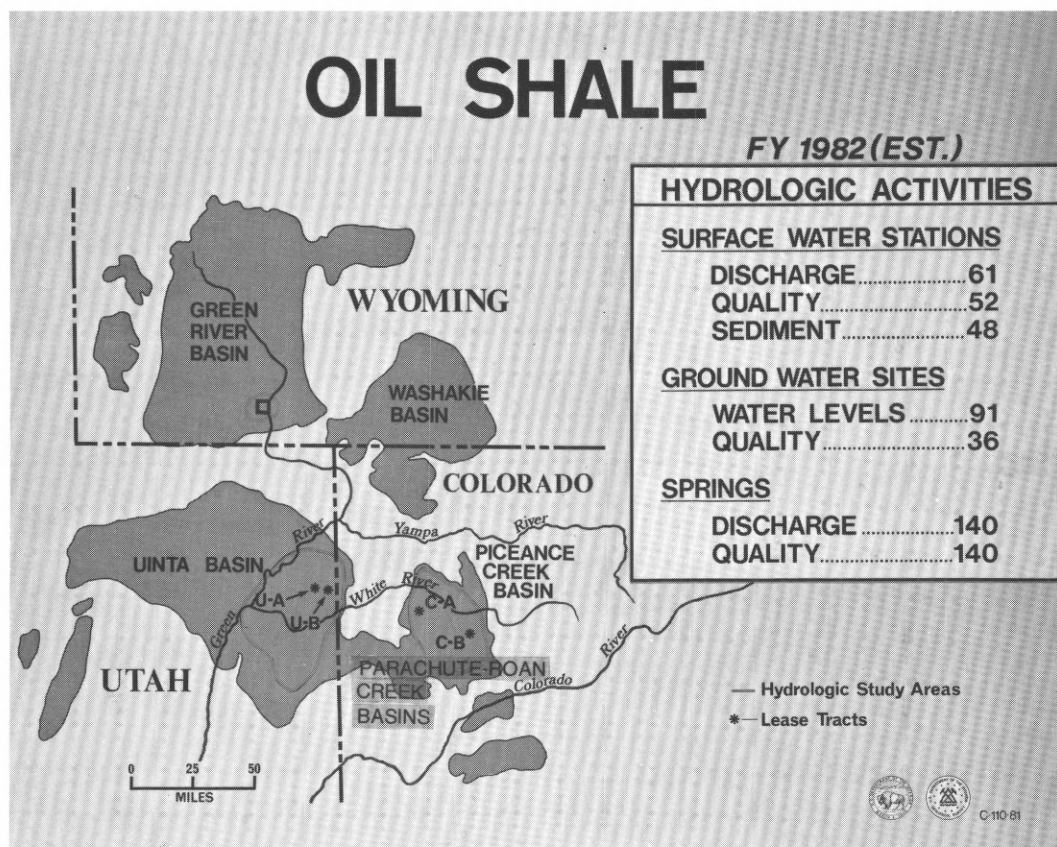
- Assess the water-supply availability for oil-shale development, and evaluate the long-term effects of oil-shale development on water quantity and quality in the oil-shale basins. (See illustration on facing page.)

Activities:

- Collect baseline data on the quantity and quality of surface and ground water in oil-shale areas.
- Develop the capability to predict the effects of both surface and underground mining on water resources.
- Develop the capability to predict the effects of both surface and *in situ* retorting of oil shale in water resources.
- Conduct hydrologic studies in the Piceance, Parachute-Roan Creek, Green River, and Uinta Basins, Colorado, Utah, and Wyoming. These studies include aquifer tests, mathematical models of the aquifer, and reaction of waste products in the surface- and ground-water system.

Accomplishments:

- Developed hydrologic models of the Piceance Creek in Colorado to predict effects of mining and retorting.
- Operated surface-water and ground-water monitoring networks in proximity to Federal oil-shale lease areas.
- Completed reports on following subjects:
 - Hydrology of the Piceance Creek Basin.
 - Ground-water and surface-water models of the oil-shale areas.
 - Sediment production and transport from the oil-shale areas.
 - Biology of Piceance Creek.
 - Chemistry of leachates from oil-shale pits.
 - Chemical effects of wastes from *in situ* retorts.
 - Acidification of lakes in the oil-shale areas.



Source: U.S. Geological Survey exhibit panel C-110-81.

ASSESSMENT OF AVAILABLE WATER FOR OIL-SHALE DEVELOPMENT

Regional Aquifer System Analysis Program

The Regional Aquifer System Analysis Program (RASA) is a systematic effort to study a number of regional ground-water systems that represent a significant part of the Nation's water supply. A regional aquifer system, as the term is used here, may be of two general types: (1) aquifers that are of regional extent, such as the Northern Great Plains, and (2) groups of aquifers that share so many characteristics that they can be studied together—for instance, the Southwestern Alluvial Basin. In general, the boundaries of these regional aquifer systems transcend political subdivisions that have limited hydrologic investigations in the past.

Purpose:

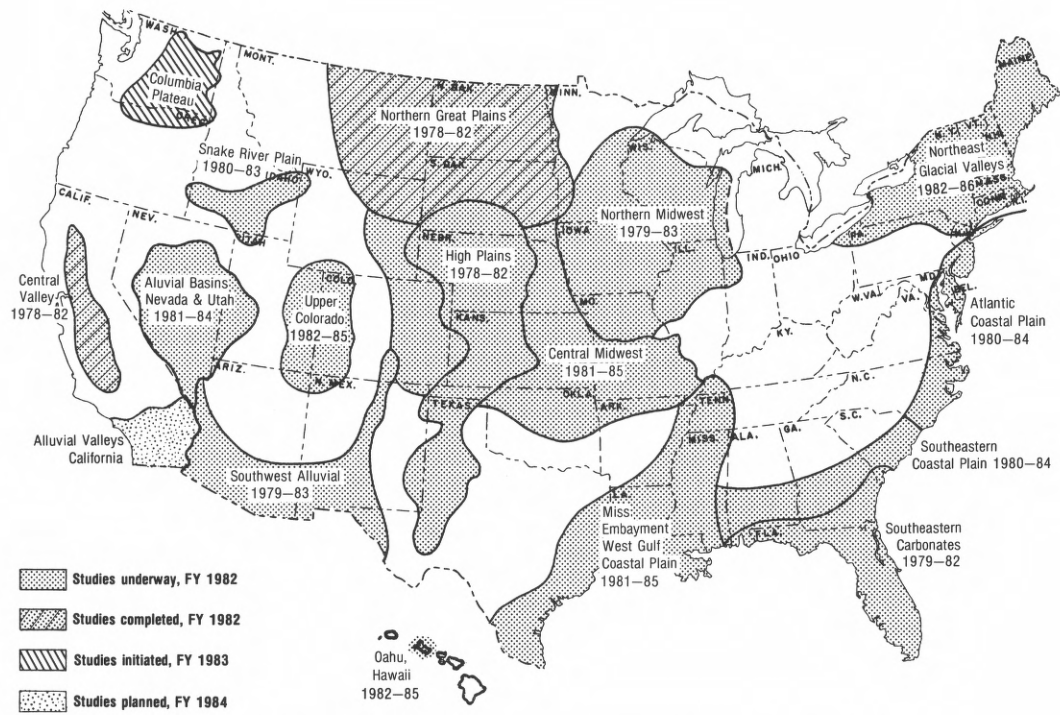
- Provide the basic information and criteria required to develop and manage ground-water supplies, particularly as a drought-resistant component of the total water supply.

Activities:

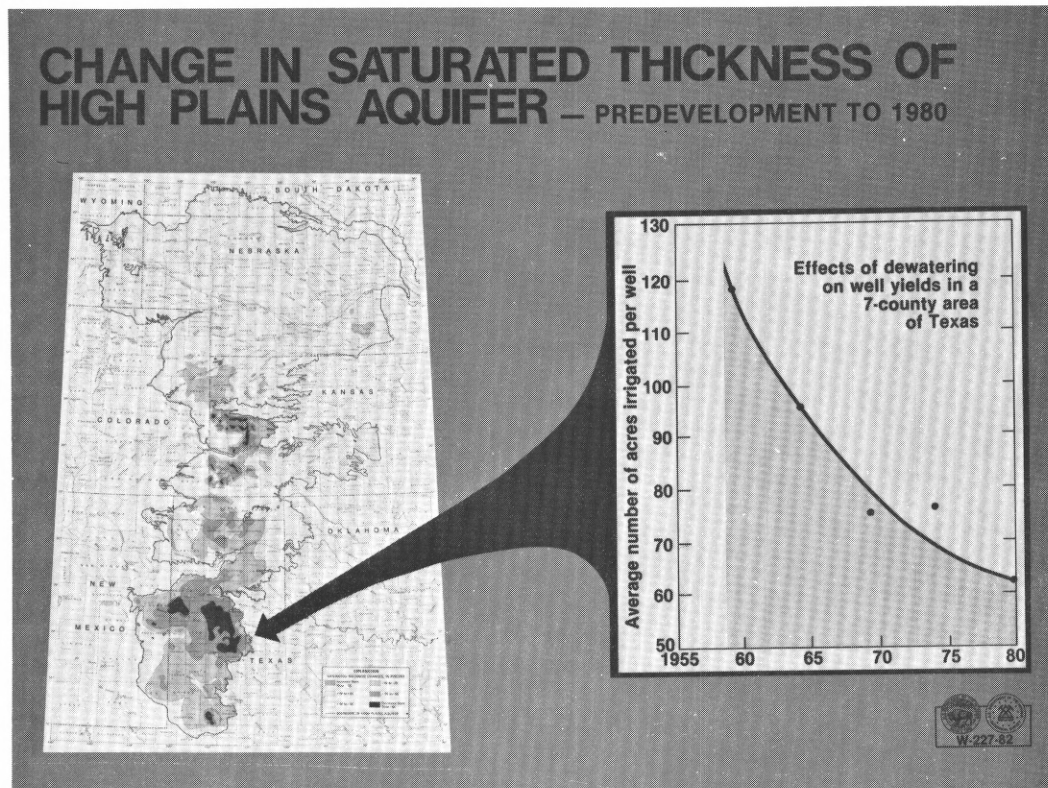
- Determine the availability and chemical quality of water stored in each aquifer system.
- Determine the discharge-recharge characteristics of each aquifer system.
- Determine the hydrogeologic and chemical controls that govern the response of aquifer systems to stress.
- Develop computer-simulation models for each aquifer to assist in understanding the ground-water-flow regime and the changes in this regime brought about by human activities, such as pumpage or artificial recharge.

Accomplishments:

- Twenty-eight systems were identified for possible study. As of March 1983, studies of two of those systems have been completed, two have been extended to encompass additional studies of special interest, 12 others are underway, and one is projected to start in 1984 (see illustration on facing page).
- The High Plains Aquifer study has mapped the volumes of ground water depleted from the aquifer by irrigation pumpage and has developed a ground-water model to test alternative strategies for mitigating effects of depletion. (See illustration on facing page.)
- The Southeastern Carbonate Aquifer study (Florida and Georgia) has determined that additional development of the aquifer is feasible, but that careful management will be needed to avoid encroachment of saline water.
- More than 100 information products describing the scientific findings of the studies have been published; about 75 reports are in progress.
- Calibrated flow-simulation models for the Northern Great Plains, Northern Midwest, California Central Valley, High Plains, and Southeastern Carbonates studies. Models for all other studies are under development.
- Developed maps that show the hydraulic and chemical characteristics of the ground-water system.
- Developed simulation models to predict the effects of future pumping.



REGIONAL AQUIFER SYSTEM ANALYSIS STUDIES



HIGH PLAINS AQUIFER STUDY

Acid Rain Program

The possible environmental effects of acid rain are in the public spotlight, and are of great concern because the problem is not yet fully understood. The Geological Survey's research and monitoring program in acid rain is coordinated through the Interagency Task Force on Acid Precipitation. The Water Resources Division chairs the Deposition Monitoring Task Group, one of nine task groups, and is a member of two other task groups (Aquatic and Terrestrial Effects). The possible effects of acid rain are shown in the illustrations on the facing page.

Purpose:

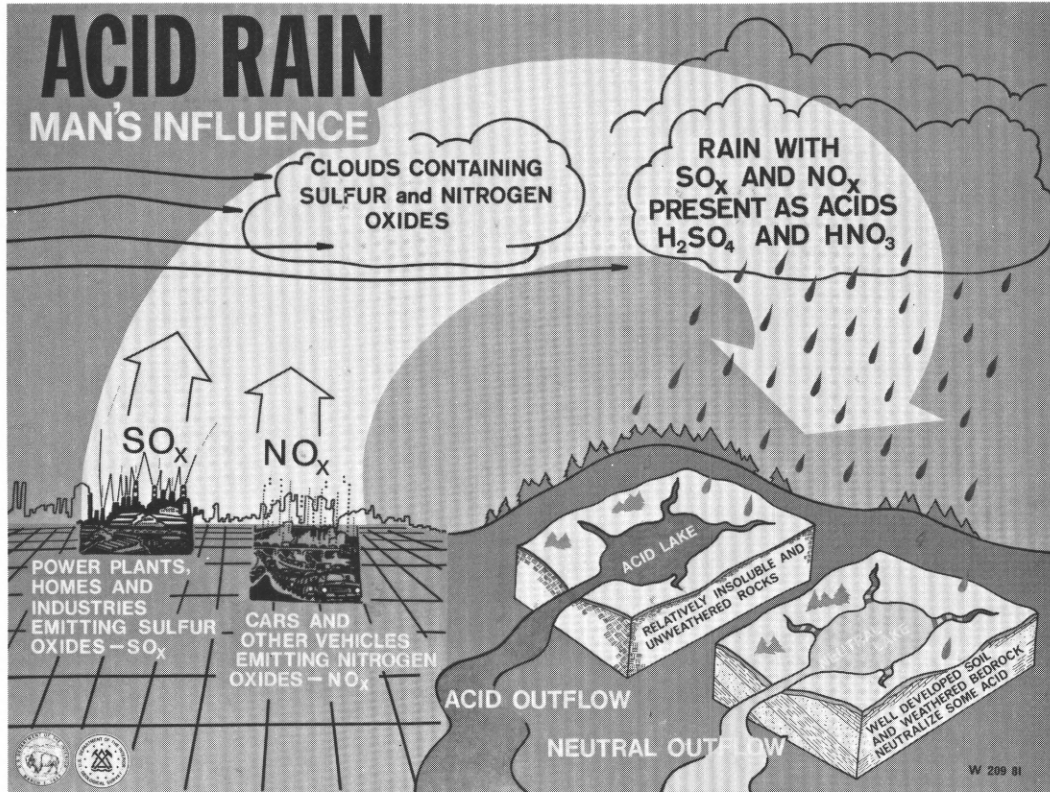
- Collect and interpret data to help formulate national policy decisions regarding control or abatement of acid rain.

Activities:

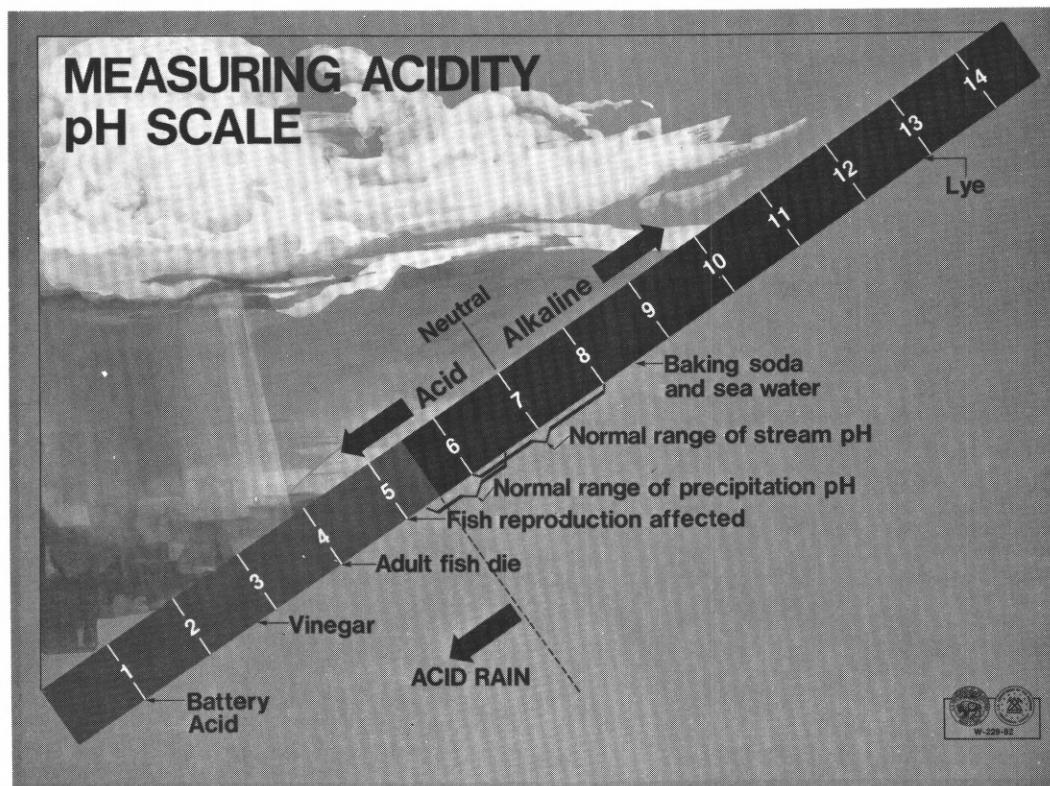
- Determine the effects of chemical composition of atmospheric deposition and its variability.
- Determine the effects of atmospheric deposition on soils and near-surface rocks.
- Determine the susceptibility of lakes, streams, and aquifers to increased acidification.
- Provide quality-assurance support for chemical analysis of atmospheric deposition.
- Predict, based upon information collected in this program, the effects of increased or decreased pollutants in rainfall on the characteristics of soils, rocks, and natural waters.
- Coordinate program with the Environmental Protection Agency, National Oceanic and Atmospheric Administration, Department of Agriculture, Department of Energy, Fish and Wildlife Service, and National Park Service.

Accomplishments:

- Designed and implemented a national network of stations for collection and analysis of atmospheric deposition.
- Completed statistical analyses of stream-quality data collected over the past decade at the Division's National Hydrologic Bench-Mark Program stations.
- Published an acid-rain report based on data collected from 1965 to 1978 at nine precipitation monitoring stations in New York.
- Assisted in identification of acid-sensitive streams and lakes.
- Conducted a reconnaissance of the chemical composition of snow in the northeast and northern midwest during the winter of 1980–81.
- Established several long-term research projects to determine the effects of acid rain on geochemical processes in aquatic and terrestrial environments.



Source: U.S. Geological Survey exhibit panel W-209-81.



Source: U.S. Geological Survey exhibit panel W-228-82.

Volcano-Hazards Program

The Geological Survey is the lead Federal agency for investigating volcano hazards. The Water Resources Division's role is to define the current and long-range effects of volcanic and seismic activities on water resources.

Purpose:

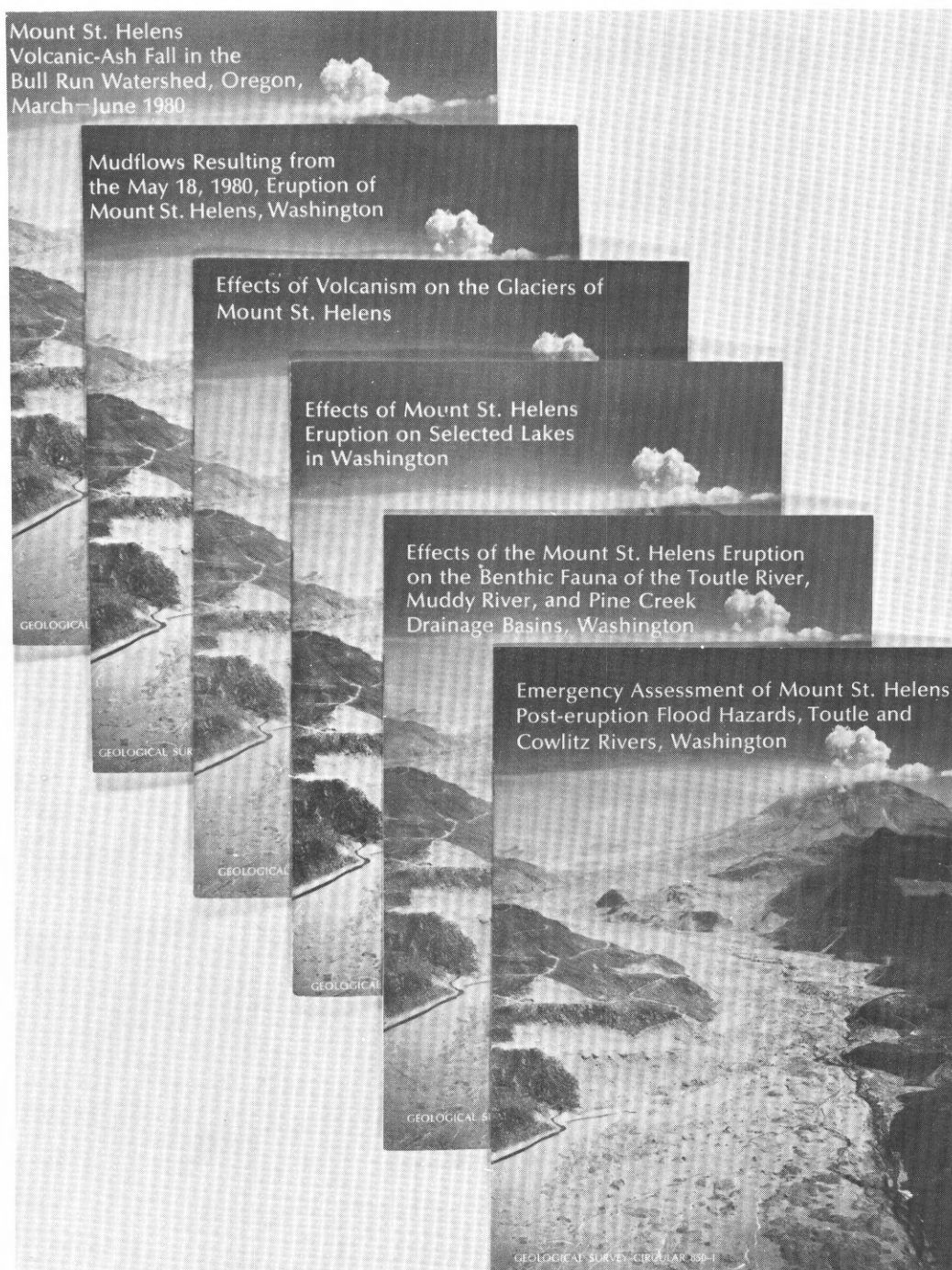
- Describe the nature and rates of processes involved in cataclysmic events, monitor potential volcano areas, provide hazard warnings, and develop information for resource planning and management.

Activities (Mount St. Helens):

- Maintain a flood-hazard and mudflow-warning system for the Toutle-Cowlitz and Lewis Rivers by use of a Geostationary Operational Environmental Satellite (GOES) platform.
- Conduct studies and develop mathematical models to describe floods, erosion, sediment transport, and mudflows.
- Determine the effects of ash deposition on the melting of glacial ice and snowfields.
- Determine the biological effects of mudflows and ashfalls on streams and lakes.
- Monitor and assess the stability of debris-dammed lakes.

Accomplishments:

- Installed a flood-hazard and mudflow-warning system in the Mount St. Helens area. The Spirit Lake debris dam and potential downstream flood hazard are monitored continuously.
- Published reports on the hydrologic effects of the Mount St. Helens eruption. (See illustration on facing page.)
- Contributed to publications released by other agencies and the private sector.
- Established a sediment laboratory at the Cascades Volcano Observatory.
- Completed plans for hydrologic reconnaissance studies at other volcanoes.



**U.S. GEOLOGICAL SURVEY PUBLICATIONS ON THE HYDROLOGIC
EFFECTS OF THE MOUNT ST. HELENS ERUPTION**

National Water-Resources Conditions Program

Federal and State agencies often are required to make assessments of the Nation's water resources to aid in formulating major water-policy decisions that involve river-basin development, water conservation, water allocation, and environmental protection. Although much information has been collected on the water resources of the United States, little has been done to organize the data in a way that aids analysis of current water issues.

To help improve understanding of the nature, geographic distribution, magnitude, and trends of the Nation's water resources and water issues, the Geological Survey established the National Water-Resources Conditions Program in 1981.

Purpose:

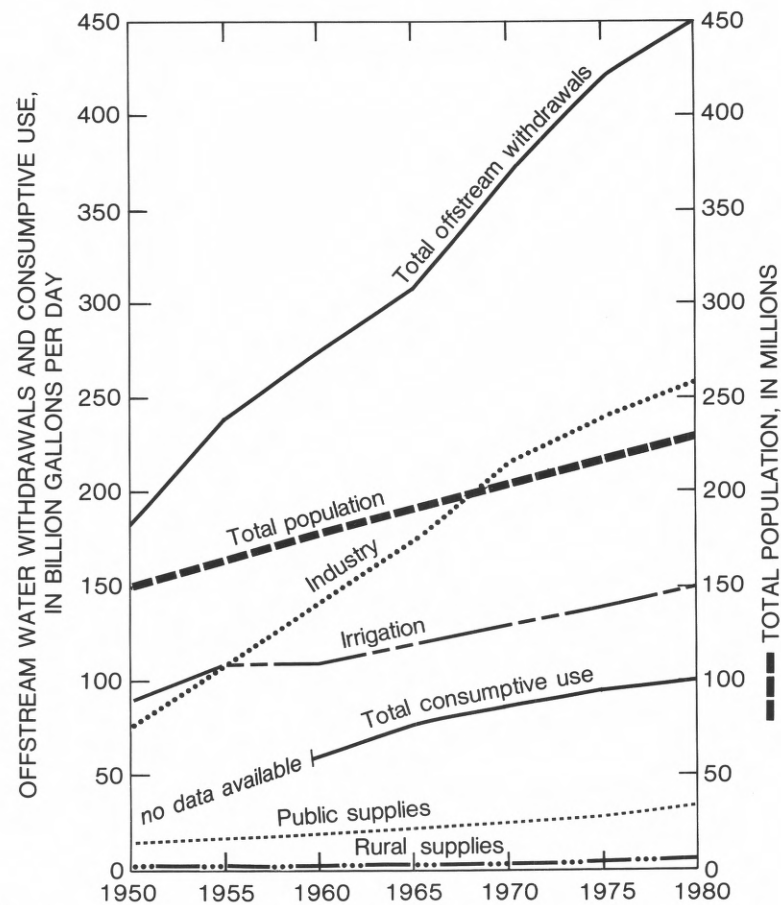
- Provide water-resources policymakers with information about the availability, quantity, quality, and use of water resources, and organize and summarize this information to portray the condition of the Nation's water resources to national, State, and local officials, and the public. (Illustrations on facing page shows how information can be presented.)

Activities:

- Develop and maintain a Water-Resources Information System to support the identification of water issues, the characterization of current water conditions, and the water-resources assessment activities of other agencies.
- Compile an inventory of water issues.
- Prepare a yearly national water summary on water-resources conditions and the nature and occurrence of water issues, beginning in the fall of 1983.
- Prepare special thematic publications such as a map showing the location of the Nation's dams and reservoirs, and detailed analyses of topical issues.
- Conduct research to improve techniques for summarizing water-resources conditions.

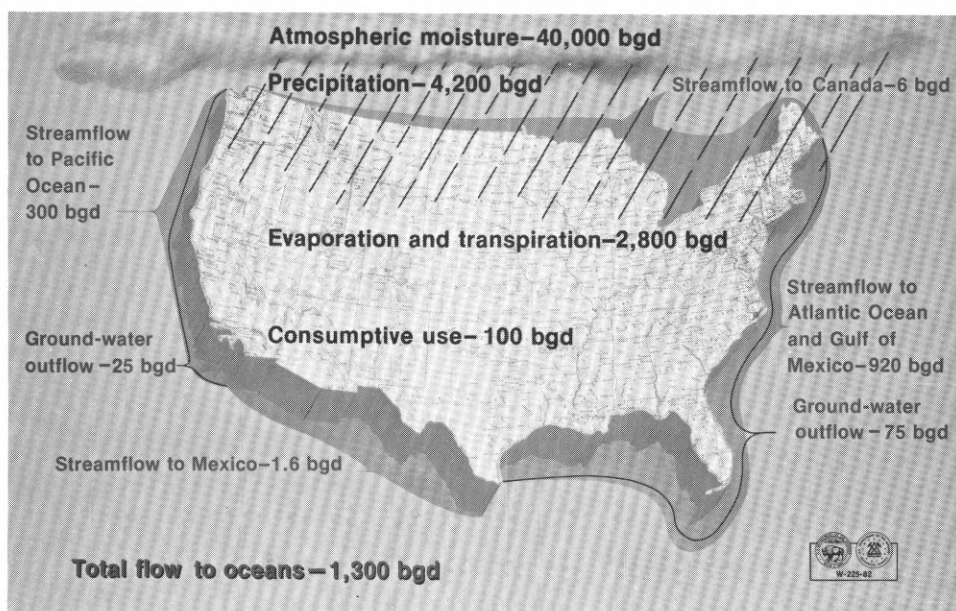
Benefits:

- Provide a uniform base of water information for use in formulating water policies and in conducting water-resources assessments.
- Provide a summary of current national, regional, and State water situations and trends.



Source: Solley and others, 1983.

TRENDS IN WATER USE AND POPULATION, 1950-80



Source: U.S. Geological Survey exhibit panel W-225-82

WATER BUDGET OF THE CONTERMINOUS UNITED STATES

Instrumentation Program

The Instrumentation Program was devised to assist investigations throughout the Division that require specialized hydrologic instrumentation and to increase the Division's ability to provide hydrologic data. The Hydrologic Instrumentation Facility at Bay St. Louis, Mississippi, and the Satellite Data Relay Project at Reston, Virginia, are major contributors to this program.

Purpose:

- Improve the Division's capability to provide hydrologic data, by improving the technology and instrumentation used in the collection and analysis of water-quantity and water-quality data.

Activities:

- Plan and develop hydrologic field instruments.
- Test and evaluate commercially available instrumentation.
- Supply and repair instrumentation.
- Test and evaluate the Geostationary Operational Environmental Satellite (GOES) and satellite telemetry for relay of hydrologic data.
- Assist the District and Research project offices of the Water Resources Division in planning and procuring GOES satellite receiving stations as part of the effort to distribute data collection and processing capabilities.

Accomplishments:

- Completed extensive tests of telemetry system on Landsat, GOES, and commercial satellites. At end of fiscal year 1982, data were being telemetered from 500 stream-gaging stations through GOES satellites, which include sites being instrumented and operated by other agencies using Geological Survey gaging stations.
- At end of fiscal year 1982, three GOES satellite receiving stations were in operation and three additional stations were scheduled for operation in early 1983.
- Established the Hydrologic Instrumentation Facility (HIF) in 1980 to improve the planning, development, repair, and supply of hydrologic instruments. (See illustration on facing page.)
- Installed the hydrologic-data real-time computer-processing system (Hydrecs) to receive data collected by GOES.
- Developed specifications for an improved and standardized field data-acquisition system known as Adaptable Hydrologic Data Acquisition System (AHDAS).
- Developed and installed 40 urban-hydrology monitoring systems.
- Completed tests of new technology for measuring streamflow, water quality, and water use.



HYDROLOGIC INSTRUMENTATION FACILITY LAYOUT



**HYDROLOGIC INSTRUMENTATION FACILITY
U.S. GEOLOGICAL SURVEY, GULF COAST HYDROSCIENCE CENTER,
MISSISSIPPI**

National Water-Quality Laboratories

The Water Resources Division maintains two national water-quality laboratories: one at Arvada (Denver area), Colorado, and the other at Doraville (Atlanta area), Georgia. The Denver laboratory probably is the largest facility of its kind in the world. The major responsibility of these laboratories is to perform chemical, biological, radiochemical, and stable-isotope analysis of water and streambed material. The activities of the laboratories are coordinated by an Analytical Services Coordinator at the Division's Headquarters. Analytical results are stored automatically in WATSTORE (see page 30). Both laboratories perform services that meet the needs of the Federal Program, the Federal-State Cooperative Program, and the Division's National Research Program. Together, the laboratories analyze more than 84,000 water samples each year, and, since 1976, have made about 6 million analytical measurements. The laboratories also are the centers for the development of and research into analytical methods needed to enhance laboratory capabilities.

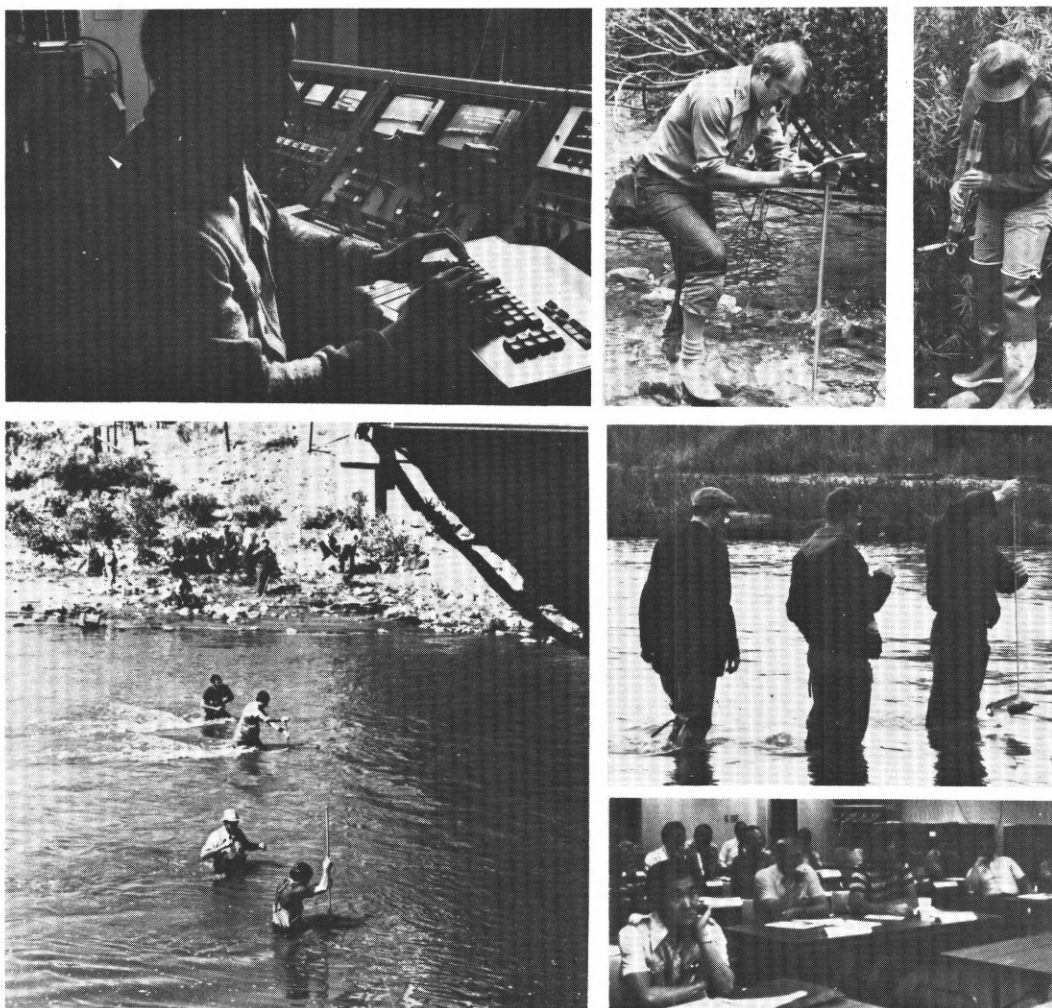


**U.S. GEOLOGICAL SURVEY NATIONAL WATER QUALITY
LABORATORY, ARVADA, COLORADO**

National Training Center

The U.S. Geological Survey's National Training Center was established in 1977 at the Denver Federal Center, Lakewood, Colorado. The training center is used by the entire Geological Survey to transfer earth-science information to its personnel. Training also is provided to personnel from other Federal, State, and local agencies, and to foreign scientists and water managers. This center is an expansion of a previous Water Resources Division training program, and the Division continues to administer the training center for the Geological Survey.

The training center has classrooms, video-tape and closed-circuit television systems, and computer and laboratory equipment. Special methods and techniques are taught to aid in developing the expertise required to understand and efficiently perform hydrologic investigations.



TRAINING HYDROLOGISTS

Dissemination of Data and Information

The Water Resources Division of the Geological Survey is the Nation's lead agency in water-data collection and dissemination of information on water resources, primarily because of the Division's ability to make water data and information readily available to water managers, policymakers, the scientific community, and the public in formats that meet their needs, and to release this information equally to all interested parties.

The Geological Survey has been publishing and releasing the results of its studies for more than 100 years. The information is multipurpose and, after its immediate need, 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 two computerized systems, WATSTORE and NAWDEX, explained earlier in this report.

A description of these publications series and the type of information presented in them is given below. Examples of these series and the number of reports released during the period 1975 to 1982 are shown on the facing page.

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 multidiscipline scientific audiences.

Bulletin—Significant interpretive results of geologic investigations of broad interest.

Circular—Short summaries of topical investigations that are of popular interest.

Techniques of Water-Resources Investigation—Documentation of methods and techniques used in collecting, analyzing, and processing hydrologic data for water-resources-oriented audiences.

Water-Resources Investigations Report—Comprehensive or topical reports and interpretive maps 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.

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

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.

Water-Resources Investigations in (State) folder—Pamphlet series that documents the Division's current programs in the 50 States, Puerto Rico, Virgin Islands, and the Trust Territories.

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

Geological Survey Research—Summaries of water-resources research in progress and results of recent investigations that are summarized each year for multidisciplinary audiences.

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 two catalogs—"Publications of the Geological Survey, 1879–1961" and "Publications of the Geological Survey, 1962–70,"—and in yearly supplements to these catalogs for 1971 through 1982. As new publications are released, they are announced in a monthly list, "New Publications of the Geological Survey."

All these publications are available from a variety of sources, and information on how to obtain the various publications is given in Geological Survey Circular 777 (Clarke and others, 1982).

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.

In late 1982, the Water Resources Division initiated a Distributed Information System, which will be a network of minicomputers located in all the Division's District and Research project offices. As the program proceeds through the 1980's, hydrologic data will be processed and analyzed at distributed computers in the Geological Survey field offices and in microprocessors at gaging stations, rather than at the centralized computers at the Geological Survey's National Center in Reston, Virginia. The advantage of a distributed information system is that users can gain immediate access to specific data for their area and use them to make sound water-management and water-planning decisions.

**NUMBER OF REPORTS APPROVED FOR RELEASE OR PUBLICATION BY
THE WATER RESOURCES DIVISION**

[Basic-data reports, bridge-site reports, HUD-flood insurance reports, Water-Data Reports, and
the series of 51 State water-resources investigations folders are not included]

Type of report	Number of approved reports							
	1975	1976	1977	1978	1979	1980	1981	1982
Water-Supply Papers	27	11	17	7	12	32	28	13
Professional Papers	17	18	13	24	13	9	10	12
Bulletins	0	0	0	1	1	2	0	1
Circulars	5	5	6	6	4	7	10	3
Techniques of Water-Resources Investigations	1	3	0	4	1	3	2	3
Water-Resources Investigations Reports	57	135	137	144	150	227	200	222
Open-file book and map reports	152	264	204	219	163	179	171	275
Map series	58	28	21	30	23	35	12	13
Outside publications (includes State publications, journal articles, abstracts, and other related items)	396	464	543	658	501	477	474	599
Journal of Research articles ¹	15	38	19	13	....	....	....	....
Miscellaneous reports	0	0	0	0	0	15	0	0
Administrative releases	24	24	23	12	9	13	3	10
Flood-prone area mapping project: Maps	1,210	451	171	103	285	222	129	173
Pamphlets ²	330	57	....	....	....	....	....	....
Total (exclusive of flood-prone area maps and pamphlets)	752	990	983	1,118	877	999	910	1,151

¹ The journal was discontinued in 1979.

² The pamphlet project was completed in 1976.



EXAMPLES OF U.S. GEOLOGICAL SURVEY PUBLICATIONS

SUMMARY AND ACCOMPLISHMENTS

Effective management of water resources requires that up-to-date scientific hydrologic information be readily available to planners and managers. The U.S. Geological Survey has the principal responsibility within the Federal government for providing hydrologic data and appraising water resources to help evaluate water problems. The Geological Survey's mission is to present impartial, accurate data and scientific analysis, and to release the information to all parties on equal terms.

The Water Resources Division provides technical support to the missions of other Federal agencies, participates in joint-funding agreements with State and local agencies, and contributes significantly to national and international efforts in hydrology. In this way, the Division keeps abreast of water-information needs at all levels of government and is able to develop programs that are responsive to these needs.

The Division's programs are funded by: (1) direct appropriation by Congress for Federal programs, (2) direct congressional appropriations for the Division's 50-percent share of the Federal-State cooperative program, (3) reimbursement by other Federal agencies, and (4) unmatched reimbursable funds from State and local agencies.

The total funds of the Water Resources Division in fiscal year 1982 amounted to less than \$200 million. Although the Division has only 5 percent of the total funds spent by the Federal government on water-resources programs, it has been extremely successful in carrying out its mission due to:

- An impartial scientific approach to describing hydrologic problems and collecting, analyzing, and interpreting hydrologic data.
- A strong field organization and staff of skilled scientists.
- Cooperative programs with more than 800 State and local agencies.
- Capabilities for conducting scientific research on critical water-resources problems.
- Continuous modification of programs as data needs and water-related problems change.
- Simultaneous release of findings to all interested parties.
- Credibility among the water-resources community.

The programs of the Division are of three types: data collection and dissemination, problem-oriented water-resources appraisals, and research. In this report, the programs are classified as long-term programs, topical programs, and technical-assistance programs. A selected list of accomplishments of these programs and the information-dissemination activity is given below. More information on the Division's programs and accomplishments can be obtained by referring to the reports given in "Selected References" or by contacting the appropriate key personnel listed at the end of this report.

Long-Term Programs

- National Water-Data Exchange (NAWDEx) was developed to serve as the focal point for indexing and providing access to a diversified water data base nationwide, thus reducing time, effort, and expense to its users.
- National Water-Data Storage and Retrieval System (WATSTORE) was expanded and automated to improve direct user access to its data files. It is the largest hydrologic-data system in the world, providing more than half of the Nation's water data and information base.
- National Water-Use Information Program, a cooperative State and Federal program, is in operation in 47 States and Puerto Rico. Research has started on methods and instrumentation for acquiring water-use data. The National Water-Use Data System (NWUDS) was established as a computerized system to store aggregated data about the amount of withdrawal, return flow,

and use of water. Several State Water-Use Data Systems have been installed. The report "Estimated Use of Water in the United States in 1980," Circular 1001, was published.

- A mathematical model of the Columbia Glacier indicates that the glacier is on the verge of a major retreat. The retreat will move the forward edge of the glacier from its present position over a shallow shoal into deeper water, which could cause an increased number of large icebergs in oil-tanker shipping lanes.
- A research study of the Potomac River Estuary in the Washington, D.C., area, revealed that nitrogen from bottom sediment sources can exceed the amount discharged from sewage-treatment plants during the critical low-flow–high-temperature summer season.
- Simulation methods for predicting the magnitude of flooding from dam breaks were developed.
- National Stream Quality Accounting Network (NASQAN) was completed to provide a national river-quality data base suitable for examining conditions and trends in river-water quality.
- National Handbook of Recommended Methods for Water-Data Acquisition was developed to improve the comparability and usability of data collected by all water-resources agencies in the United States. The Handbook is a product of interagency cooperation among more than 25 Federal agencies and is coordinated with the non-Federal sector through the Advisory Committee on Water Data for Public Use.
- A hydrologic unit map of the United States and individual State hydrologic unit maps were published.

Topical Programs

- Regional Aquifer Systems Analysis (RASA) Program began studies of regional ground-water systems that collectively account for a significant part of the Nation's water supply. These studies are designed to determine the flow patterns and chemical quality of ground water under natural conditions; the hydrologic effects of pumping, waste disposal, and other human activities; and the potential for and results of further water-resources development.
- Coal hydrology reports are being prepared for 62 surface-mining areas in the Eastern, Interior, Rocky Mountain, and Northern Great Plains Coal Provinces.
- The ground-water system of the oil-shale-rich Piceance Creek basin was mathematically modeled to help analyze the availability of ground water for mining operations and the effects of oil-shale mining on the hydrologic system.
- Ground-water recharge studies under experimental field conditions have demonstrated that artificial recharge is technically feasible in the southern High Plains, an area where ground-water withdrawals far exceed natural recharge.
- Landsat imagery has proven useful for delineating irrigated acreage and enables a quicker and more accurate determination of irrigation water use.
- The management of low-level radioactive waste disposal was improved by the application of geo-hydrologic principles.
- River-quality assessments were completed for five basins, and the technology was made available for use at the local levels.
- Hydrologic events associated with the Mount St. Helens volcanic eruption were documented in U.S. Geological Survey Circular 850.
- Flood hazard maps and flood-potential studies were prepared to assist in flood-plain management.

Technical-Assistance Programs

- A centralized laboratory system was established to improve the Division's ability to analyze the physical, chemical, and biological properties of water.
- Real-time collection of water data using satellites has increased from 40 to 350 sites.

- The Hydrologic Instrumentation Facility was established in 1980 to provide effective and efficient planning and management of the supply, repair, and performance of hydrologic instruments. Application of new technology has led to development of improved sensors for measuring of water quality.

Dissemination of data and information

- In 1982, information was made available through 1,151 reports.
- Installation was begun on a network of minicomputers at Water Resources Division field offices to increase the timeliness of the hydrologic data and to improve the information provided to users of water data.

Users of the information released by the Geological Survey's Water resources Division include:

- Legislative bodies and associated committees.
- Courts.
- Other Federal agencies.
- State, regional, and local agencies.
- Water-management, irrigation, drainage, and conservation districts.
- Public-interest groups, universities, and consultants.
- Industry and the public.

The accomplishments listed throughout this report and highlighted above reflect the trends in water-resources issues and needs at the beginning of the 1980's. The remainder of this decade will bring new programs, new techniques, and new data.

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Associate Chief Hydrologist.	Russell H. Langford	6921	408
Program Officer	Francis B. Sessums	6992	406A
Office of International Hydrology, Chief	Della Laura	6547	470
Office of Water Data Coordination, Chief.	Porter E. Ward	6931	417
National Water-Resources Conditions Program, Chief.	David W. Moody	6925	409
Assistant Chief Hydrologist for Operations.	Thomas J. Buchanan	6801	441
Deputy Assistant Chief for Operations.	Bruce K. Gilbert	6801	441
Finance and Fiscal Analysis Section, Chief.	Clara L. Chambliss	6813	443
Operation Section, Chief.	Alberto Condes	6861	405
Manpower Section, Chief	Jerry C. Stephens	6944	406
Planning Section, Chief.	George E. Williams	6941	404
Instrumentation Group, Chief	Richard W. Paulson	6014	460
Assistant Chief Hydrologist for Research and Technical Coordination	Gordon D. Bennett	6971	414
Deputy Assistant Chief Hydrologist for Research and Technical Coordination.	Roger G. Wolff	6971	413
Ground Water Branch, Chief	Eugene P. Patten, Jr.	6904	411
Quality of Water Branch, Chief	R. J. Pickering	6834	412
Surface Water Branch, Chief	Marshall E. Moss	6837	415
Office of Hazardous Waste Hydrology, Chief	John B. Robertson	6976	410
Coal and Oil-Shale Hydrology, Coordinator	Solomon M. Lang	6846	407
Systems Analysis Group, Chief.	Robert M. Hirsch	6927	410
Assistant Chief Hydrologist for Scientific Publications and Data Management	James E. Biesecker	6878	440
Deputy Assistant Chief Hydrologist for Scientific Publications and Data Management.	John E. Moore	6878	440
Office of Scientific Information, Chief	John E. Moore	6878	440
National Water-Use Information Program, Manager	William B. Mann IV	6878	440
Scientific Publications Program, Chief	Eugene R. Hampton	6881	439
Office of Computer Technology, Chief	J. Ronald Jones	6877	440
National Water-Data Storage and Retrieval System, Chief	Charles R. Showen	6871	437
Branch of Water Information Transfer, Manager	Gary D. Cobb	6031	421
National Water Data Exchange, Manager	Melvin D. Edwards	6031	421
Water Resources Scientific Information Center, Manager.	Raymond A. Jensen	7455	423
Environmental Affairs Program, Chief (Acting).	Richard A. Watkins	7455	423
Information Transfer Program, Manager.	Kenneth H. Suter	6867	421

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Northeastern Region

Connecticut, Delaware, Illinois, Indiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia, Washington, D. C., West Virginia, Wisconsin

OFFICE OF THE REGIONAL HYDROLOGIST

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Office hours: 7:45 a.m. to 4:15 p.m. Eastern Time

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DISTRICT OF COLUMBIA *See* Maryland

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District Chief, WRD
U.S. Geological Survey
6023 Guion Road, Suite 201
Indianapolis, IN 46254

INDIANA—Continued

Telephone: (317) 927-8640; FTS 336-8640

Office hours: 7:45 a.m. to 4:15 p.m. Eastern Time

MAINE *See also* Massachusetts

Address:

Hydrologist-in-Charge
Maine Office, WRD
U.S. Geological Survey
26 Ganneston Drive
Augusta, ME 04330

Telephone: (207) 622-8208; FTS 833-6208

Office hours: 7:45 a.m. to 4:15 p.m. Eastern Time

MARYLAND Mid-Atlantic District (Delaware, Maryland, Virginia, Washington, D. C.,)

Address:

District Chief, WRD
U.S. Geological Survey
208 Carroll Bldg.
8600 La Salle Road
Towson, MD 21204

Telephone: (301) 828-1535; FTS 922-7872

Office hours: 7:45 a.m. to 4:15 p.m. Eastern Time

MASSACHUSETTS New England District (Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island, and Vermont)

Address:

District Chief, WRD
U.S. Geological Survey
150 Causeway Street, Suite 1309
Boston, MA 02114

Telephone: (617) 223-2822; FTS 223-2822

Office hours: 8:30 a.m. to 5:00 p.m. Eastern Time

MICHIGAN

Address:

District Chief, WRD
U.S. Geological Survey
6520 Mercantile Way, Suite 5
Lansing, MI 48910

MICHIGAN—Continued

Telephone: (517) 377-1608; FTS 374-1608

Office hours: 7:45 a.m. to 4:15 p.m. Eastern Time

MINNESOTA

Address:

District Chief, WRD
U.S. Geological Survey
Post Office Bldg., Rm. 702
St. Paul, MN 55101

Telephone: (612) 725-7841; FTS 725-7841

Office hours: 7:45 a.m. to 4:30 p.m. Central Time

NEW HAMPSHIRE *See also* Massachusetts

Mailing address:

Hydrologist-in-Charge
New Hampshire Office, WRD
U.S. Geological Survey
525 Clinton St., RFD 2
Bow, NH 03301

Office address:

525 Clinton St., NH RT 13
Bow, NH 03301

Telephone: (603) 225-4681; FTS 834-4611

Office hours: 7:45 a.m. to 4:15 p.m. Eastern Time

NEW JERSEY

Address:

District Chief, WRD
U.S. Geological Survey
Room 430, Federal Building
402 East State Street
Trenton, NJ 08608

Telephone: (609) 989-2162; FTS 483-2162

Office hours: 7:45 a.m. to 4:15 p.m. Eastern Time

NEW YORK

Mailing address:

District Chief, WRD
U.S. Geological Survey
P.O. Box 1350
Albany, NY 12201

Office address:

U.S. Post Office and Courthouse, Rm. 343
Albany, NY 12201

Telephone: (518) 472-3107; FTS 562-3107

Office hours: 7:45 a.m. to 4:30 p.m. Eastern Time

OHIO

Address:

District Chief, WRD
U.S. Geological Survey
975 West Third Avenue
Columbus, OH 43212

Telephone: (614) 469-5553; FTS 943-5553

Office hours: 7:45 a.m. to 4:30 p.m. Eastern Time

PENNSYLVANIA

Mailing address:

District Chief, WRD
U.S. Geological Survey
P.O. Box 1107
Harrisburg, PA 17108

Office address:

Federal Bldg., 4th Floor
228 Walnut Street
Harrisburg, PA 17108

Telephone: (717) 782-4514; FTS 590-4514

Office hours: 8:00 a.m. to 4:30 p.m. Eastern Time

RHODE ISLAND *See also* Massachusetts

Address:

Hydrologist-in-Charge
Rhode Island Office, WRD
U.S. Geological Survey
John O. Pastore Federal Bldg. & U.S. Post Office,
Rm. 224
Providence, RI 02903

Telephone: (401) 528-4655; FTS 838-4655

Office hours: 8:00 a.m. to 4:30 p.m. Eastern Time

VERMONT *See* Massachusetts

VIRGINIA *See also* Maryland

Address:

Hydrologist-in-Charge
Virginia Office, WRD
U.S. Geological Survey
200 West Grace Street, Rm. 304
Richmond, VA 23220

Telephone: (804) 771-2427; FTS 925-2427

Office hours: 8:00 a.m. to 4:45 p.m. Eastern Time

WEST VIRGINIA

Address:

District Chief, WRD
U.S. Geological Survey
Federal Bldg. and U.S. Courthouse, Rm. 3416
500 Quarrier Street, East
Charleston, WV 25301

Telephone: (304) 347-5130; FTS 930-5132

Office hours: 7:45 a.m. to 4:30 p.m. Eastern Time

WISCONSIN

Address:

District Chief, WRD
U.S. Geological Survey
1815 University Avenue
Madison, WI 53705

Telephone: (608) 262-2488; FTS 262-2488

Office hours: 8:00 a.m. to 4:30 p.m. Central Time

Southeastern Region

Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Puerto Rico, South Carolina, Tennessee, Virgin Islands

OFFICE OF THE REGIONAL HYDROLOGIST

Address:

Regional Hydrologist
U.S. Geological Survey
Richard B. Russell Federal Bldg.
75 Spring Street, SW, Rm. 772
Atlanta, GA 30303

Telephone: (404) 221-5174; FTS 242-5174

Office hours: 7:30 a.m. to 4:15 p.m. Eastern Time

DISTRICT OFFICES

ALABAMA

Address:

District Chief, WRD
U.S. Geological Survey
520 19th Avenue
Tuscaloosa, AL 35401

Telephone: (205) 752-8104; FTS 229-2957

Office hours: 7:30 a.m. to 4:15 p.m. Central Time

ARKANSAS

Address:

District Chief, WRD
U.S. Geological Survey
Federal Office Bldg., Rm. 2301
700 West Capitol Avenue
Little Rock, AR 72201

Telephone: (501) 378-6391; FTS 740-6391

Office hours: 7:30 a.m. to 4:00 p.m. Central Time

FLORIDA

Address:

District Chief, WRD
U.S. Geological Survey
Hobbs Federal Building, Suite 3015
Tallahassee, FL 32301

Telephone: (904) 681-7620; FTS 965-7620

Office hours: 7:45 a.m. to 4:30 p.m. Eastern Time

GEORGIA

Address:

District Chief, WRD
U.S. Geological Survey
6481 Peachtree Industrial Blvd., Suite B
Doraville, GA 30360

Telephone: (404) 221-4858; FTS 242-4858

Office hours: 7:45 a.m. to 4:30 p.m. Eastern Time

KENTUCKY

Address:

District Chief, WRD
U.S. Geological Survey
Federal Bldg., Rm. 572
600 Federal Place
Louisville, KY 40202

Telephone: (502) 582-5241; FTS 352-5241

Office hours: 8:00 a.m. to 4:45 p.m. Eastern Time

LOUISIANA

Mailing address:

District Chief, WRD
U.S. Geological Survey
P.O. Box 66492
Baton Rouge, LA 70896

Office address:

6554 Florida Boulevard
Baton Rouge, LA 70896

Telephone: (504) 389-0281; FTS 687-0281

Office hours: 7:45 a.m. to 4:30 p.m. Central Time

MISSISSIPPI

Address:

District Chief, WRD
U.S. Geological Survey
Federal Office Bldg., Suite 710
100 West Capitol Street
Jackson, MS 39269

Telephone: (601) 960-4600; FTS 490-4600

Office hours: 7:45 a.m. to 4:30 p.m. Central Time

NORTH CAROLINA

Mailing address:

District Chief, WRD
U.S. Geological Survey
P.O. Box 2857
Raleigh, NC 27602

Office address:

300 Fayetteville Street Mall,
Century Postal Station, Rm. 436
Raleigh, NC 27602

Telephone: (919) 755-4510; FTS 672-4510

Office hours: 8:00 a.m. to 4:45 p.m. Eastern Time

PUERTO RICO Caribbean District (Puerto Rico and U.S. Virgin Islands)

Mailing address:

District Chief, WRD
U.S. Geological Survey
GPO Box 4424
San Juan, PR 00936

Office address:

GSA Center, Building 652
Highway 28, Pueblo Viejo
San Juan, PR 00936

Telephone: (809) 783-4660; FTS (809) 753-4414

Office hours: 7:45 a.m. to 4:30 p.m. Atlantic Time

SOUTH CAROLINA

Address:

District Chief, WRD
U.S. Geological Survey
Suite 658
1835 Assembly Street
Columbia, SC 29201

Telephone: (803) 765-5966; FTS 677-5966

Office hours: 7:45 a.m. to 4:30 p.m. Eastern Time

TENNESSEE

Address:

District Chief, WRD
U.S. Geological Survey
Federal Bldg., and U.S. Court House,
Rm. A-413
Nashville, TN 37203

Telephone: (615) 251-5424; FTS 852-5424

Office hours: 7:45 a.m. to 4:30 p.m. Central Time

VIRGIN ISLANDS See Puerto Rico

Central Region

Colorado, Iowa, Kansas, Missouri, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, Utah, Wyoming

OFFICE OF THE REGIONAL HYDROLOGIST

Mailing address:

Regional Hydrologist
U.S. Geological Survey
Mail Stop 406, Box 25046
Denver Federal Center
Lakewood, CO 80225

Office address:

Denver Federal Center, Bldg. 25
Lakewood, CO 80225

Telephone: (303) 234-3661; FTS 234-3661

Office hours: 8:00 a.m. to 4:30 p.m. Mountain Time

DISTRICT OFFICES

COLORADO

Mailing address:

District Chief, WRD
U.S. Geological Survey
Mail Stop 415, Box 25046
Denver Federal Center
Lakewood, CO 80225

Office address:

Denver Federal Center, Bldg. 53
Lakewood, CO 80225

Telephone: (303) 234-5092; FTS 234-5092

Office hours: 8:00 a.m. to 4:30 p.m. Mountain Time

IOWA

Mailing address:

District Chief, WRD
U.S. Geological Survey
P.O. Box 1230
Iowa City, IA 52244

Office address:

Federal Bldg., Rm. 269
400 South Clinton Street
Iowa City, IA 52244

Telephone: (319) 337-4191; FTS 863-6521

Office hours: 7:30 a.m. to 4:15 p.m. Central Time

KANSAS

Address:

District Chief, WRD
U.S. Geological Survey
1950 Avenue "A"—Campus West
University of Kansas
Lawrence, KS 66044

Telephone: (913) 864-4321; FTS 752-2300

Office hours: 8:00 a.m. to 4:30 p.m. Central Time

MISSOURI

Address:

District Chief, WRD
U.S. Geological Survey
1400 Independence Road, Mail Stop 200
Rolla, MO 65401

Telephone: (314) 341-0824; FTS 277-0824

Office hours: 7:30 a.m. to 4:00 p.m. Central Time

MONTANA

Address:

District Chief, WRD
U.S. Geological Survey
Federal Bldg, Rm. 428
301 South Park Avenue
Drawer 10076
Helena, MT 59626

Telephone: (406) 449-5302; FTS 585-5302

Office hours: 7:45 a.m. to 4:30 p.m. Mountain Time

NEBRASKA

Address:

District Chief, WRD
U.S. Geological Survey
Federal Bldg. and U.S. Court House, Rm. 406
100 Centennial Mall North
Lincoln, NE 68508

Telephone: (402) 471-5082; FTS 541-5082

Office hours: 7:45 a.m. to 4:30 p.m. Central Time

NEW MEXICO

Address:

District Chief, WRD
U.S. Geological Survey
Western Bank Bldg., Rm. 720

Central Region—Continued

NEW MEXICO—Continued

505 Marquette, NW
Albuquerque, NM 87102
Telephone: (505) 766-2246; FTS 474-2246
Office hours: 7:45 a.m. to 4:45 p.m. Mountain Time

NORTH DAKOTA

Address:
District Chief, WRD
U.S. Geological Survey
821 East Interstate Avenue
Bismarck, ND 58501
Telephone: (701) 255-4011, ext. 601; FTS 783-4601
Office hours: 8:00 a.m. to 5:00 p.m. Central Time

OKLAHOMA

Address:
District Chief, WRD
U.S. Geological Survey
215 Dean A. McGee Avenue, Rm. 621
Oklahoma City, OK 73102
Telephone: (405) 231-4256; FTS 736-4256
Office hours: 8:00 a.m. to 4:45 p.m. Central Time

SOUTH DAKOTA

Address:
District Chief, WRD
U.S. Geological Survey
Federal Bldg., Rm. 317
200 4th Street, SW
Huron, SD 57350
Telephone: (605) 352-8651, ext. 258; FTS 782-2258
Office hours: 8:00 a.m. to 5:00 p.m. Central Time

TEXAS

Address:
District Chief, WRD
U.S. Geological Survey
Federal Bldg., Rm. 649
300 East 8th Street
Austin, TX 78701
Telephone: (512) 482-5766; FTS 770-5766
Office hours: 7:45 a.m. to 4:30 p.m. Central Time

UTAH

Address:
District Chief, WRD
U.S. Geological Survey
Administration Bldg., Rm. 1016
1745 West 1700 South
Salt Lake City, UT 84104
Telephone: (801) 524-5663; FTS 588-5663
Office hours: 8:00 a.m. to 4:30 p.m. Mountain Time

WYOMING

Mailing address:
District Chief, WRD
U.S. Geological Survey
P.O. Box 1125
Cheyenne, WY 82003
Office address:
J.C. O'Mahoney Federal Center, Rm. 4007
2120 Capitol Avenue
Cheyenne, WY 82003
Telephone: (307) 772-2153, FTS 328-2153
Office hours: 8:00 a.m. to 4:30 p.m. Mountain Time

Western Region

Alaska, Arizona, California, Guam, Hawaii, Idaho, Nevada, Oregon, Washington

OFFICE OF THE REGIONAL HYDROLOGIST

Address:
Regional Hydrologist
U.S. Geological Survey
345 Middlefield Road, Mail Stop 66
Menlo Park, CA 94025
Telephone: (415) 323-8111, ext. 2337; FTS 467-2337
Office hours: 7:45 a.m. to 4:15 p.m. Pacific Time

DISTRICT OFFICES

ALASKA

Address:
District Chief, WRD
U.S. Geological Survey
1515 East 13th Avenue
Anchorage, AK 99501
Telephone: (907) 271-4138; FTS (907) 271-4138
Office hours: 7:45 a.m. to 4:15 p.m. Alaska-Hawaii Time

HAWAII—Continued

P.O. Box 50166
Honolulu, HI 96850
Office address:
300 Ala Moana Boulevard, Rm. 6110
Honolulu, HI 96850
Telephone: (808) 546-8331; FTS (808) 546-8331
Office hours: 7:45 a.m. to 4:15 p.m. Alaska-Hawaii Time

ARIZONA

Address:
District Chief, WRD
U.S. Geological Survey
Federal Bldg., 301 West Congress Street, FB-44
Tucson, AZ 85701
Telephone: (602) 629-6671; FTS 762-6671
Office hours: 7:30 a.m. to 4:00 p.m. Mountain Time

IDAHO—Idaho—Nevada District

Address:
District Chief, WRD
U.S. Geological Survey
230 Collins Rd.
Boise, ID 83702
Telephone: (208) 334-1750; FTS 554-1750
Office hours: 7:45 a.m. to 4:15 p.m. Mountain Time

CALIFORNIA

Address:
District Chief, WRD
U.S. Geological Survey
Federal Bldg., Rm. W-2235, 2800 Cottage Way
Sacramento, CA 95825
Telephone: (916) 484-4606; FTS 468-4606
Office hours: 7:30 a.m. to 4:00 p.m. Pacific Time

NEVADA See also Idaho

Address:
Hydrologist-in-Charge
Nevada Office, WRD
U.S. Geological Survey
Federal Bldg., Rm. 229, 705 North Plaza Street
Carson, City, NV 89701
Telephone: (702) 882-1388; FTS 598-6011,
ask operator for 882-1388
Office hours: 7:45 a.m. to 4:45 p.m. Pacific Time

GUAM See also Hawaii

Mailing address:
Hydrologist-In-Charge
Subdistrict Office, WRD
U.S. Geological Survey
P.O. Box 188
FPO San Francisco, CA 96630
Office address:
U.S. Navy Public Works Center, Bldg. 104
Agana, GU 96910
Telephone: 339-9123 (commercial operator for overseas
call)
Office hours: 7:45 a.m. to 4:15 p.m. Kilo Time

HAWAII Hawaii—Guam District

Mailing address:
District Chief, WRD
U.S. Geological Survey

OREGON

Address:
District Chief, WRD
U.S. Geological Survey
847 NE 19th Avenue, Suite 300
Portland, OR 97232
Telephone: (503) 231-2009; FTS 429-2009
Office hours: 7:30 a.m. to 4:15 p.m. Pacific Time

WASHINGTON

Address:
District Chief, WRD
U.S. Geological Survey
1201 Pacific Avenue, Suite 600
Tacoma, WA 98402
Telephone: (206) 593-6510; FTS 390-6510
Office hours: 7:45 a.m. to 4:30 p.m. Pacific Time

Regional Research Hydrologists

OFFICE OF THE ASSISTANT CHIEF HYDROLOGIST FOR RESEARCH AND TECHNICAL COORDINATION

DEPUTY ASSISTANT CHIEF HYDROLOGIST FOR RESEARCH AND TECHNICAL COORDINATION

Address:

U.S. Geological Survey
413 National Center
12201 Sunrise Valley Drive
Reston, VA 22092

Telephone: (703) 860-6971; FTS 928-6971

Office hours: 7:45 a.m. to 4:15 p.m. Eastern Time

OFFICES OF THE REGIONAL RESEARCH HYDROLOGISTS

NORTHEASTERN REGION

Address:

Regional Research Hydrologist, NR
U.S. Geological Survey
432 National Center
12201 Sunrise Valley Drive
Reston, VA 22092

Telephone: (703) 860-6958; FTS 928-6958

Office hours: 7:45 a.m. to 4:15 p.m. Eastern Time

CENTRAL REGION

Address:

Regional Research Hydrologist, CR
U.S. Geological Survey
Mail Stop 412, Box 25046
Denver Federal Center, Bldg. 25
Lakewood, CO 80225

Telephone: (303) 234-4175; FTS 234-4175

Office hours: 8:00 a.m. to 4:30 p.m. Mountain Time

SOUTHEASTERN REGION

Address:

Regional Research Hydrologist, SR
U.S. Geological Survey
Gulf Coast Hydrosience Center
Building 1100, Room 312
NSTL Station, MS 39529

Telephone: (601) 688-3130; FTS 494-1512

Office hours: 8:00 a.m. to 4:30 p.m. Central Time

WESTERN REGION

Address:

Regional Research Hydrologist, WR
U.S. Geological Survey
Mail Stop 66
345 Middlefield Road
Menlo Park, CA 94025

Telephone: (415) 323-8111, ext. 2339; FTS 467-2339

Office hours: 7:45 a.m. to 4:15 p.m. Pacific Time

