WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN NEW JERSEY, 1990-91

Compiled and edited by F.L. Schaefer and R.M. Larkins

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West Trenton, New Jersey
1993

U.S. DEPARTMENT OF THE INTERIOR

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U.S. GEOLOGICAL SURVEY

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Message from the District Chief

The U.S. Geological Survey (USGS) is recognized for its impartial fact-finding and research mission. The USGS's Water Resources Division gathers and interprets hydrologic data that enable water-resources managers to make decisions based on objective scientific information. This report, which is the first in a series, describes the activities of the U.S. Geological Survey, Water Resources Division, New Jersey District, during 1990-91. It provides summaries of current program activities and a listing of recently completed publications. Sources of information on other activities of the USGS and sources of publications also are included.

The New Jersey District continually strives to develop a water-resources program that provides a balance of hydrologic data collection, resource appraisals, and research that is relevant to the major water issues and to the needs of water managers in New Jersey. Our program addresses a wide variety of issues that include water-supply availability, resource development, water-quality protection and mitigation, and preservation of New Jersey's water resources. The quality of our program is a reflection of the high level of interest by numerous local cooperators in a water-resources management approach based on sound scientific information. Thank you for your continued support.

I hope that you find this first report to be interesting and informative. Comments and suggestions for future reports are welcomed. If you would like more information on the activities described, please contact me or any of the personnel listed in the Organization and Staffing section of this report.

Janice R. Ward
District Chief

Introduction

Purpose and Scope

The purpose of this report is to present an overview of the U.S. Geological Survey, Water Resources Division, and a description of the work conducted in the New Jersey District during 1990-91. Also included are a bibliography of reports and journal articles published from 1986 through 1991 and a description of sources of additional information on U.S. Geological Survey programs.

Origin of the U.S. Geological Survey

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

Since 1879, the research and fact-finding role of the USGS has grown and been modified to meet the changing needs of the Nation it serves. As part of that evolution, the USGS has become the Federal government's largest earth-science research agency, the Nation's largest civilian map-making agency, the primary source of data on the Nation's surface- and ground-water resources, and the employer of the largest number of professional earth scientists. Today's programs serve a diversity of needs and users. Programs include--

- o Conducting detailed assessments of the energy and mineral potential of the Nation's land and offshore areas.
- o Investigating and issuing warnings of earthquakes, volcanic eruptions, landslides, and other geologic and hydrologic hazards.
- o Conducting research on the geologic structure of the Nation.
- o Studying the geologic features, structure, processes, and history of the other planets of our solar system.
- o Conducting topographic surveys of the Nation and preparing topographic and thematic maps and related cartographic products.
- o Developing and producing digital cartographic data bases and products.
- o Collecting data on a routine basis to determine the quantity, quality, and use of surface and ground water.
- o Conducting water-resources appraisals in order to describe the consequences of alternative plans for developing land and water resources.
- o Conducting research in hydraulics and hydrology, and coordinating all Federal water-data acquisition.

- o Using remotely sensed data to develop new cartographic, geologic, and hydrologic research techniques for natural-resources planning and management.

- o Providing earth-science information through an extensive publications program and a network of public-access points.

Along with its continuing commitment to meet the growing and changing earth-science needs of the Nation, the USGS remains dedicated to its original mission to collect, analyze, interpret, publish, and disseminate information about the natural resources of the Nation--providing "Earth Science in the Public Service." This is accomplished by five Divisions within the USGS: Water Resources, National Mapping, Geologic, Information Systems, and Administrative.

Water Resources Division's Mission, Programs, Organization, and Funding

The mission of the Water Resources Division is to provide the hydrologic information and understanding needed for the optimum utilization and management of the Nation's water resources for the overall benefit of the people of the United States. This is accomplished, in large part, through cooperation with other Federal and non-Federal agencies, by:

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

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

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

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

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

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

- o Acquiring, developing, and disseminating information on water-related natural hazards such as droughts, floods, landslides, land subsidence, mudflows, and volcanoes.

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

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

Introduction

Authority for carrying out this mission is derived from legislation of 1879, which created the USGS, and legislation of 1888 and 1894, which provided for gaging of streams and determining the Nation's water supply. Congressional appropriations have been made annually since 1894 for gaging streams and performing other functions relating to water resources. In 1964, the Geological Survey's 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 task was assigned to the Department of the Interior in Office of Management and Budget Circular A-67.

The Water Resources Division is headquartered in Reston, Va. Under the direction of the Chief Hydrologist, a host of tasks are completed in Reston, including administrative and technical oversight for the Division, external and hydrologic research, scientific-information management, and water assessment and data coordination.

The Division includes a network of District offices in almost every State in the country. The majority of hydrologic data collection, resource appraisals and interpretive studies, and research is conducted through these District offices (fig. 1). Additional Division activities are carried out at the numerous subdistrict and field offices.

In May 1991, a nationwide reorganization was implemented which added 15 Area Hydrologist positions to the Division to enhance our ability to conduct multistate projects and to achieve flexibility in program coordination and oversight on a regional basis. The New Jersey and Pennsylvania Districts comprise the Mideast Area Program, under the direction of Donald E. Vaupel, Area Hydrologist.

Work conducted by the Water Resources Division of the USGS is supported by Federal appropriations (Federal Program), by funds from State and local units of government that are matched up to 50 percent with Federal funds (Cooperative Program), and by funds from other Federal agencies (Other Federal Agency Program) (fig. 2). The total Cooperative Program accounted for about 45 percent of total funding in the Water Resources Division in fiscal years 1990-91. Federal and Other Federal Agency Programs accounted for 31 percent and 24 percent, respectively, of total funding.

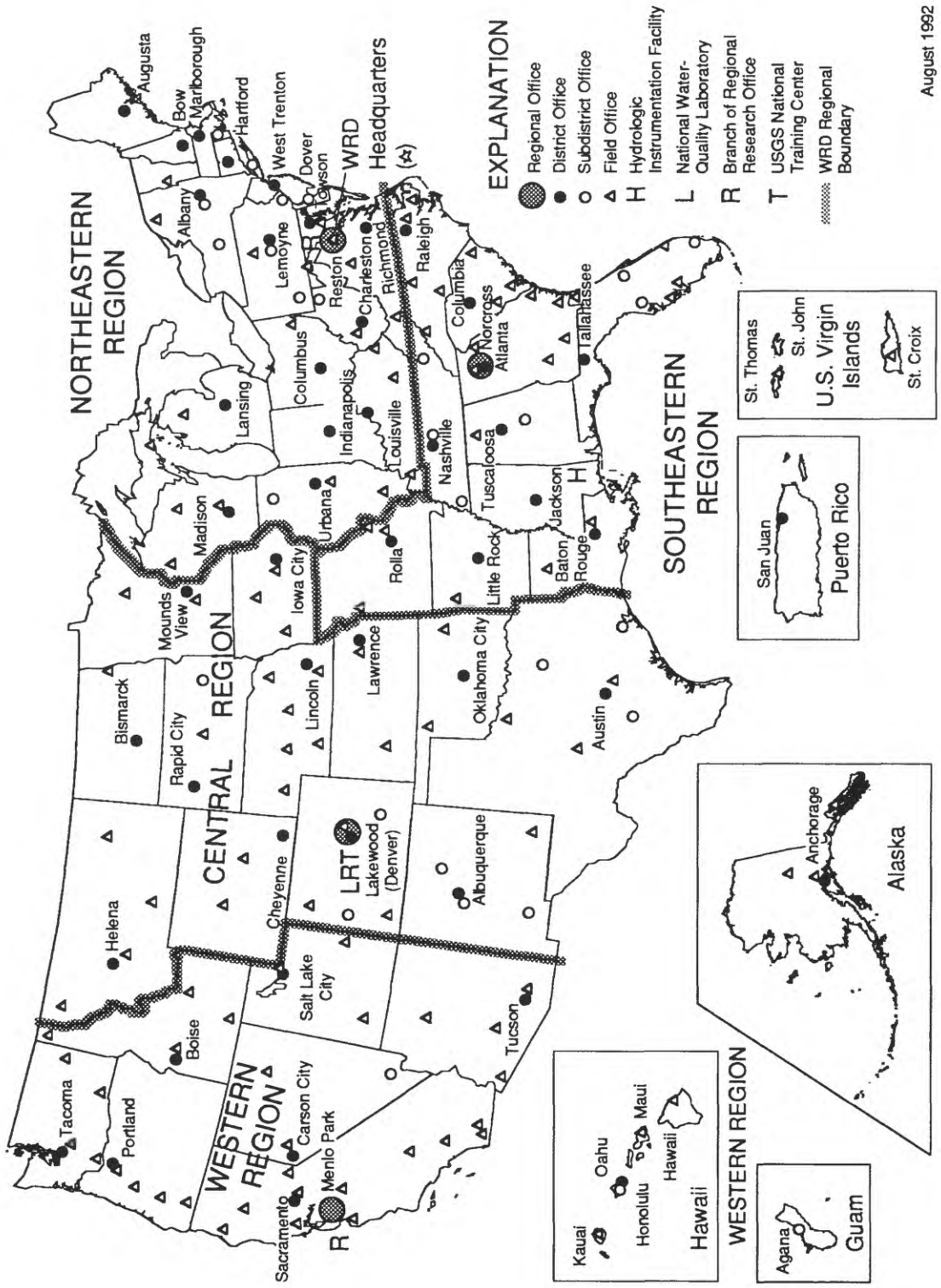


Figure 1.--U.S. Geological Survey, Water Resources Division, offices.

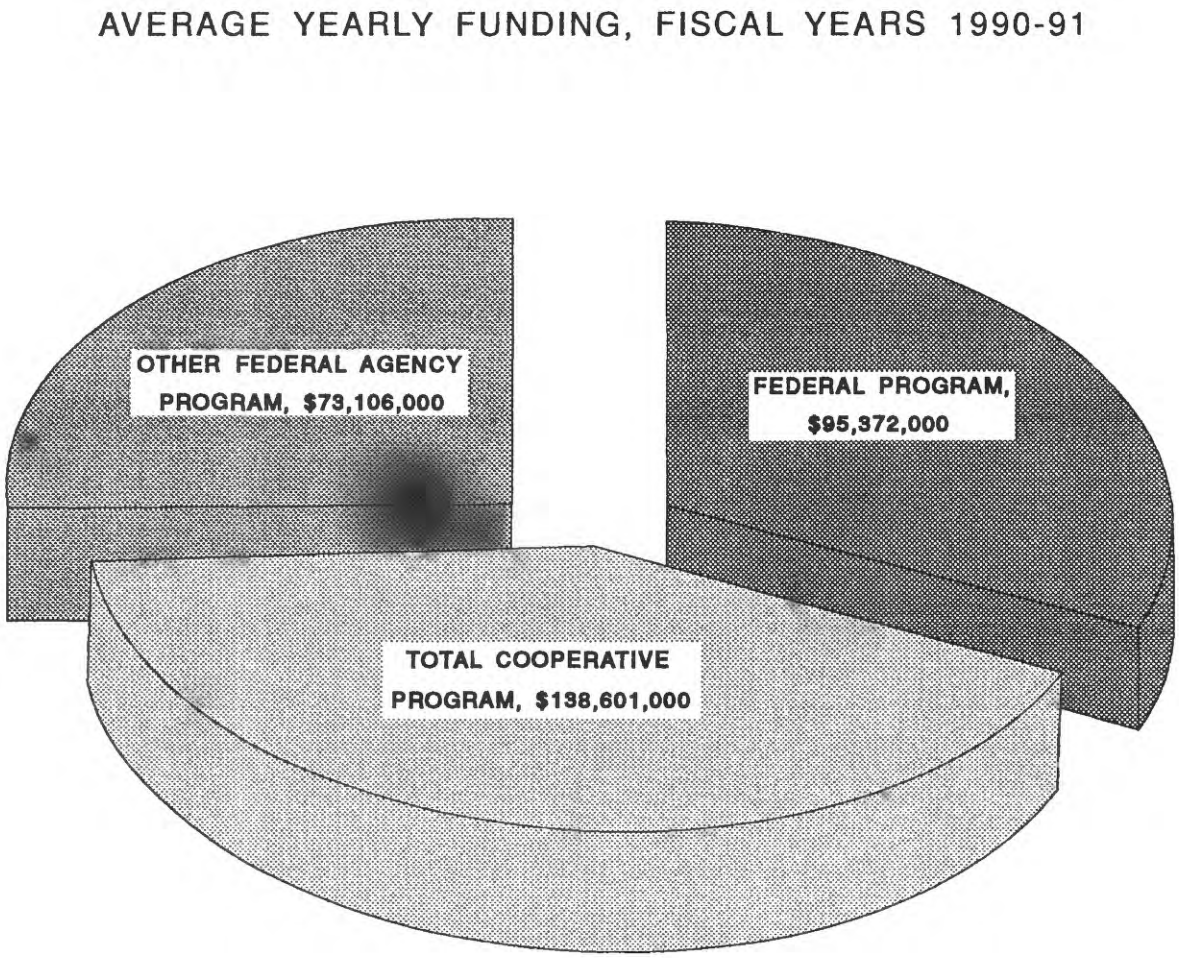


Figure 2.--Funding sources for the Water Resources Division (nationwide).

Organization and Staffing

The New Jersey District office is located in West Trenton, N.J. The program is managed by the District Chief and two Assistant District Chiefs. Six Program Chiefs help to guide the technical program. An organizational chart is shown in figure 3, and a description of the six program areas with key District personnel is listed below.

District Chief	Janice R. Ward
Administrative Officer	Carolyn L. Bellante
Reports Specialist	Dale L. Simmons
Assistant District Chief for Hydrologic Data Assessment, Studies, and Information Management	Eric J. Evenson
Surface-Water Specialist	Robert D. Schopp
Water-Quality Specialist	Jacob Gibs
Hydrologic Data Assessment - collection of basic records for surface water, ground water, and water quality	William R. Bauersfeld
Hydrologic Studies - interpretive studies and research in surface-water hydraulics and modeling, water-quality appraisals, and watershed projects	David A. Stedfast
Information Management - District support in computer technology, data-base management, reports processing, and information dissemination	Keith W. Robinson
Information-Requests Specialist	Frederick L. Schaefer
Assistant District Chief for Hydrologic Systems Investigations and Research	Herbert T. Buxton
Ground-Water Specialist	George M. Farlekas
Ground-Water-Modeling Specialist	Vacant
Environmental Studies - interpretive studies and research on the effects of human activities on water resources, primarily ground-water resources	Julia L. Barringer
Geohydrologic Studies - interpretive studies and research on geo-hydrologic framework and the presence and flow of ground water	Otto S. Zapecza
Hydrologic Simulation - interpretive studies and research on effects of stresses on the hydrologic system, primarily ground-water resources; development of ground-water-flow and solute-transport models	Steven D. McAuley

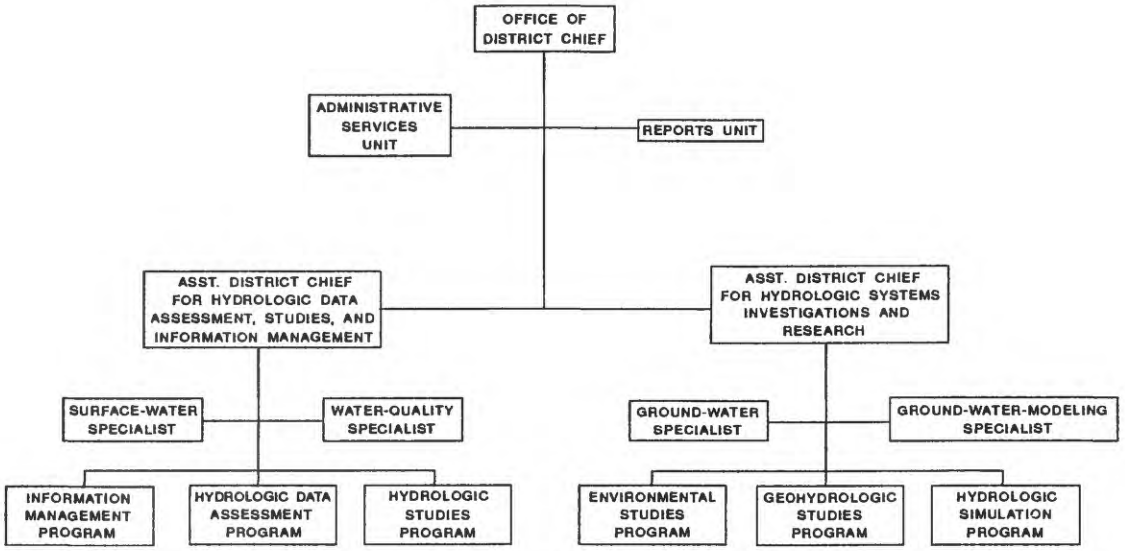


Figure 3.--Organization of the New Jersey District.

The District employs about 90 people, including about 50 hydrologists, engineers, and other professionals. About 30 technical support personnel are involved in the collection, analysis, and publication of data and reports. The staff is highly trained in hydrology and related fields such as geology, geohydrology, chemistry, geochemistry, engineering, hydraulics, and statistics. About one-half of the professional staff have advanced degrees. Almost all of the technical staff have taken specialized training as part of the Water Resources Division's National Training Program. Many routinely take courses at nearby colleges and universities.

Funding, Fiscal Years 1990-91

Figure 4 shows the sources of funding for the New Jersey District program during 1990-91. The Cooperative Program was 68 percent of the total program, and was composed of roughly equal amounts of Federal and local cooperator funds. The remainder of the total program consisted of USGS funds (23 percent) and Other Federal Agency funds (9 percent).

Figure 5 shows how these funds, averaging about $6.5 million per year, were used. The program is broken down into three broad categories--hydrologic-data assessment, resource appraisals, and research. Nearly half of the program was resource assessment, about 34 percent was hydrologic data assessment, and 20 percent was research. All of these investigations provide information needed by water-resources, managers and planners to solve or alleviate water problems in New Jersey.

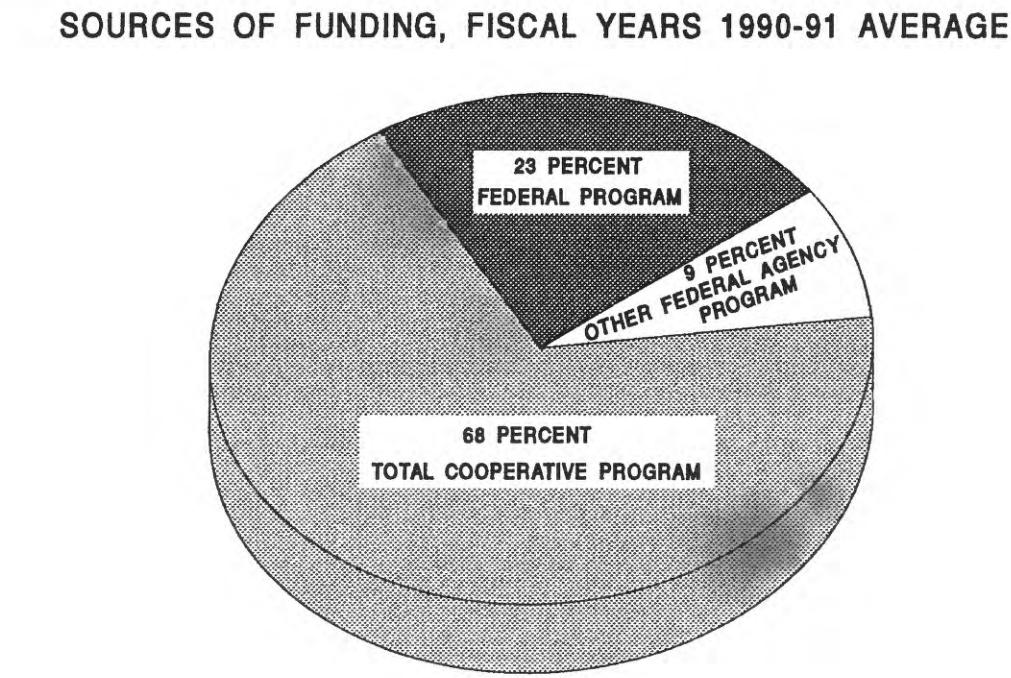


Figure 4.--Funding sources for the water-resources program in New Jersey for fiscal years 1990-91.

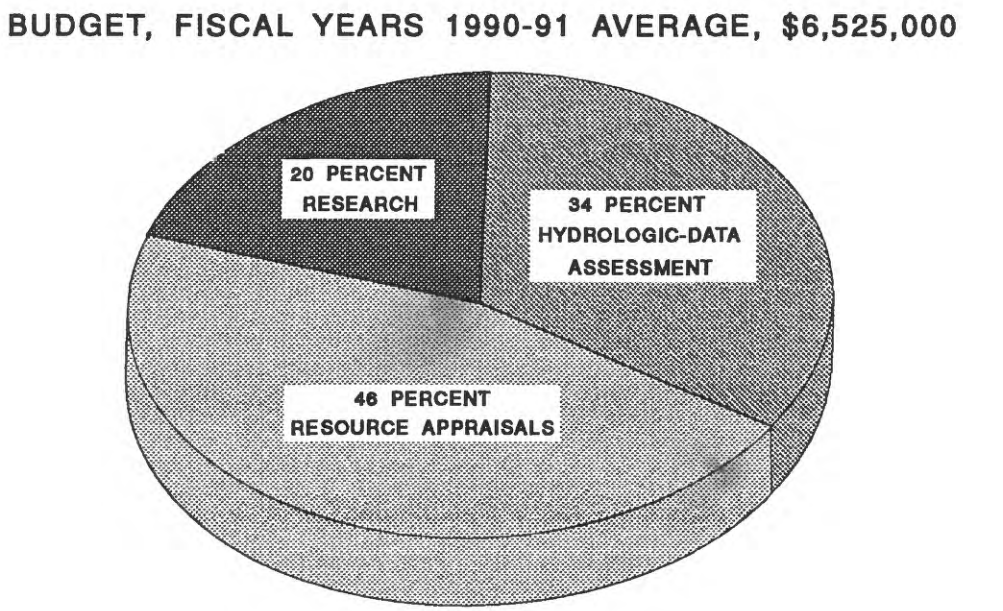
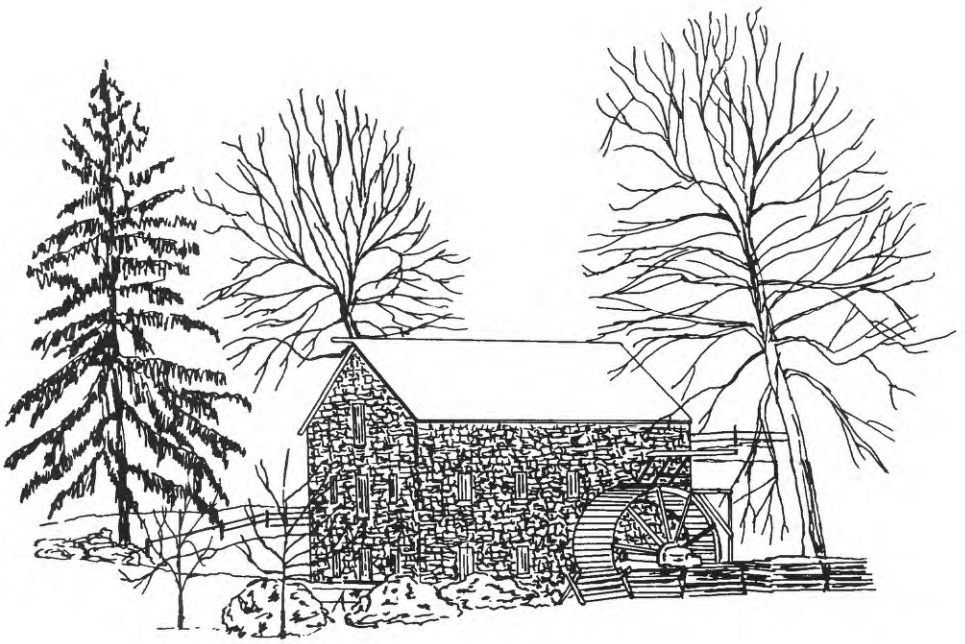


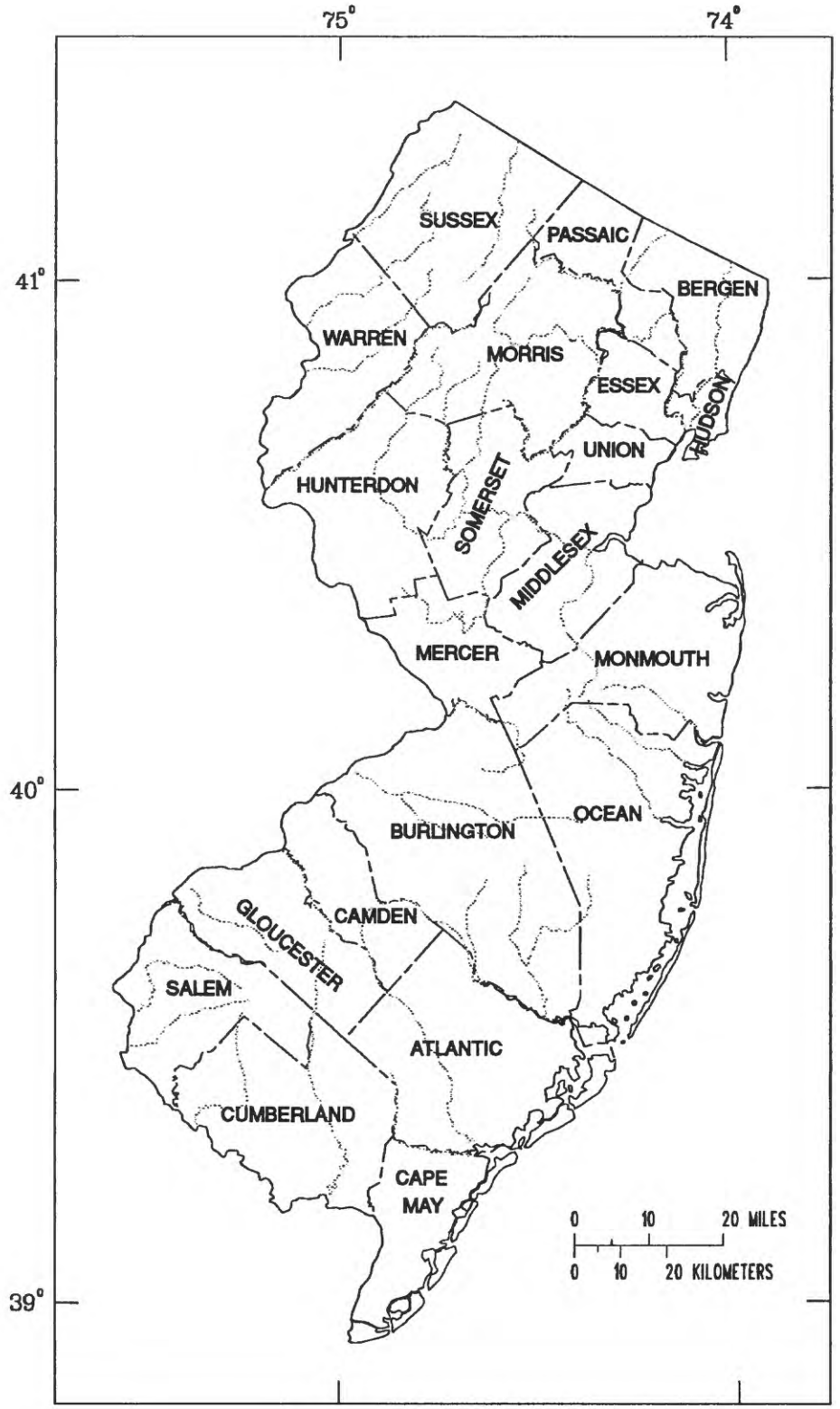
Figure 5.--Funding allocation for the water-resources program in New Jersey for fiscal years 1990-91.

Cooperating Agencies in New Jersey

The agencies listed below cooperated with the USGS in New Jersey during the 1990-91 fiscal years.

Bergen County
Brick Township Municipal Utilities Authority
City of Cape May, Cape May County
City of New Brunswick, Middlesex County
City of Wildwood, Cape May County
City of Woodstown Sewage Authority, Salem County
Federal Energy Regulatory Commission
Gloucester County Planning Commission
Lower Township, Cape May County
Morris County Municipal Utilities Authority
New Jersey Department of Agriculture
New Jersey Department of Environmental Protection and Energy
New Jersey Water Supply Authority
North Jersey District Water Supply Commission
Passaic Valley Water Commission
Pinelands Commission
Rutgers - The State University
Somerset County Board of Chosen Freeholders
U.S. Army - Picatinny Arsenal
U.S. Army - Corps of Engineers, New York District
U.S. Army - Corps of Engineers, Philadelphia District
U.S. Environmental Protection Agency, Washington, D.C.
U.S. Environmental Protection Agency, Region 2, New York, N.Y.
U.S. Environmental Protection Agency, Region 3, Philadelphia, Pa.
U.S. Fish and Wildlife Service, Region 5, Boston, Ma.
Washington Township Municipal Utilities Authority, Gloucester County
West Windsor Township, Mercer County





Counties of New Jersey.

Water-Data Program, NAWDEX, and WATSTORE

Water-Data Program

Water-data stations at selected locations throughout the Nation are used by the USGS for the collection of data on stream discharge (flow) and stage (height), reservoir and lake stage and storage, ground-water levels, well and spring discharge, and the quality of surface water and ground water. These data provide a continuing record of the quantity and quality of the Nation's surface-water and ground-water resources and thus provide the hydrologic information needed by Federal, State, and local agencies and the private sector for the development and management of land and water resources. All data collected are stored in the USGS's National Water Data Storage and Retrieval System (see section "WATSTORE" for additional information on this system) and also are published by water year (October 1-September 30) for each State in a publication series entitled "U.S. Geological Survey Water-Data Reports." Information about the Water-Data Program in New Jersey can be obtained from the District Chief of the New Jersey office.

National Water-Data Exchange (NAWDEX)

The National Water-Data Exchange is a confederation of Federal and non-Federal water-oriented organizations working together to improve access to water data that are collected by a variety of agencies nationwide. It is managed by a Program Office, which is administered by the Water Resources Division. Information on sites for which water data are available, the types of data available, and the organizations that store the data is available from NAWDEX. Assistance in identifying, locating, and acquiring data is provided by the Program Office at Reston, Va.; by NAWDEX Assistance Centers at the Water Resources Division District offices; and by offices of other NAWDEX member organizations. A directory of assistance centers, and more detailed information about services, can be obtained from the NAWDEX Program Office, Branch of Water Information Transfer. The NAWDEX headquarters address is National Water-Data Exchange, U.S. Geological Survey, 421 National Center, Reston, VA 22092. The office can be reached by phone at (703) 648-5677.

National Water-Data Storage and Retrieval System (WATSTORE)

As explained in the section "Water-Data Program," all data collected as part of that program are stored in WATSTORE, and the data are available on request. The data bases listed below are managed by the USGS and are maintained at each District office. The data from these data bases also are stored in WATSTORE.

- Automated Data Processing System (ADAPS) - Contains daily values of streamflows, stream stages, reservoir contents, water temperatures, specific conductances, sediment concentrations, sediment discharges, and ground-water levels.

- Ground-Water Site Inventory (GWSI) Data Base - Contains inventory data for wells, springs, and other sources of ground water. The data base includes site location, geohydrologic characteristics, and well-construction history.

- National Water-Use Data System - Contains water-use data for surface and ground water. Personnel of District offices and cooperating State agencies collect the water-use data and aggregate these data by county and hydrologic unit; the aggregated data are compiled by USGS personnel for incorporation into the National Water-Use Data System.

o Water-Quality File - Contains results of analyses of water samples that describe the chemical, physical, biological, and radiochemical characteristics of surface and ground water.

These data can be retrieved in machine-readable form or as computer-printed tables or graphs, statistical analyses, and digital plots. Local assistance in the acquisition of service or products from WATSTORE can be obtained from the District offices. A pamphlet, "WATSTORE: A WATer Data STOrage and REtrieval System," can be obtained from these offices or from the WATSTORE Program Office, Branch of Computer Technology, U.S. Geological Survey, 440 National Center, Reston, VA 22092. The office can be reached by phone at (703) 648-5680.

Explanation of Project Descriptions

Projects of the New Jersey District that were active during 1990-91 are described on the following pages. Included with the descriptions are maps that show study-area locations. The order of presentation is by project type--Data-Collection Projects, Hydrologic Investigations (Cooperative Projects), Hydrologic Investigations (Other Federal Agency Projects), and Hydrologic Investigations (Federal Projects). Projects in the Hydrologic Investigations (Cooperative Projects) section are grouped by cooperating agency.

View of Hudson River from Palisades State Park, Bergen County.

DATA-COLLECTION PROJECTS

Streamflow measurement technique used on ice-covered Delaware and Raritan Canal at Port Mercer.

SURFACE-WATER STATIONS (NJ001)

PROJECT CHIEF: Edward W. Moshinsky
COOPERATOR(S): Bergen County,City of New Brunswick,City of Woodstown Sewage Authority, Federal Energy Regulatory Commission, Gloucester County Planning Commission, N.J. Department of Environmental Protection and Energy, N.J. Water Supply Authority, North Jersey District Water Supply Commission, Passaic Valley Water Commission, Pinelands Commission, Somerset County Board of Chosen Freeholders, U.S. Army-Corps of Engineers
PERIOD OF PROJECT: Continuous since 1921

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

OBJECTIVE: A. To collect surface-water-discharge data sufficient to satisfy needs for current uses, such as (1) assessment of water resources, (2) operation of reservoirs or industries, (3) forecasting stream-discharge conditions, (4) administering pollution-control programs, (5) obtaining discharge data to accompany water-quality measurements, (6) compliance with Delaware River Compact and other legal requirements, and (7) conducting research or special studies. B. To collect data necessary for analytical studies to determine the statistical characteristics of, and trends in, the flow of water in rivers and streams.

APPROACH: Data are collected at continuous-record gages, tidal stations, and miscellaneous sites and are entered into the Automated Data Processing System (ADAPS) data base. Standard methods of data collection are used as described in the publication series "Techniques of Water-Resources Investigations of the U. S. Geological Survey."

PROGRESS and PLANS: Streamflow and stage data were collected at 92 continuous gaging stations in 1991. Collection of records at two gaging stations was discontinued during 1991. Tidal data were collected at 4 stations with continuous recorders and at 11 crest-stage gages. Discharge measurements were made at 40 water-quality sampling sites. Plans are to ensure that all data are stored in the ADAPS data base and are published in the annual Water Resources Data report.

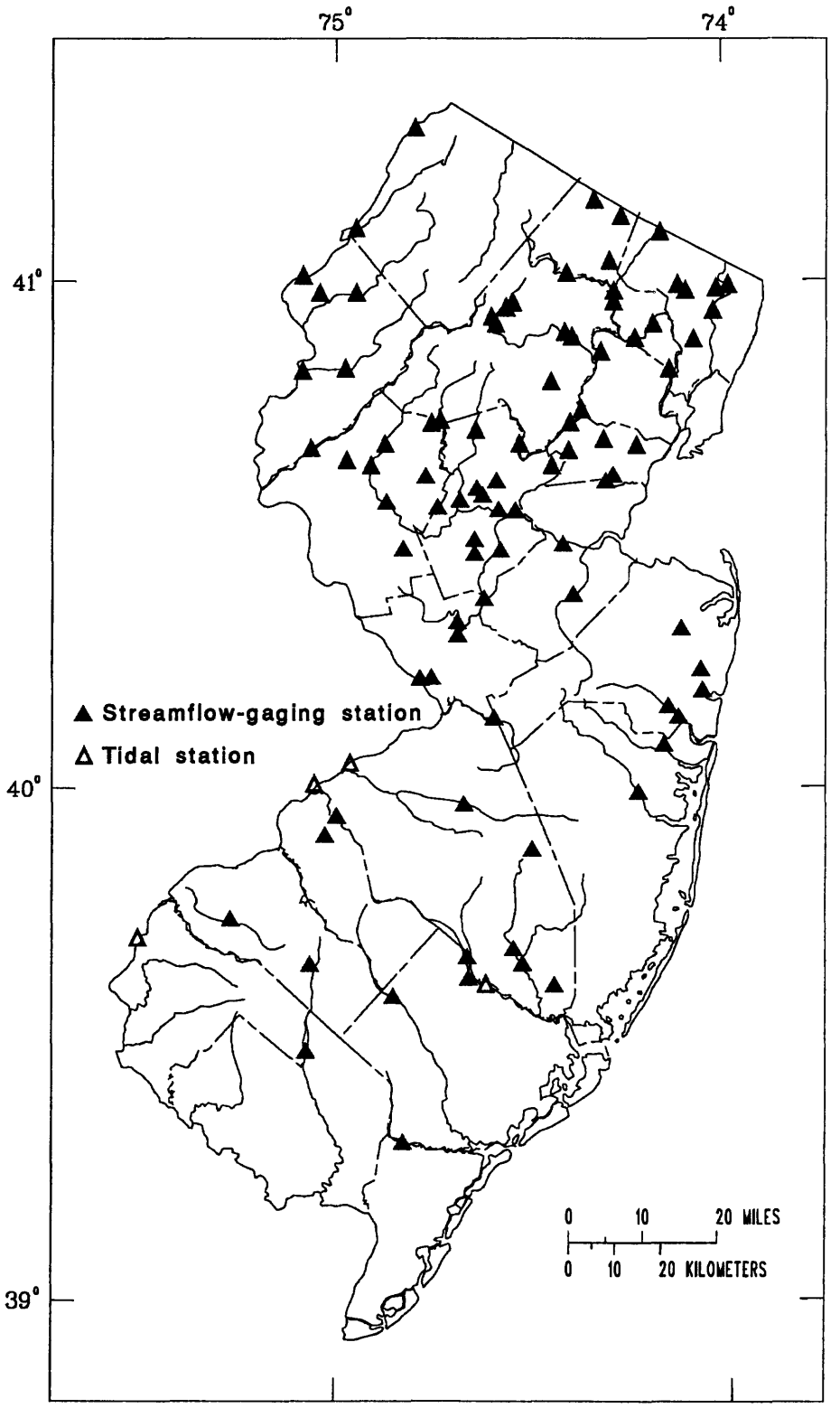


Figure 6.--Streamflow-gaging stations and tidal stations in New Jersey, water year 1991 (NJ001).

GROUND-WATER STATIONS (NJ002)

PROJECT CHIEF: Walter D. Jones
COOPERATOR(S): Gloucester County Planning Commission, N.J. Department of Environmental Protection and Energy, Pinelands Commission, and Washington Township Municipal Utilities Authority
PERIOD OF PROJECT: Continuous since 1931

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

OBJECTIVE: To collect ground-water-level data sufficient to provide a minimum long-term data base so that the general response of the hydrologic system to natural climatic variations and induced stresses is known and potential problems can be defined early enough to allow for effective planning and management. To provide a data base against which the short-term records acquired as part of areal studies can be analyzed.

APPROACH: Ground-water levels are measured in a network of observation wells tapping all the principal aquifers in the State, with the frequency of measurement ranging from continuous to annual. All data are stored in computer files for ready access by the public and for report generation. Well-location, geologic, hydrologic, and well-construction data are collected routinely and stored in the Ground Water Site Inventory (GWSI) data base.

PROGRESS AND PLANS: Ground-water levels were measured in 242 observation wells tapping all of the major aquifers in the State. In 1991, 103 wells were equipped for continuous monitoring, 18 were used to monitor extreme conditions, and 121 were measured manually. All verified data were stored in computer files. Personnel specializing in data-base management continued to add to and update the GWSI data base. By September 30, 1991, GWSI contained records of 10,370 wells. Plans are to continue data collection and computer storage of water-level data from the statewide network. Data will be published in the annual Water Resources Data report. Continue to expand and update the GWSI data base.

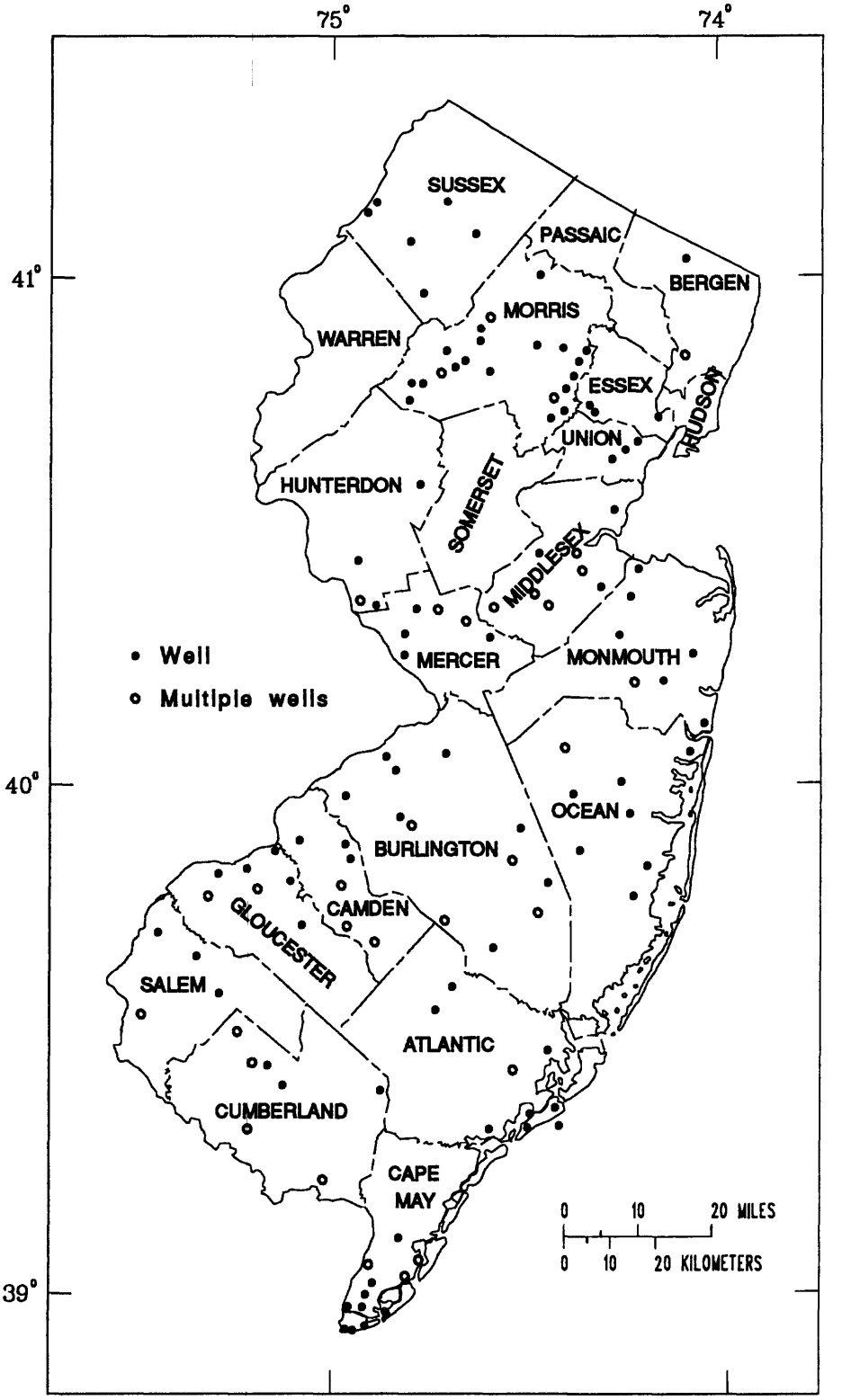


Figure 7.--Ground-water-level observation wells in New Jersey, water year 1991 (NJ002).

WATER-QUALITY STATIONS (NJ003)

PROJECT CHIEF: Edward A. Pustay
COOPERATOR(S): N.J. Department of Environmental Protection and Energy, Pinelands Commission, and U.S. Army - Corps of Engineers
PERIOD OF PROJECT: Continuous since 1963

PROBLEM: Water-quality assessment for water-resources planning in New Jersey requires a statewide data base to assist in providing information on water-quality conditions that can affect aquatic biota, recreation potential, public supply, and industrial uses of water.

OBJECTIVE: To collect water-quality data sufficient for maintaining a long-term data base in order to facilitate planning and management of New Jersey waters. To assist in special studies and to provide for statistical analysis of spatial and temporal trends in water quality.

APPROACH: Water-quality data are collected at monitoring networks, including the cooperative New Jersey Department of Environmental Protection and Energy (NJDEPE)/USGS network, the National Stream Quality Accounting Network (NASQAN) and Bench-mark stations, at which water-quality data are collected. Bench-mark stations are located in small, undeveloped watersheds that are affected minimally by human activities. In addition to the collection of water samples and the measurement of physical and chemical properties of water, activities include the operation and maintenance of several continuous recording water-quality monitors. Sampling frequencies range from continuous at some NASQAN and Bench-mark stations to bimonthly at stations in the routine NJDEPE/USGS network. A variety of water-quality constituents is determined for each network.

PROGRESS AND PLANS: Sample collection at all network sites is continuing. Water-quality data for 1990 were published in the Water Resources Data report. An evaluation of the cooperative surface-water network was completed. Results of the evaluation led to changes in sampling sites and constituents deterined. A report on surface-water-quality trends in New Jersey was published. A report examining the causative factors of observed trends in surface-water-quality has been prepared and is in draft form. A report assessing the water resources of the Rockaway River basin, New Jersey, is in review. A report on hydrologic conditions in the Jacobs Creek, Stony Brook, and Beden Brook drainage basins in west-central New Jersey has been submitted for review. Plans are to continue sampling at all network sites and, in addition to the Water Resources Data report for 1991, publish the Rockaway River basin report, the report on the Jacobs Creek, Stony Brook, and Beden Brook drainage basins; and the report on causative factors of observed trends in surface-water quality.

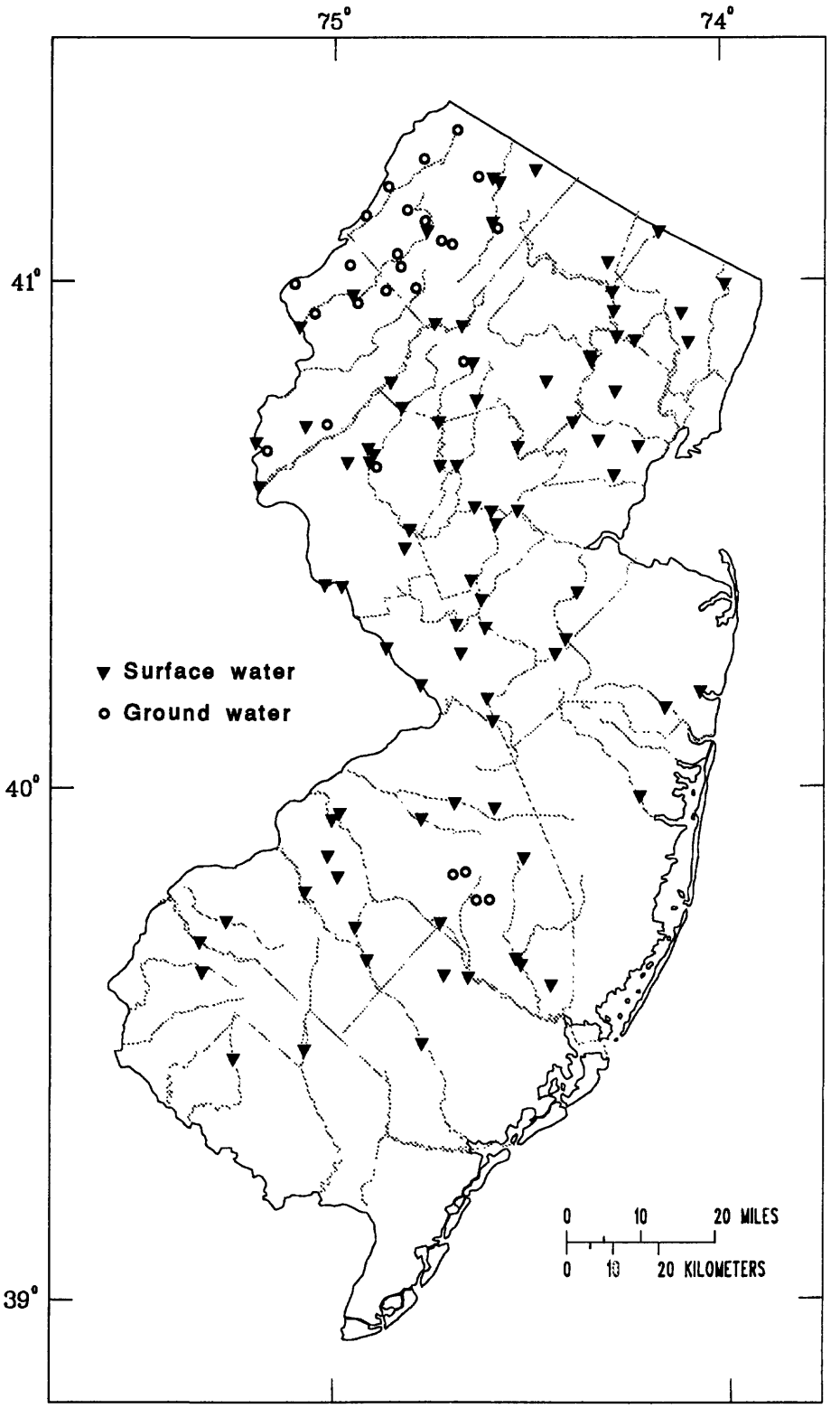


Figure 8.--Surface- and ground-water-quality stations in New Jersey, water year 1991 (NJ003).

INVESTIGATION OF WATER QUALITY IN THE WANAQUE SOUTH DIVERSION AREA, MORRIS AND PASSAIC COUNTIES, NEW JERSEY (NJ003a)

PROJECT CHIEF: Michael J. Deluca
COOPERATOR(S): North Jersey District Water Supply Commission
PERIOD OF PROJECT: Continuous since June 1987

PROBLEM: New diversions of water from the Pompton River at Two Bridges and the Ramapo River at Pompton Lakes pose two potential problems to the quality of freshwater in the Passaic River basin. First, the withdrawal of water from high-quality rivers in the system can degrade water quality in downstream locations where water quality already is poor. Second, storage of the diverted waters in reservoirs can change the quality of water in those reservoirs. Nutrients are of particular concern because excessive nutrients can cause algal blooms, which subsequently lower concentrations of dissolved oxygen.

OBJECTIVE: To provide water-quality data that can be used to manage diversions in order to protect the quality of downstream water and that of receiving reservoirs.

APPROACH: Dissolved oxygen, water temperature, and specific conductance are continuously monitored below each of the two diversions. Telephone-line transmissions of the data provide diversion-facility managers with real-time data reflecting current river conditions. In addition, 15 samples are collected yearly at each of 5 sites and are analyzed for dissolved and total nitrogen and phosphorus species. Data from these locations represent the quality of water flowing to the diversions or the quality of water downstream from the diversions.

PROGRESS AND PLANS: Samples were collected at the five sites and water quality was monitored continuously at the two sites throughout 1990-91. All data were published in the annual Water Resources Data report. Sampling and continuous monitoring will continue according to the schedule used this year. Data will be published in the annual Water Resources Data report.

WATER USE (NJ007)

PROJECT CHIEF: Rick M. Clawges
COOPERATOR(S): N.J. Department of Environmental Protection and Energy
PERIOD OF PROJECT: Continuous since 1979

PROBLEM: Government agencies, consulting engineers, and community developers need a water-use data base to provide a basis for effective decisions regarding the use of New Jersey's water resources. These data were historically uncatalogued and scattered among various sources. Data reliability also suffers from a lack of standards.

OBJECTIVE: To create a State water-use data base and collection program that will function as a part of the National Water-Use Data System.

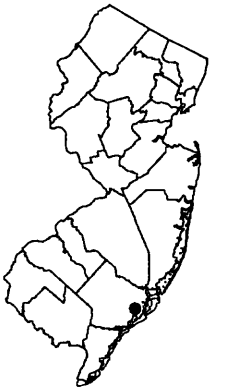
APPROACH: The responsibility for the development of a New Jersey Water-Use data base is shared by NJDEPE and USGS personnel. The USGS is responsible for direction, standards, and development to meet the National needs. Data collection is primarily the responsibility of the NJDEPE. Activities relating to storage and dissemination of data are shared by both agencies.

PROGRESS AND PLANS: Nonagricultural ground- and surface-water-withdrawal data for 1988 and 1989 were added to approximately 2,300 sites in the Site-Specific Water-Use Data System (SSWUDS) data base. Estimates and documentation produced for New Jersey for the 1990 water-use compilation were completed. All data were entered into the Aggregate Water-Use Data System (AWUDS). Plans were made to prepare a water-withdrawal report for 1990. An ARC/INFO[1] menu-driven program for mapping new water-withdrawal points was written and presented to the NJDEPE. Requests for water-use information from District personnel and the public were answered. Entering of water-withdrawal data into the data base SSWUDS will continue. The water-withdrawal report will be completed in cooperation with NJDEPE. Development of a water-use data base that will be consistent with other USGS National Water Information System (NWIS) data bases will continue. Personnel who need water-use data will be assisted.

[1]The use of brand, trade, or firm names in this report is for identification purposes only and does not constitute endorsement by the U.S. Geological Survey.

HYDROLOGIC INVESTIGATIONS (COOPERATIVE PROJECTS)

LAND SUBSIDENCE RELATED TO GROUND-WATER WITHDRAWALS IN THE COASTAL PLAIN OF NEW JERSEY (NJ036)



PROJECT CHIEF: William R. Bauersfeld
COOPERATOR(S): N.J. Department of Environmental Protection and Energy
PERIOD OF PROJECT: October 1978 to September 1990

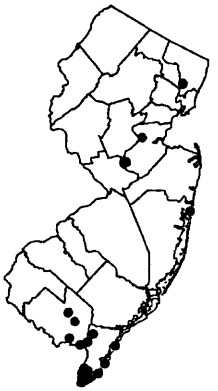
PROBLEM: Land subsidence, probably a result, in part, of a decline in artesian head (water levels), is occurring along the Atlantic coastal area of New Jersey. Data based on leveling abstracts (1924 and 1964) from the National Geodetic Survey indicate that Atlantic City and parts of the area surrounding Great Egg Harbor Bay and Absecon Bay have subsided relative to central New Jersey. Other coastal areas from Ocean City to Sandy Hook also may be affected. Subsidence can cause extensive problems, including collapse of well casings as a result of compression of compacting sediments, failure of structures and sewer lines as a result of differential subsidence of the land surface, loss of land and beaches as a result of inundation of nearshore areas, reduction in ground-water storage capacity, and acceleration of saltwater intrusion into freshwater aquifers.

OBJECTIVE: Knowledge of the magnitude and extent of subsidence is essential in order to successfully manage these highly productive fresh-ground-water reservoirs without severely affecting engineering structures, beaches, and streams. The purpose of this study is to obtain vertical control on the land surface to define the extent, rate, and magnitude of subsidence, and to determine the depth range within which compaction of sediments is occurring.

APPROACH: (1) Monitor compaction with recorder in rehabilitated well in Atlantic City. Also measure water-level changes in nearby wells within the depth range of pumped wells. (2) Establish a network of benchmarks throughout the areas of suspected subsidence. This network will include the lines of earlier leveling and will be tied to them. Releveling of the subsidence network will be done wherever indicated. (3) Collect cores of fine-grained sediments, where possible, for laboratory testing of consolidation characteristics.

PROGRESS AND PLANS: Data are collected on graphic charts. During 1980-91, 0.05 foot of subsidence was measured. Project work was transferred into the Ground-Water Stations project (NJ002) as of October 1990.

GEOPHYSICAL CHARACTERISTICS OF AQUIFERS IN NEW JERSEY (NJ047)



PROJECT CHIEF: G. Allan Brown
COOPERATOR(S): N.J. Department of Environmental Protection and Energy
PERIOD OF PROJECT: October 1980 to September 1991

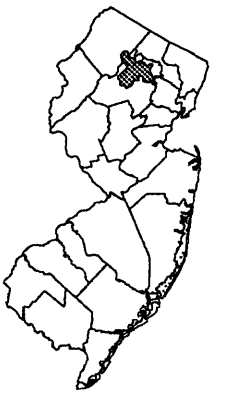
PROBLEM: Increased ground-water pumpage in the State of New Jersey necessitates the continued collection and analysis of geophysical data to determine the subsurface character and extent of the aquifers, confining units, and contained fluids of the ground-water system. These data are needed to define the geohydrologic framework for the solution of local and regional problems and as input to the development and construction of regional simulation models that are used in the planning and management of the ground-water resources.

OBJECTIVE: Obtain geophysical data in selected areas throughout the State to (1) identify lithologic variations in stratigraphy; (2) identify vertical variations in salinity; (3) identify fracture zones and zones of high permeability in bedrock areas; (4) document vertical temperature variations; (5) determine direction and velocity of borehole flow; (6) verify well-construction data before observation-well use or testing (for example, well-screen size and depth); (7) determine integrity of well casings where freshwater aquifers are contaminated with saltwater; (8) identify wells that can be added to the observation-well network; and (9) determine thickness of glacial deposits in buried valleys.

APPROACH: Anticipate areas of need, then design and implement the type of geophysical survey appropriate in the investigation of ground-water reservoirs. In the southern part of the State, geophysical logs will be made for selected new and previously installed water-supply and test wells as logging opportunities arise. In this way, a comprehensive file of geophysical-log data will be made available for interpretation of aquifer, ground-water, and water-well characteristics. Tables and location maps generated from computerized log data will be used to evaluate potential sites for collection of additional geophysical data. Geophysical logs will be made of observation and test wells to verify well depth, diameter, and casing integrity before these wells are used for hydrologic-data collection. Geophysical-logging techniques will be used to analyze the structural integrity of wells in which changes in water quality are found where structural casing failure may endanger the quality of freshwater in the aquifer. Close contact with well drillers, well owners, and the NJDEPE, which issues well-drilling permits, provides the opportunity to identify wells suitable for inclusion in the observation-well network. Surface and borehole geophysics will be used to investigate glacial deposits in buried valleys in the northern part of the State.

PROGRESS AND PLANS: In 1991, 51 logs were run in 23 wells at 18 sites (see map). Of these wells, 19 were in Coastal Plain sediments and 4 were in bedrock. Many logs were digitized and entered into the geophysical-log data base. Project was suspended in October 1991 because of lack of funding.

GROUND-WATER-RESOURCES INVESTIGATION OF THE ROCKAWAY RIVER BURIED VALLEY (NJ094)



PROJECT CHIEF: Alison D. Gordon
COOPERATOR(S): N.J. Department of Environmental Protection and Energy
PERIOD OF PROJECT: October 1986 to September 1990

PROBLEM: A State-mandated minimum passing flow of 7 million gallons per day must be maintained in the Rockaway River above the Boonton Reservoir in order to ensure an adequate supply of freshwater to communities below the Reservoir. Effects of pumping on ground-water discharge to the Rockaway River must be quantified in order to manage reservoir supply. The buried-valley aquifer system supplies both the reservoir and water for wells that are screened in both the unconfined and leaky confined aquifers. Water-resource managers and purveyors are concerned about possible effects of pumping, such as well-field interference and streamflow depletion.

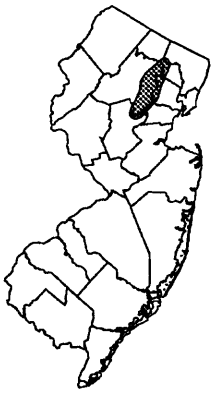
OBJECTIVE: (1) Quantify water-level declines and streamflow depletion that occur within the buried-valley aquifer system under current and predicted conditions, (2) determine ground-water discharge to the Rockaway River above the Boonton Reservoir under current conditions and under predicted ground-water-withdrawal scenarios.

APPROACH: Compile data from previous studies that describe extent and thickness of unconsolidated buried-valley aquifers and confining units. Collect and analyze data to describe water levels and stream base flow in response to current pumping. Use ground-water flow model to assess quantitative effects of ground-water withdrawals on flow to the Boonton Reservoir and on water levels and stream base flow throughout the upper Rockaway River valley, during both current conditions and conditions of predicted increased development of ground water.

PROGRESS AND PLANS: Collection of hydrologic field data has been completed. The ground-water flow simulation model has been calibrated to average hydrologic conditions in the late 1980's. Hydrologic information and model simulation results were used to evaluate the effects of ground-water withdrawals on the aquifer system and stream base flow. A simulation of future ground-water withdrawals will be made and used to evaluate the potential effects of future development on water resources.

VALLEY-FILL HYDROLOGIC SYSTEMS: CENTRAL PASSAIC RIVER BASIN (NJ095)

PROJECT CHIEF: Julia L. Barringer
COOPERATOR(S): N.J. Department of Environmental Protection and Energy
PERIOD OF PROJECT: October 1986 to September 1990



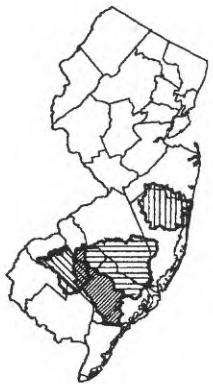
PROBLEM: Throughout northern New Jersey, the hydrologic systems are essentially individual systems operating independently in each of the valley-fill deposits. Rapid development of this area has resulted in a broad spectrum of hydrogeologic problems, such as ground-water contamination, well-field interference, and streamflow depletion. The development and associated hydrologic effects have constrained personnel responsible for the State's water-allocation process from making informed decisions based on up-to-date information. Although the ground-water supplies of some of these watersheds have been investigated previously, none of these studies is recent. The central part of the Passaic River basin is of particular interest because of population growth in that area.

OBJECTIVE: To develop a water-quality data base for glacial and bedrock aquifers in the Passaic River basin, and to analyze those data. The study will assist NJDEPE in determining (1) the present state of the water quality, and (2) the susceptibility of the ground water to contamination.

APPROACH: The approach includes (1) the compilation of available water-quality data and establishment of a data base, (2) development of a water-quality-data collection network, (3) sampling and analysis of ground-water samples, and (4) interpretation and definition of geochemical systems.

PROGRESS: Data collection, analysis, and interpretation are completed. The final report is in the last stages of review. The quality of water in the glacial aquifer generally is similar to that in the bedrock aquifers. The water contains small concentrations of dissolved solids. Water in the sedimentary bedrock aquifer generally contains larger concentrations of barium, calcium, magnesium, strontium, and sulfate than does water from either the glacial or basalt bedrock aquifer.

WATER RESOURCES OF THE UNCONFINED AQUIFER SYSTEM IN SELECTED RIVER BASINS IN THE COASTAL PLAIN OF NEW JERSEY (NJ096)



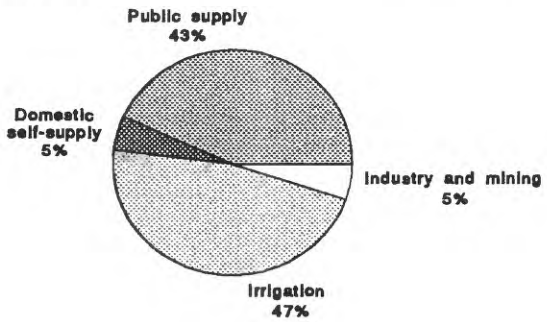
PROJECT CHIEF: Martha K. Watt
COOPERATOR(S): N.J. Department of Environmental Protection and Energy
PERIOD OF PROJECT: October 1986 to September 1995

PROBLEM: Increased ground-water withdrawals from the unconfined Kirkwood-Cohansey aquifer system are anticipated in the near future as a result of legislation that will limit water withdrawals from confined aquifers in the area. Hydrologic conditions within the Kirkwood-Cohansey aquifer system have not been studied extensively; therefore, any management decisions pertaining to optimal use of the aquifer would be made without strong scientific basis.

OBJECTIVE: To determine the quantity and quality of ground water in the Kirkwood-Cohansey aquifer system for selected surface-water drainage basins in the Coastal Plain.

APPROACH: (1) Document water levels and measure seasonal fluctuations, (2) generate a geohydrologic map and section, (3) define the hydraulic character of the aquifer and the relations between the ground water and surface-water bodies, (4) assess present ground- and surface-water withdrawals and develop a water budget of the study area, (5) conduct a survey of ambient ground- and surface-water quality. Initial study areas include the following drainage basins: Great Egg Harbor River, Maurice River, Toms River, and Mullica River.

PROGRESS AND PLANS: Studies on the Great Egg Harbor River, the Maurice River, and the Metedeconk and Toms Rivers have been completed. A study of the surficial aquifer in the Mullica River basin is planned for next year.



Water-use category	Million gallons	Inches over the basin
Public supply	1,062.95	0.176
Domestic self-supply	129	.021
Irrigation	1,154.17	.191
Industry and mining	128.33	.021
Total consumptive use	2,470	0.409

Figure 9.--Summary of consumptive water use in the Great Egg Harbor River basin. (From Watt, M.K., and Johnson, M.L., 1992, Water resources of the unconfined aquifer system of the Great Egg Harbor River basin, New Jersey, 1989-90: U.S. Geological Survey Water-Resources Investigations Report 91-4126, fig. 5-3.)

REMOVAL OF VOLATILE GROUND-WATER CONTAMINANTS BY INDUCING AIR-PHASE TRANSPORT (NJ098)

PROJECT CHIEF: Jeffrey M. Fischer
COOPERATOR(S): N.J. Department of Environmental Protection and Energy
PERIOD OF PROJECT: October 1987 to September 1990

PROBLEM: Contamination from spills of organic liquids like gasoline and chlorinated solvents has been identified as the greatest threat to the ground-water resources of New Jersey. The portion of the spill remaining in the unsaturated zone can provide a long-term source of contamination as a result of vapor and solute transport from residual saturations. A need exists to develop and evaluate techniques for removing these contaminants from the unsaturated zone. This study focuses on the evaluation of contaminant removal by inducing air-phase transport.

OBJECTIVE: To develop field methods to document recovery of volatile contaminants and rates of microbial degradation associated with an actual venting system. To field test a method for removing volatile organic contaminants from shallow ground water involving the injection of air beneath the water table. To develop a mathematical model to predict air flow and vapor transport associated with induced venting of the unsaturated zone. To develop guidelines for applying this model to determine venting feasibility and optimize borehole configuration.

APPROACH: An existing site of gasoline contamination within the New Jersey Coastal Plain will be selected. A venting installation will be designed based on in situ determinations of unsaturated-zone properties. Air withdrawn from the unsaturated zone will be analyzed for hydrocarbons, oxygen, carbon dioxide, and methane. After baseline levels are determined, the saturated-zone recovery phase, consisting of injecting air beneath the water table, will be initiated. The transport of organic compounds across the water table will be monitored by continued venting of the unsaturated zone. Water may be circulated in the saturated zone to enhance recovery rates. Modeling will consist of two- and three-dimensional vapor-transport descriptions.

PROGRESS AND PLANS: The final report was completed. Microbial degradation of hydrocarbons was studied and rates were quantified. A mathematical model of convective air flow in the subsurface was developed. The project was completed.

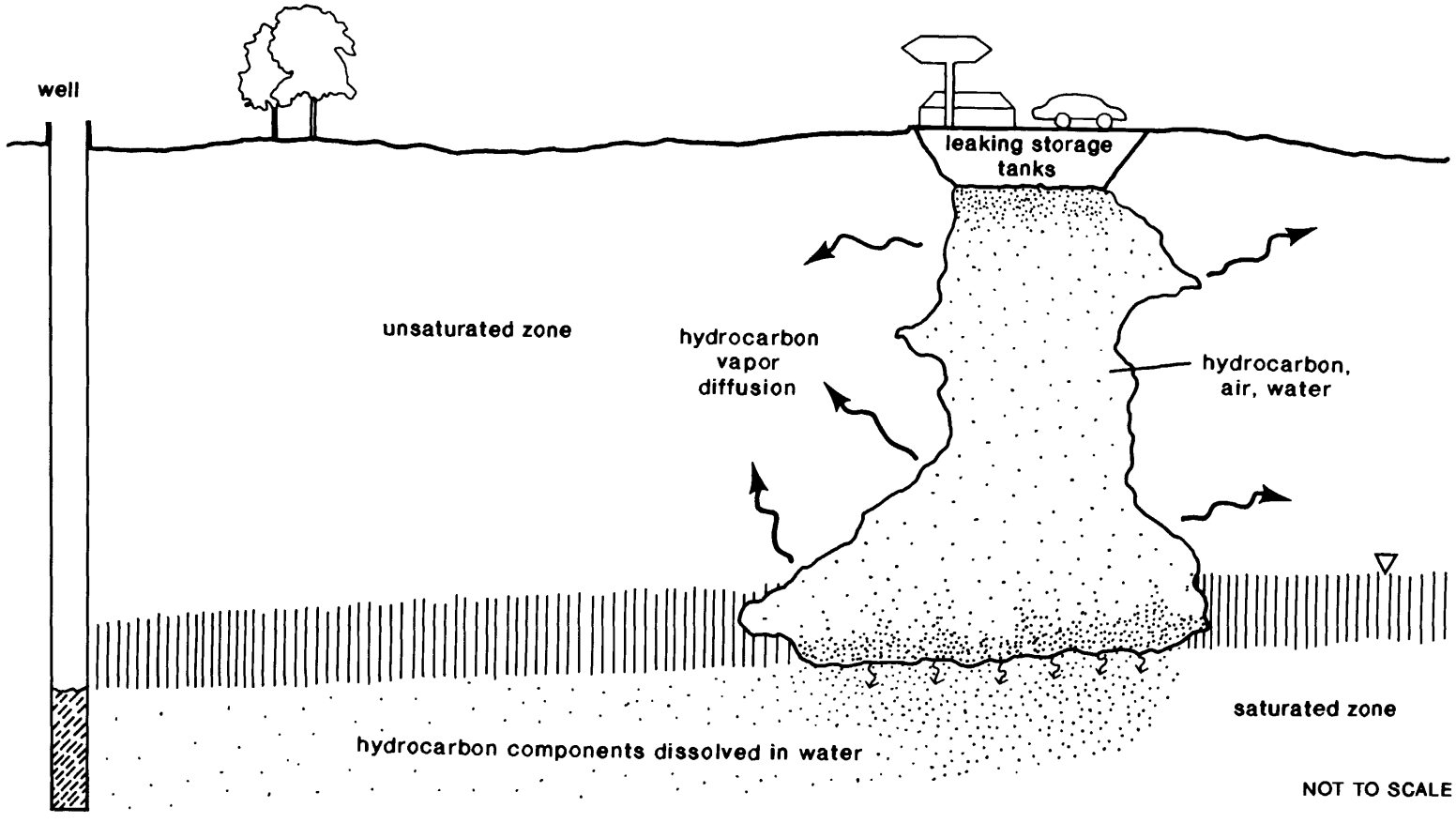
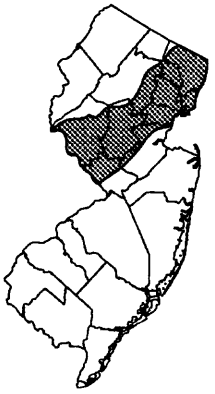


Figure 10.--Transport of spilled hydrocarbons in the subsurface under natural conditions. (From Fischer, J.M., Baehr, A.L., and Smith, N.P., 1991, An investigation of the transport and microbial degradation of hydrocarbons in the subsurface at a gasoline spill site in Galloway Township, New Jersey, in Mallard, G.E., and Aronson, D.A., eds., U.S. Geological Survey Toxic Substances Hydrology Program--Proceedings of the technical meeting, Monterey, California, March 11-15, 1991: U.S. Geological Survey Water-Resources Investigations Report 91-4034, fig. 1, p. 243.)

MOBILITY, TRANSPORT, AND FATE OF NATURALLY OCCURRING RADIONUCLIDES IN GROUND WATER, NEWARK BASIN, NEW JERSEY (NJ099)



PROJECT CHIEF: Zoltan Szabo
COOPERATOR(S): N.J. Department of Environmental Protection and Energy
PERIOD OF PROJECT: October 1987 to September 1992

PROBLEM: Elevated levels of radon, uranium, and radium have been detected in ground water in the Newark Basin. Results of previous studies have been used to describe geologic and geochemical factors controlling their distribution and concentrations. Additional work is needed to determine the mechanisms that control radionuclide mobility, transport, and fate in ground water in this fractured-rock terrain. These mechanisms are of considerable interest and are a major environmental concern because radionuclides pose a potential hazard to human health.

OBJECTIVE: (1) Determine factors controlling the mobility and fate of radionuclides along ground-water flow paths, (2) define mechanisms that release radionuclides to ground water or retain them in aquifer solids and determine the effect of water-rock interactions in controlling radionuclide concentration, and (3) characterize the spatial variation of radionuclide concentrations at selected sites and factors that affect parent/daughter activities and isotope ratios.

APPROACH: Ground-water flow and aquifer characteristics at three study sites will be defined by using borehole geophysics, aquifer tests, and packer tests. Observation wells will be installed along selected gradients. Test drilling will be used to obtain uranium-enriched core material. Rock analyses will be used to study the sources and sinks of radium, uranium, and radon. Detailed ground-water sampling and chemical modeling will be used to define reactions along flow paths.

PROGRESS AND PLANS: Uranium mineralization and mechanisms controlling uranium distribution and variability in specific rock types have been defined from extensive rock cores obtained by test drilling. The distribution of radionuclides in ground water was defined on the basis of uranium distribution in the aquifer matrix and the geochemistry of the water. Plans are to determine the potential mobility of radionuclides from results of permeability analysis and data on mineral distribution in specific rock types.

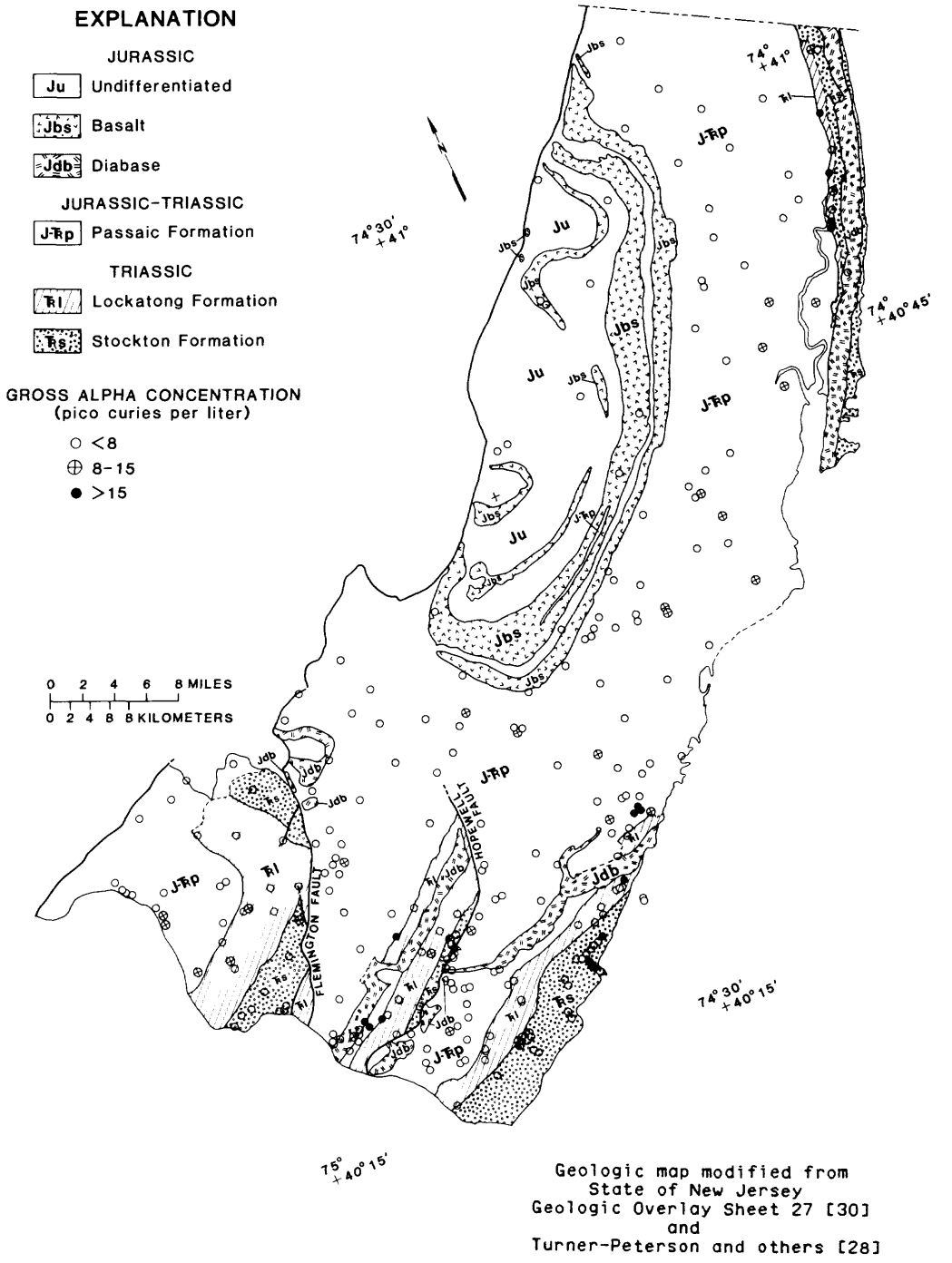
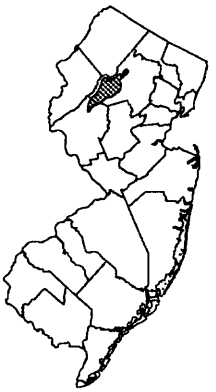


Figure 11.--Gross alpha-particle activities in ground water, Newark Basin, New Jersey. (From Zapecza, O.S., and Szabo, Zoltan, Source and distribution of natural radioactivity in ground water in the Newark Basin, New Jersey, in Graves, Barbara, ed.: Proceedings of the National Water Well Association Conference on Radon, Radium, and other Radioactivity, April 7-9, 1987, Somerset, New Jersey, fig. 4, p. 59.)

HYDROGEOLOGY OF THE VALLEY-FILL AND CARBONATE-ROCK AQUIFERS NEAR LONG VALLEY IN THE NEW JERSEY HIGHLANDS (NJ100)



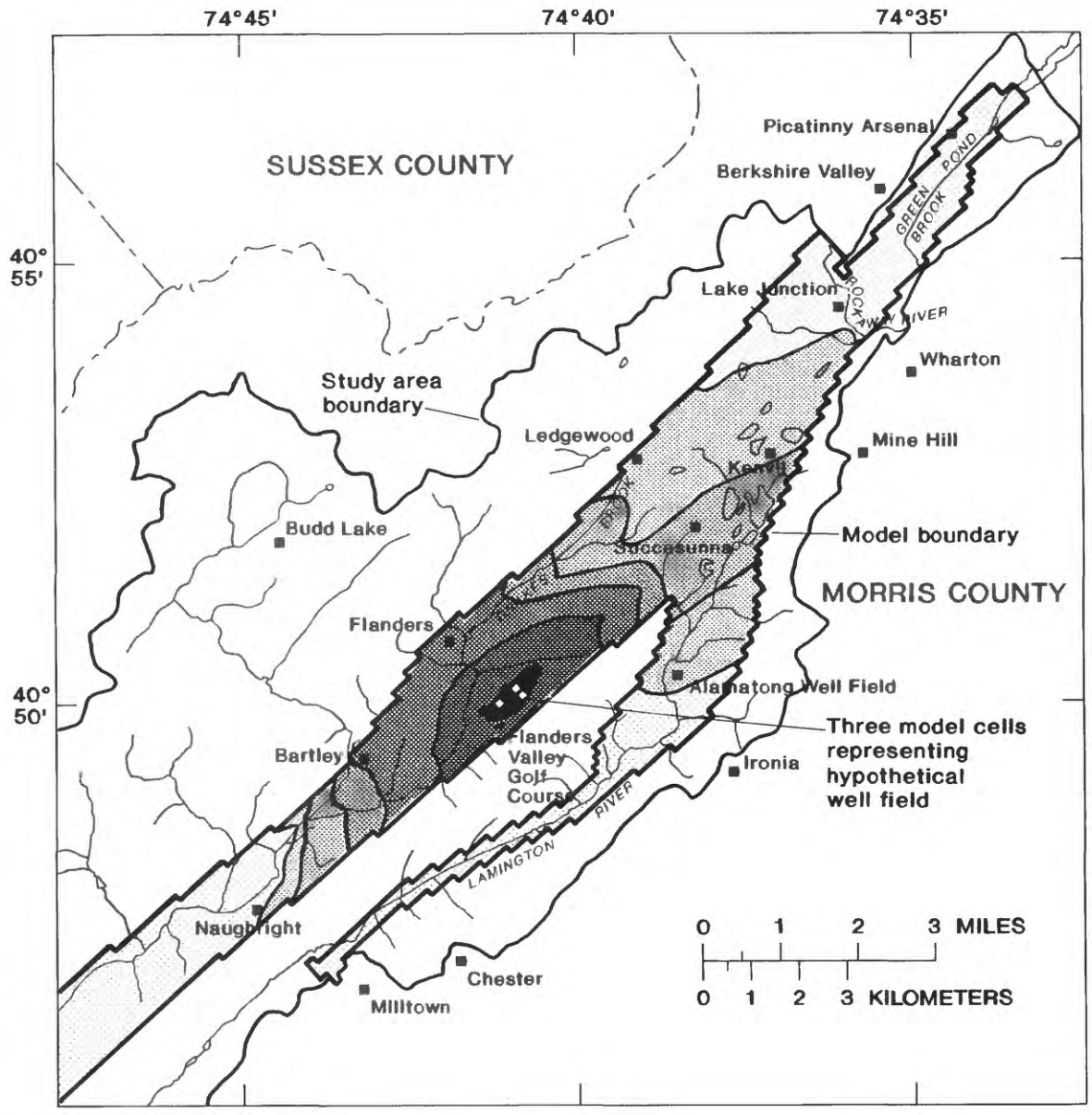
PROJECT CHIEF: Robert S. Nicholson
COOPERATOR(S): N.J. Department of Environmental Protection and Energy
PERIOD OF PROJECT: October 1987 to September 1991

PROBLEM: Residential and commercial development in the New Jersey Highlands in western Morris County and northeastern Hunterdon County, New Jersey, has resulted in concern about the adequacy of ground-water supplies to meet predicted water needs, and has the potential to result in hydrogeologic problems, such as ground-water contamination, well-field interference, and streamflow depletion. Understanding of hydrogeologic processes in the area is insufficient to address these potential problems.

OBJECTIVE: To evaluate the hydrogeology of the valley-fill and carbonate-rock aquifers in the study area by means of (1) hydrogeologic assessment of the aquifers and present hydrologic conditions, and (2) simulation of present and predicted future hydrologic conditions with numerical ground-water-flow modeling techniques.

APPROACH: Collect and analyze data to describe water-level, water-quality, and streamflow conditions prevailing under the current level of ground-water development. Data analysis and interpretation will include a hydrogeologic assessment of current conditions, a description of geochemical processes and ambient water quality, and use of a numerical ground-water-flow model to further evaluate current conditions and to predict system responses to additional development of the ground-water supply.

PROGRESS AND PLANS: Plan-of-study report was approved. Data collection was completed. Geochemical statistical analyses and interpretations are nearly complete. The ground-water-flow model was calibrated to hydrologic conditions in the mid-1980's. The model will be used to simulate the hydrologic effects of alternative ground-water-withdrawal scenarios.



EXPLANATION

CHANGE IN AVERAGE WATER LEVEL, IN FEET

[Negative values indicate water-level decline; > Greater than; ≤ Less than or equal to]

> -1 to 0	> -18 to ≤ -12
> -4 to ≤ -1	> -24 to ≤ -18
> -8 to ≤ -4	> -28 to ≤ -24
> -12 to ≤ -8	

Figure 12.--Simulated changes in average water levels in the carbonate-rock aquifer resulting from an additional withdrawal of 5.7 million gallons per day from a hypothetical well field tapping the carbonate-rock aquifer. (From Nicholson, R.S., McAuley, S.D., Barringer, J.L., and Gordon, A.D., in press, Hydrogeology of, and ground-water flow in, a valley-fill and carbonate-rock aquifer system near Long Valley in the New Jersey Highlands: U.S. Geological Survey Water-Resources Investigations Report 93-4157, fig. 51.)

SIMULATION AND EXPERIMENTAL INVESTIGATION OF HYDROCARBON TRANSPORT AND BIODEGRADATION IN THE UNSATURATED ZONE (NJ106)

PROJECT CHIEF: Arthur L. Baehr
COOPERATOR(S): N.J. Department of Environmental Protection and Energy
PERIOD OF PROJECT: October 1988 to September 1990

PROBLEM: Analyzing the transport and biodegradation of volatile organic contaminants in the unsaturated zone is difficult because of the complexities inherent in considering the gaseous phase. Because contaminated soils resulting from leaking tanks can pose a long-term threat to ground-water quality, development of an understanding of these transport mechanisms is essential.

OBJECTIVE: To conduct laboratory experiments to determine the relative importance of advective and diffusive transport mechanisms and to quantify the biodegradation rate of selective hydrocarbons and chlorohydrocarbons. To construct a mathematical model to describe the experiments and to extend findings to field studies.

APPROACH: The experiments focusing on advective-diffusive mechanisms are to be conducted in aluminum column reactors at the University of Lowell, Lowell, Mass. Biological experiments are to be conducted in glass column reactors in the New Jersey District laboratory. The mathematical model under development is multiphase and compositional.

PROGRESS AND PLANS: Further experiments were designed and initiated on the basis of results of prototype glass reactor experiments. A successful method to inoculate sediment with microbes was developed. A final report, titled "Application of the Stefan-Maxwell equations to determine limitations of Fick's Law when modeling organic vapor transport in sand columns," by Arthur L. Baehr and Clifford J. Bruell, was published in the journal Water Resources Research. The project is completed.

WATER RESOURCES OF, AND SALTWATER INTRUSION IN, CAPE MAY COUNTY, NEW JERSEY (NJ108)

PROJECT CHIEF: Pierre J. Lacombe
COOPERATOR(S): N.J. Department of Environmental Protection and Energy
PERIOD OF PROJECT: October 1988 to September 1993

PROBLEM: Ground-water withdrawals from the five aquifers of Cape May County have reduced ground-water levels below the level that is required to balance the saltwater/freshwater interface in these aquifers. As a result of the sustained ground-water withdrawals and subsequent lowering of water levels, the saltwater/freshwater interface has moved landward in many coastal areas. Since 1940, more than 20 public and industrial supply wells and more than 100 domestic supply wells have been abandoned because of saltwater contamination. In particular, Cape May Point, Cape May City, the Wildwood communities, and Stone Harbor Manor have abandoned public supply wells because the water became salty. Three industries located in these same areas also have abandoned supply wells because of saltwater intrusion. Domestic supply wells at more than 50 homes have been abandoned because the well water became salty.

OBJECTIVE: Investigate the effects of present and future ground-water-supply development on water levels, streamflow, and saltwater movement in both the shallow aquifer system and the deep regional confined flow system. Conduct a comprehensive hydrologic appraisal of the aquifers through collection and analysis of geohydrologic-framework, water-level, water-quality, streamflow, and pumpage data. Results of the appraisal will be used to provide the conditions from which the flow-system response to development will be quantified by using numerical ground-water flow models.

APPROACH: Map extents and thicknesses of all supply aquifers and intervening confining units under Delaware Bay. Refine mapping of hydrogeologic units in Cape May County to include additional detail. Measure and map water levels to determine flow directions, recharge areas, and discharge areas in all aquifers. Measure stream base flows to quantify ground-water discharge rates. Determine flow directions and travel times for salty water to reach public supply wells in deep confined aquifers under current conditions and predicted conditions. Use ground-water flow model coupled with the regional sharp-interface model (SHARP) to simulate effects of moving interface on ground-water velocities near pumping centers. Refine determination of areas of salty water and analyze general effects of land use on shallow ground-water quality in the shallow flow system by means of drilling and water-quality sampling. Use SHARP numerical model to quantify movement of salty water toward pumping centers, to delineate changes in recharge areas, and to quantify streamflow depletion under both current and predicted conditions.

PROGRESS AND PLANS: The water-quality, water-level, and streamflow-gaging networks have been maintained since October 1990. The description of the geohydrologic framework is complete and the framework has been depicted in a series of structure-contour maps and hydrogeologic sections. Measured hydraulic-head data are being mapped to define the patterns of ground-water flow. These results will be used to calibrate two ground-water flow models--one of the deep system (the Atlantic City 800-foot sand), and one of the shallow system (the Cohansey Sand, the estuarine sand, and the Holly Beach water-bearing zone).

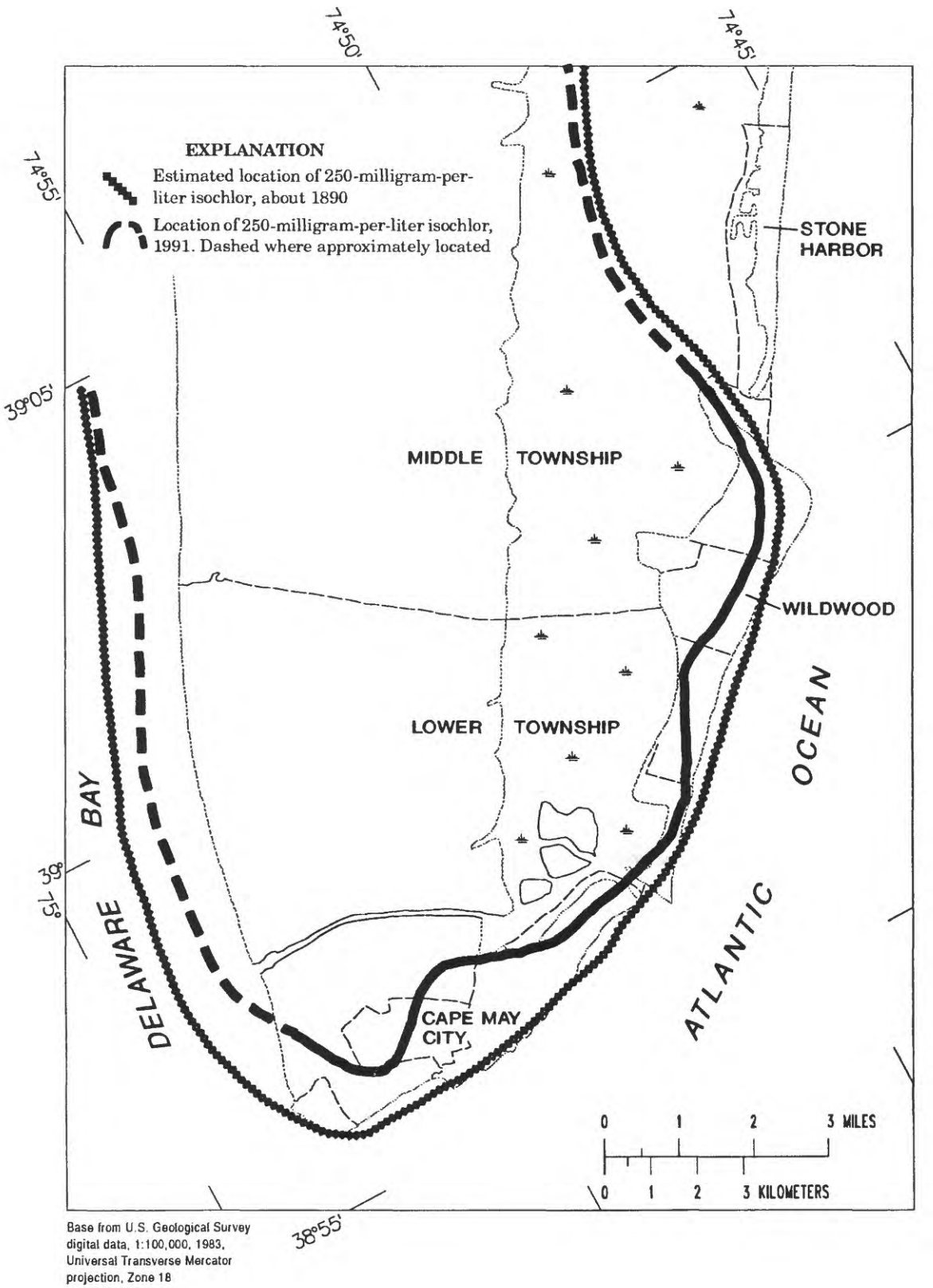


Figure 13.--Estimated locations of the 250-milligram-per-liter isochlor in the Cohansey Sand in the Cape May City area about 1890 and 1991. (Modified from The Future Availability of Ground Water Resources, American Water Resources Association, April 1992, fig. 4b, p. 291.)

EFFECTS OF STREAMFLOW DIVERSIONS ON THE QUALITY OF WATER IN SELECTED NEW JERSEY ESTUARIES (NJ112)

PROJECT CHIEF: Robert E. Hickman
COOPERATOR(S): N.J. Department of Environmental Protection and Energy
PERIOD OF PROJECT: October 1988 to September 1991

PROBLEM: The State of New Jersey would like to know the effects of proposed surface-water diversions on the water quality and biota of selected estuaries. The State is considering initiating surface-water diversions on three streams and increasing the current rate of diversion on a fourth stream; all four streams discharge to estuaries. Estuarine salinity, water temperature, plant nutrient concentrations, and water-surface elevations are of special concern to the State.

OBJECTIVE: (1) To determine the streamflow characteristics of a selected group of tributaries to southern New Jersey estuaries. (2) To conduct reconnaissance surveys of water quality of estuaries during various seasons.

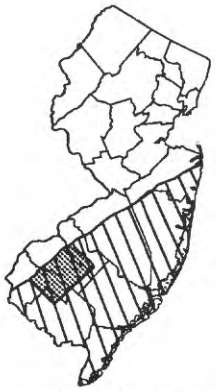
APPROACH: For the first objective, streamflows contributing to Great Egg Harbor and Barnegat Bay will be determined on the basis of available discharge data. Relations between discharge and the head of tide will be evaluated. Data on temperature, salinity, and dissolved-oxygen concentration will be collected in the field to fulfill the second objective. The Metedeconk, Toms, Great Egg Harbor, Tuckahoe, and Maurice Rivers will be sampled, primarily during periods of low inflow from freshwaters. Cross-sectional grab samples will be collected.

PROGRESS AND PLANS: Two reports have been approved. One describes the variation of streamflow through time in tributaries of selected estuaries. The second is a data report presenting results of reconnaissance surveys of estuarine water quality in 1989. Project was completed.

South River near Mays Landing, Atlantic County.

MOBILITY, TRANSPORT, AND FATE OF NATURALLY OCCURRING RADIONUCLIDES IN GROUND WATER IN THE KIRKWOOD-COHANSEY AQUIFER SYSTEM, COASTAL PLAIN, NEW JERSEY (NJ113)

PROJECT CHIEF: Zoltan Szabo
COOPERATOR(S): N.J. Department of Environmental Protection and Energy
PERIOD OF PROJECT: October 1989 to September 1992



PROBLEM: Elevated levels of dissolved radium have been detected in ground water in the Kirkwood-Cohansey aquifer system. High levels of radium in ground water may increase cancer risks if ingested. Little work has been conducted to determine the mechanisms that control the mobility, transport, and fate of the natural radionuclides in ground water in a Coastal Plain aquifer system. These mechanisms are of considerable interest and are a major environmental concern.

OBJECTIVE: This study proposes to define geochemical and hydrologic processes that, coupled with mineral distribution in the aquifer, control radium, uranium, and radon availability and movement in ground water in the Kirkwood-Cohansey aquifer system in the Coastal Plain of southern New Jersey.

APPROACH: The approach includes (1) ground-water sampling to define the distribution of naturally occurring radionuclides and their relations with other chemical constituents, (2) installation of nested monitoring wells for sample collection and geochemical analysis and modeling along vertical flow paths, (3) mineralogical analyses of aquifer material to identify source minerals and mechanisms of mobilization, (4) analysis of radium isotope ratios to determine where radium is being leached most effectively in the aquifer, and (5) use of radon emanation coefficients to determine the amount of accessible radium in the aquifer medium.

PROGRESS AND PLANS: Nested monitoring wells were sampled, and water levels were measured. Inorganic, radiochemical, and pesticide constituents were found to vary in concentration by orders of magnitude even with small changes in depth, with higher concentrations at shallow depths. Plans are to complete geochemical modeling by examining potential sorption capacity of aquifer matrix, and to simulate a generic flow system by using head measurements at a nested-well site to describe migration of radium-laden water through the hydrologic system.

OPTIMIZATION OF GROUND-WATER-WITHDRAWAL STRATEGIES FOR THE COASTAL PLAIN AQUIFER SYSTEM OF NEW JERSEY (NJ114)

PROJECT CHIEF: Daryll A. Pope
COOPERATOR(S): N.J. Department of Environmental Protection and Energy
PERIOD OF PROJECT: October 1989 to September 1992

PROBLEM: Ground water is the major source of water supply in the New Jersey Coastal Plain. Ground-water policy in this area has developed within the framework of a permit process by which applications for additional withdrawals are approved on a well-by-well basis. As a result, withdrawals have been concentrated near population centers, causing critical water-supply problems in these areas. Detailed evaluation of the response of the ground-water system to the combined effects of Coastal Plain withdrawals is needed.

OBJECTIVE: The primary objective of this investigation is to provide a mechanism to incorporate the cause-and-effect relations between ground-water development and adverse hydrologic effects in the development of a long-term ground-water-resource management strategy for the Coastal Plain aquifer system of New Jersey. Specifically, the objectives of this study are to (1) evaluate current conditions, (2) define hydrologic criteria for use in resource optimization and planning, and (3) identify ground-water-withdrawal scenarios and determine the optimal withdrawal strategy for each scenario on the basis of the previously defined hydrologic criteria.

APPROACH: Effects of current pumpage and water demand projections through 2040 on both the saltwater and freshwater portions of the flow system and on saltwater-interface movement will be simulated by using the SHARP model. The effects of historical changes in sea level on the location of the current saltwater interface will be simulated. Model simulations of the response of the ground-water system to various future water-supply alternatives will be used to (1) provide a technical basis to define management criteria, and (2) define the extent of hydrologic effects associated with these criteria.

PROGRESS AND PLANS: Used the SHARP model to simulate the effects of changes in sea level over the last 100,000 years on the location of the saltwater interface. Used the predevelopment location of the saltwater interface as the initial condition for simulation of the stressed system for 1896-1988. Completed revisions to the description of the hydrogeologic framework. Calibration and analysis of the model for 1896-1988 will be completed. Data on water demand through 2040 will be compiled and the simulated system response to future water demand will be executed.

RELATION OF AGRICULTURAL PESTICIDE USE TO PRESENCE OF THESE PESTICIDES IN SURFACE WATERS USED FOR WATER SUPPLY IN NEW JERSEY (NJ115)

PROJECT CHIEF: Debra E. Buxton
COOPERATOR(S): N.J. Department of Environmental Protection and Energy
PERIOD OF PROJECT: October 1989 to September 1992

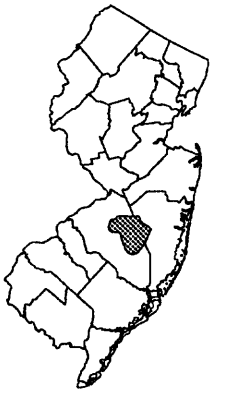
PROBLEM: The presence of pesticides in surface waters is an area of concern for the NJDEPE. Surface waters that are used as a potable supply may be affected by pesticides applied in the watershed. Water-supply purveyors must sample water at their surface-water intakes for pesticides, and the delivered water must meet drinking-water-quality standards for concentrations of pesticides. An investigation is needed to determine the presence of pesticides in surface waters of the State and to develop a vulnerability index to determine when concentrations may exceed the standards.

OBJECTIVE: To evaluate pesticide-application data in conjunction with basin soils and topographic information, to derive a surface-water pesticide contamination vulnerability index, and to determine the temporal variability of surface-water pesticide concentrations in relation to the timing of application and climatic factors.

APPROACH: Development of the vulnerability index will involve collection and development of spatial data bases that describe soils, geology, land use, pesticide-application rates, and surface-water supply intakes. On the basis of these data and the results of a previously completed reconnaissance study, two basins will be selected for sampling. The vulnerable basin will be sampled intensively over time to determine temporal variability in pesticide concentrations in relation to timing of application and climatic conditions. The control basin, in which no pesticides are applied, will be sampled less frequently. The comparison of results from the vulnerable and control basins will provide a crude initial test of the vulnerability index.

PROGRESS AND PLANS: Work has begun on determining the variables that will be used in the vulnerability index. Variables being investigated include soil parameters, basin characteristics, and hydrologic parameters. Chi-square statistics computed for two-by-two tables relating 1990 detection/non-detection levels of four classes of pesticides to selected basin characteristics have shown that several basin characteristics are significant, such as pesticide application rate, runoff, soil slope, and percent of agricultural land. Work on developing and implementing the vulnerability index will continue. Two basins, a highly vulnerable basin and a control basin, will be sampled throughout the 1992 growing season. Results will be evaluated to determine the accuracy of the vulnerability index. A report will be written describing the results of the study.

RELATIONS BETWEEN GROUND-WATER HYDROLOGY AND ECOLOGY OF WETLAND VEGETATION (NJ118)



PROJECT CHIEF: Edward Modica
COOPERATOR(S): N.J. Department of Environmental Protection and Energy
PERIOD OF PROJECT: October 1990 to September 1993

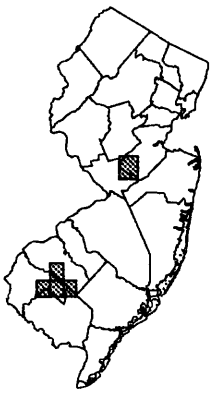
PROBLEM: Present understanding of relations between ground-water-system operation and surface-water hydrology, water quality, and vegetative ecology of wetland habitats is insufficient to permit effective management and preservation of these environments. These relations need to be quantified, and the mechanisms controlling the availability of moisture and nutrients need to be more clearly defined in order to develop the ability to predict the hydrologic effects of human activities and natural processes on wetland environments.

OBJECTIVE: (1) To quantify the processes that control local-scale variations in depth to water, ground-water discharge, and subsurface-water availability in the wetland environment; (2) estimate water-consumption requirements of vegetative communities throughout the wetland; (3) define spatial and seasonal variation in hydrologic characteristics of each vegetative community; and (4) estimate availability of nutrients transported with subsurface waters.

APPROACH: (1) The ground-water subsystem within the McDonalds Branch basin will be described and analyzed with the aid of flow simulations, (2) the structure and composition of the wetland vegetative community will be defined by means of gradient analysis, (3) the unsaturated-zone process controlling ground-water discharge to evaporation and root uptake will be evaluated,(4) water-quality samples will be collected and the analysis results will be used to develop an understanding of the flux of plant nutrients, and (5) integration and analysis of all data will be performed by use of simulations.

PROGRESS AND PLANS: A subregional model of the unconfined aquifer system underlying the upper Rancocas River basin was constructed. Preliminary analysis of flow patterns and residence times of ground water within sections of the modeled area was conducted. Observation wells will be installed in a section of the upper Rancocas River drainage area, and the subregional model will be refined and calibrated.

SOURCES OF NITRATE IN GROUND WATER IN THE NEW JERSEY COASTAL PLAIN (NJ119)



PROJECT CHIEF: Eric F. Vowinkel
COOPERATOR(S): N.J. Department of Environmental Protection and Energy
PERIOD OF PROJECT: October 1990 to September 1992

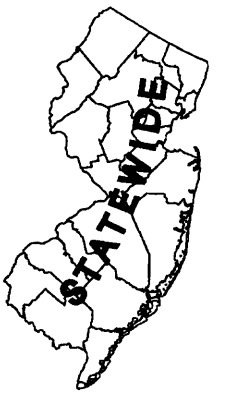
PROBLEM: The NJDEPE has determined that the presence of elevated nitrate concentrations in shallow ground water in the New Jersey Coastal Plain is a major water-quality problem. The predominant source of the nitrate in domestic wells needs to be determined. Knowledge of the sources of the nitrate contamination in water from domestic wells can help water-supply managers to prioritize strategies and to develop plans to mitigate nitrate contamination from excessive fertilization, leaky septic systems, or other sources.

OBJECTIVE: The primary objective of the research is to develop and test methods to determine the source(s) of nitrate contamination in water from domestic wells in agricultural land in the New Jersey Coastal Plain. Other water-quality constituents will be evaluated to determine whether their presence can be used as indicators of the source of nitrate contamination.

APPROACH: Previously collected ground-water-quality, hydrogeologic, and land-use information will be reviewed to improve understanding of the relations between sources and sinks of nutrients in the system. A sampling network will be designed to test hypotheses concerning the relation of nitrate concentrations to indicators of nitrate contamination. Seasonal variability of water-quality data will be tested as a possible indicator of contamination source. The sampling network will consist of 12 to 15 domestic wells located in agricultural land. Water samples will be analyzed for nutrients, nitrogen isotopes, carbamate insecticides, and triazine herbicides.

PROGRESS AND PLANS: The sampling network was designed to evaluate sources of nitrate in domestic wells in agricultural land. Ground-water sampling was conducted in April and August 1991 at 12 wells, and the water-quality data were mapped and statistically evaluated. The last two sampling rounds will be completed in November 1991 and March 1992, and the data will be evaluated.

EFFECT OF ORGANIC CATIONS ON THE TRANSPORT OF ORGANIC CONTAMINANTS THROUGH POROUS SAND AND CLAY MEDIA (NJ120)



PROJECT CHIEF: James A. Smith
COOPERATOR(S): N.J. Department of Environmental Protection and Energy
PERIOD OF PROJECT: October 1990 to September 1993

PROBLEM: Although the effect of different organic cations on contaminant sorption to pure Wyoming bentonite are known, little or no information is available with regard to multiconstituent (competitive) sorption, contaminant dispersion/diffusion, or permeability for a sand-and-clay porous medium.

OBJECTIVE: The goal of this research is to examine the effect of five organic cations of known molecular structure on contaminant sorption, dispersion/diffusion, and advection. Measurement of these properties is needed so that the effectiveness of organoclay mixtures can be evaluated for use as improved barriers to the transport of contaminants in the subsurface.

APPROACH: Contaminant sorption will be measured with batch equilibrium experiments. Permeabilities of the sand-and-clay media (treated with different organic cations) will be measured with flexible-wall permeameters. Dispersion/diffusion coefficients will be measured by means of tracer tests with tritiated water. Results will be combined in a one-dimensional solute-transport model.

PROGRESS AND PLANS: The hydraulic conductivities of six types of compacted sand-and-clay porous media have been measured in triplicate with flexible-wall permeameters. Five of the types of compacted soil cores differ only by the type of organic cation exchanged onto the clay. The sixth type of soil core does not have any organic cation exchanged onto its mineral surface. For all types of soil cores, the measured hydraulic conductivities are less than 10^{-8} meters per second. A one-dimensional solute-transport model with nonlinear sorption is being developed. Tracer tests will be conducted to measure the dispersion/diffusion coefficients for six types of sand-and-clay porous media. Development of the solute transport model will be completed. Batch sorption experiments will be conducted to study competitive sorption. Experimental data on sorption, hydraulic conductivity, dispersion, and diffusion will be incorporated into the solute-transport model to simulate contaminant migration through a landfill liner.

EFFECTS OF FRESHWATER WITHDRAWALS ON ESTUARINE WATER QUALITY OF THE TOMS AND METEDECONK RIVERS (NJ121)

PROJECT CHIEF: Robert E. Hickman
COOPERATOR(S): N.J. Department of Environmental Protection and Energy
PERIOD OF PROJECT: October 1990 to September 1993

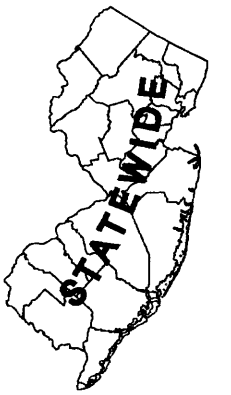
PROBLEM: New Jersey water-management officials need to know the effects of present and future freshwater withdrawals in the drainage basins of the Toms and Metedeconk Rivers on the quality of water in the estuaries downstream. Ground water is withdrawn from the unconfined (water-table) aquifers of both basins, and surface water is diverted from the Metedeconk River. Both types of withdrawals reduce river discharge, and both types of withdrawals are expected to increase in the future. Of special interest to State water managers is the effect of reduced freshwater river discharge on the locations of the saltwater front in these rivers.

OBJECTIVE: (1) Determine relations between the locations of the saltwater front and river discharge in both the Toms and Metedeconk Rivers, (2) determine how the saltwater fronts will change as a result of reduced river discharge, and (3) provide information on how plant nutrient concentrations in the estuaries will change with reduced river discharges.

APPROACH: (1) In conjunction with the State of New Jersey, conduct a year-long field program to measure tide, river discharge, and estuarine water quality, including salinity; (2) use correlation techniques to develop relations between saltwater-front location, tide, estuarine salinity, and river discharge; (3) attempt to adapt a 1- or 2-dimensional flow model to simulate the locations of the saltwater fronts as a function of river discharge; (4) use one or both methods to determine the effect of reduced river discharge on the locations of the saltwater fronts; and (5) provide information on the effect of reduced river discharges on plant nutrient concentrations in the estuaries by examining the year-round variation of estuarine plant nutrient concentrations with salinity.

PROGRESS AND PLANS: Developed draft work plan for the study to determine the effects of diversions on water quality in the estuaries of the Toms and Metedeconk Rivers and submitted it to the NJDEPE. Plans are to finalize the work plan and initiate data collection.

REGIONALIZATION OF LOW FLOWS FOR NEW JERSEY STREAMS (NJ040)



PROJECT CHIEF: Robert G. Reiser
COOPERATOR(S): Morris County Municipal Utilities Authority, N.J. Department of Environmental Protection and Energy, North Jersey District Water Supply Commission, and Passaic Valley Water Commission
PERIOD OF PROJECT: Continuous since 1979

PROBLEM: No previous attempt has been made to regionalize low-flow relations of New Jersey streams. Except at the approximately 100 continuous-record and 300 partial-record sites distributed throughout the State, low-flow frequencies, such as the 10-year 7-day low flows, are relatively unknown. Therefore, regional low-flow relations must be determined to allow an accurate estimate of low-flow frequencies for ungaged sites. This information is used in a wide variety of water-resource planning and management efforts.

OBJECTIVE: To determine regional low-flow relations for both the 2-year and 10-year 7-day low flows throughout New Jersey, so that accurate estimates of these values at ungaged sites can be made.

APPROACH: All low-flow relations will be estimated by standard regionalization techniques, such as multiple-regression analysis. Characteristics of drainage basins for which low-flow relations have previously been determined will be used as parameters in the regression analysis. To reduce the standard error of the regression equations, the State may be divided into subareas where local geologic conditions are relatively homogeneous.

PROGRESS AND PLANS: Low-flow discharge measurements were made at 48 active sites statewide during 1991. Measurements at nine sites at which data were sufficient were discontinued. Nine new sites have been added to the active list. Base-flow discharge measurements also were made at 11 water-quality sites that formerly were low-flow sites. Monthly base-flow discharge measurements were made at 10 sites in Monroe Township and at 12 new sites in the upper Mullica River basin. Updating of flow-duration statistics and low-flow frequency analyses at continuous-record gaging stations through the 1990 water year was begun. A WATSTORE program was developed for running daily, monthly, and annual statistics for a gaging station and for entering these statistics into the streamflow/basin characteristics file. The FLOWSTAT program was installed on the District computer to compile statistics in a condensed report. A comparison between results obtained with the midline regression technique, used in Gillespie, B.D., and Schopp, R.D., 1982, Low-flow characteristics and flow duration of New Jersey streams: U.S Geological Survey Open-File Report 81-1110, 164 p., and the MOVE1 regression technique (Hirsch, R.M., 1982, A comparison of four streamflow record extension tchniques: Water Resources Research, v. 18, no. 4, p. 1081-1088) was completed for selected partial-record sites throughout the State. Data collected at active partial-record stations will be analyzed. Ten to twenty percent of the active low-flow sites will be replaced statewide. Updating low-flow statistics for continuous-record sites will be completed. Low-flow correlation analysis for partial-record stations will be run by using the MOVE1 regression technique, and results will be published in a data report.

FLOOD CHARACTERISTICS OF NEW JERSEY STREAMS
(NJ054)

PROJECT CHIEF: Robert D. Schopp
COOPERATOR(S): Bergen County, Brick Township Municipal Utilities Authority, N.J. Department of Environmental Protection and Energy, and West Windsor Township
PERIOD OF PROJECT: Continuous since 1981

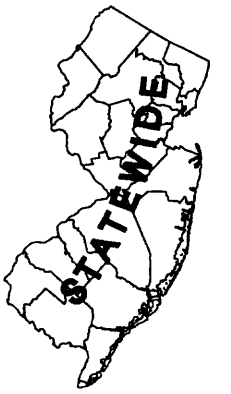
PROBLEM: Water-management officials of Federal, State, and local agencies need flood-peak data for zoning, building permits, and flood protection. Flood data needed are high-water elevations, flood discharges, and flood-frequency information. In previous reports, equations relating peak discharge to basin characteristics were developed. An additional 46 percent station years of flood data are now available for analysis. Many of the additional data are for small drainage areas where previous work has been limited.

OBJECTIVE: (1) To update and refine the previous study of magnitude and frequency of floods in New Jersey (Stankowski, S.J., 1974, Magnitude and frequency of floods in New Jersey with effects of urbanization: New Jersey Department of Environmental Protection Special Report 38, 46 p.), and (2) to continue the collection and annual publication of high-water elevations and flood discharges at crest-stage gages, and at other additional sites for major floods.

APPROACH: (1) Data through 1990 for gaging stations and crest-stage gages on unregulated streams in New Jersey will be analyzed by using the guidelines in Interagency Advisory Committee on Water Data, 1982, Guidelines for determining flood frequency: U.S. Geological Survey Bulletin 17B of the Hydrology Subcommittee, Revised September 1981, Editorial corrections March 1982. The basin characteristics in the earlier study will be reviewed and updated. Regressions will be run with the Statistical Analysis System (SAS). Specifically, relations will be developed for the 2-, 5-, 10-, 25-, 50-, 100-, and 500-year floods. (2) Operation of a network of crest-stage gages will be continued to provide annual-peak-discharge and stage measurements. The network will be reviewed annually to eliminate stations with sufficient records and establish new stations that fulfill current needs or fill gaps in the knowledge of the variability of floods.

PROGRESS AND PLANS: Sixty-two crest-stage gages were operated. The crest-stage network and data were informally reviewed, and two gages were dropped from the network. Stream-stage telemetry was operated at 58 stations. The telemetry is a mix of Geostationary Operational Environmental Satellite, Very High Frequency radio, and telephone-based systems. A computer base station in the USGS office compiles all of the data and shares it with four National Weather Service offices as well as State and county offices. Flood-frequency figures were updated with data through 1990. Trends in the flood peaks were investigated for several gaging stations. Plans are to review the crest-stage network and revise as needed. Flood regionalization equations will be rerun with updated flood-frequency data through 1990. The regionalization report will be completed. Expansion of the local flood-warning system to Trenton and coastal areas will be studied.

SIMULATION OF AGRICULTURAL WATER DEMAND IN NEW JERSEY (NJ101)



PROJECT CHIEF: Rick M. Clawges
COOPERATOR(S): N.J. Department of Agriculture
PERIOD OF PROJECT: October 1987 to September 1990

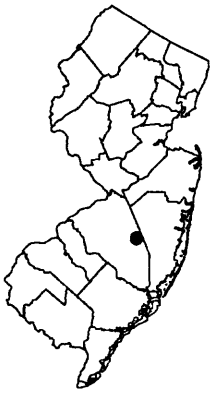
PROBLEM: Seasonal climatic variation requires the irrigation of agricultural crops throughout New Jersey. The New Jersey Department of Agriculture (NJDA) has determined that provisions in the 1981 Water Supply Management Act of New Jersey for protection of water supply for agricultural use are inadequate. The NJDA foresees an increase in irrigated acreage as a result of the conversion of land to production of high-value fresh-market vegetable crops and of efforts by the State to preserve New Jersey's farmland. In an effort to ensure suitable water supplies for agricultural purposes, the NJDA convened an advisory committee to study the problem. The committee recommended that methods to estimate short- and long-term agricultural water demand needed to be developed.

OBJECTIVE: The primary objective of the study is to develop a statistical model to predict water demand for irrigated crops in New Jersey. The model will be used to examine trends in urban encroachment on agricultural land, and trends in crop acreages. A second objective is to estimate water use for livestock and the food-processing industry in New Jersey in 1987. A third objective is to evaluate current irrigation technology and the accuracy of agricultural water-use data reported to the NJDEPE each year by certified water users.

APPROACH: The approach for the primary objective of the study is to develop a statistical model predicting the number of irrigated acres in New Jersey on the basis of available agricultural and socioeconomic data. Once irrigated acreage has been predicted, irrigation amounts will be calculated by using climatic data and a water-budget model. Food-processing water use will be estimated on the basis of the type and size of the industry. Livestock water use will be estimated by using actual numbers of livestock and estimates of per capita livestock water needs. To accomplish the third objective, a sample of randomly selected farms will be visited, and digital vibration time totalizers will be installed on irrigation pipes to determine duration of pumpage. Pumpage times will be multipied by pumpage rates to estimate water use by farmers. Pumpage data reported by farmers to the NJDEPE will be compared to pumpage values determined by using the time totalizers to analyze variance.

PROGRESS AND PLANS: Final water-demand predictions for irrigated crops in 1990, 2000, 2010, and 2020 were completed. Estimates of water demand for livestock and food-processing purposes in 1987 also were completed. A draft report on methods for prediction of long-term agricultural water demand has been written and has been approved for publication. A menu-diven FORTRAN program that uses the prediction model has been prepared for use by the cooperator. Plans are to ready the final report for publication.

HYDROLOGIC FACTORS AFFECTING SURFACE-WATER ACIDITY IN A SMALL WATERSHED IN THE NEW JERSEY PINELANDS (NJ116)



PROJECT CHIEF: Julia L. Barringer
COOPERATOR(S): Pinelands Commission
PERIOD OF PROJECT: October 1989 to September 1990

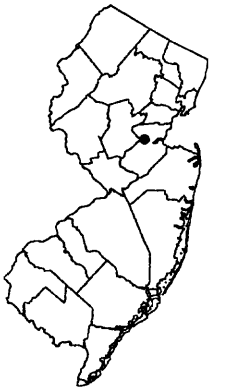
PROBLEM: Stream waters in the Pinelands region of New Jersey are characterized by low pH. Acidity is a major factor affecting the dissolution and transport of metals in Pinelands streams. Surface-water acidity can change markedly during or after some storms. Results of previous studies at McDonalds Branch basin in the Pinelands have shown that relations between hydrology and stream chemistry are complex, and may complicate the identification of long-term trends caused by acid rain. Further study of the relative importance of seasonal and storm-related fluctuations in surface-water chemistry is needed.

OBJECTIVE: The short-term objective of the study is to examine relations between precipitation events and stream acidity at McDonalds Branch. The results of this initial effort will be used for future work, the objective of which is to determine the effect of hydrologic inputs on surface-water chemistry of Pinelands streams, including the identification of hydrologic factors that cause seasonal and storm-related fluctuations.

APPROACH: Relations between stream chemistry and precipitation characteristics such as intensity, duration, and antecedent conditions will be determined by examining continuous stream-temperature, pH, specific-conductance, dissolved-oxygen, and discharge data from McDonalds Branch, as well as continuously recorded precipitation data. Various statistical techniques will be used.

PROGRESS AND PLANS: Analysis of relations between precipitation and increases in surface-water acidity was completed. McDonalds Branch is subject to episodic acidification although the pH of its waters is lower than that of incident precipitation. Acidic episodes are linked to periods of precipitation; water passing through acid soils apparently is responsible for episodic declines in pH. Work is suspended pending further funding.

TRANSPORT OF VOLATILE ORGANIC CONTAMINANTS AND DELINEATION OF CONTAMINANT PLUME IN FRACTURED BEDROCK OF THE PASSAIC FORMATION, RUTGERS UNIVERSITY BUSCH CAMPUS, NEW BRUNSWICK, NEW JERSEY (NJ122)



PROJECT CHIEF: Kenneth S. Turner
COOPERATOR(S): Rutgers - The State University
PERIOD OF PROJECT: March 1991 to September 1992

PROBLEM: Volatile organic compounds (VOC's) were detected in ground water during a preliminary investigation conducted at the Rutgers University Busch Campus near the C-Wing Engineering Building and during subsequent ground-water sampling in five monitoring wells installed adjacent to the building. The major contaminants include carbon tetrachloride, tetrachloroethene, and chloroform. Tetrachloroethene also is present in two production wells downgradient from the Engineering Building, but has not been detected in water from a number of domestic drinking-water wells farther downgradient. The direction and rate of contaminant movement in this fractured-rock aquifer are unknown; delineation of contaminant movement is complicated by the orientation of water-bearing zones, which dip and are intersected by near-vertical fractures. Because the definition of contaminant transport within this hydrologic environment is more complex than that of contaminant transport in porous media, innovative methods of data collection and analysis will need to be applied at this site.

OBJECTIVE: A key objective of the study is to gain a greater understanding of geologic and hydrogeologic frameworks at the study site and of the effects of these frameworks on ground-water flow and contaminant transport. A variety of methods and techniques will be applied to reach the related objectives of defining the extent of the contaminant plume and its direction and rate of movement. This definition will lead to the final objective of understanding the environmental processing of organic contaminants in fractured-rock systems.

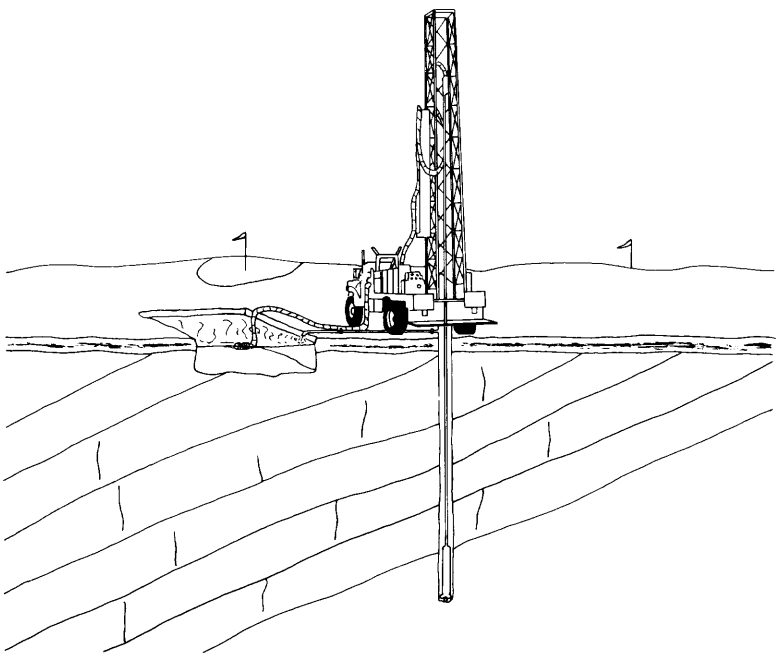
APPROACH: The first, reconnaissance, phase of the study will involve the compilation of available borehole data for the area, and the measurement of strike and dip at nearby bedrock outcrops. Soil-gas probes will be installed downgradient from the contaminant source and sampled for VOC's. In addition, a series of small-diameter boreholes to bedrock will be augered with a portable drilling rig. These well bores will be used to (1) collect water samples, (2) measure depths to bedrock, and (3) measure water-table altitudes. Geophysical techniques (electromagnetic, resistivity, and seismic) also will be used to determine the elevation of the bedrock surface and the orientation of fractures in the study area. The second phase of the study will involve the development of a ground-water flow and transport model and the installation of a series of well nests to (1) determine the vertical extent of contamination and (2) refine and calibrate the model.

PROGRESS AND PLANS: A geophysical survey of the study area has been completed. Results of an azimuthal resistivity survey indicate the orientations of near-vertical fractures in the bedrock. The local strike and dip of the bedrock have been determined from measurements at outcrops in the study area. The soil-gas sampling network has been designed.

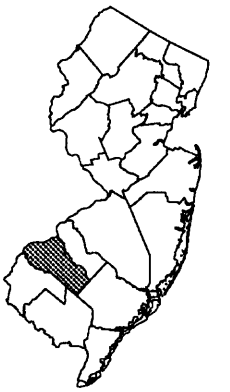
Continued on next page

TRANSPORT OF VOLATILE ORGANIC CONTAMINANTS AND DELINEATION OF CONTAMINANT PLUME IN FRACTURED BEDROCK OF THE PASSAIC FORMATION, RUTGERS UNIVERSITY BUSCH CAMPUS, NEW BRUNSWICK, NEW JERSEY (NJ122) --Continued

PROGRESS AND PLANS--Continued: Sampling for fixed gases and VOC's has begun. A shallow test borehole was drilled; conditions encountered during this and previous drilling indicate that parts of the shallowest water-bearing zone lie below competent bedrock, whereas other parts lie within the weathered zone above competent bedrock. Drilling strategies are being planned. During the first, reconnaissance, phase of the study, the soil-gas sampling will be completed. Drilling of shallow boreholes to the uppermost water-bearing zone will be completed and water-quality samples will be collected. For the second phase, on the basis of the areal extent of contaminated ground water, a network of nested wells will be designed. A preliminary ground-water model will be constructed to aid in well placement. Wells will be installed and sampled; the model will be refined and used to predict further contaminant movement.



DEVELOPMENT OF A GEOGRAPHICAL INFORMATION SYSTEM DATA BASE, GLOUCESTER COUNTY, NEW JERSEY (NJ002a)



PROJECT CHIEF: Curtis V. Price
COOPERATOR(S): Gloucester County Planning Commission
PERIOD OF PROJECT: May 1990 to April 1992

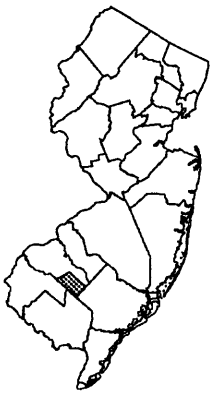
PROBLEM: The Gloucester County Planning Commision has information that is useful for County planning activities and current and future hydrologic studies. These data currently are in the form of maps, paper files, or local personal computer data bases. Conversion of these data to a Geographic Information System (GIS) format would allow them to be used for automated spatial analysis and map creation.

OBJECTIVE: (1) The main objective is to develop and evaluate a GIS data base containing hydrologic information on Gloucester County by using ARC/INFO software. This data base will be useful for current hydrologic investigations in the County. (2) A second objective is to assist the County in becoming familar with the GIS, so that County planners can develop their own system in the future. The USGS will evaluate the usefulness of County land-use data and will compare these data to those in available National land-use data bases.

APPROACH: Selected data will be digitized, produced, or compiled into a GIS data base resident on the USGS PRIME computer. Maps will be produced as needed. USGS staff will provide GIS assistance to County Planning Commission personnel.

PROGRESS AND PLANS: All data needed for hydrologic investigations have been entered into the PRIME data base. Data specific to Franklin Township include land use, road centerlines, planimetric base maps, and exact sheet boundaries. Countywide data sets include census tracts, water bodies, transportation, and township boundaries. The data will be maintained and supplied for ongoing USGS and Gloucester County Planning Commission activities as requested. Additional data will be gathered as needed and included in the data base.

RELATION BETWEEN LAND USE AND GROUND-WATER QUALITY IN FRANKLIN TOWNSHIP, GLOUCESTER COUNTY, NEW JERSEY (NJ003b)



PROJECT CHIEF: Eric F. Vowinkel
COOPERATOR(S): Gloucester County Planning Commission
PERIOD OF PROJECT: October 1991 to September 1992

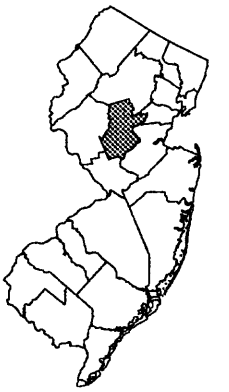
PROBLEM: Results of previous studies have shown that certain types of land use tend to be associated with the presence of particular substances or groups of substances in ground waters. For example, nitrate concentrations in ground water have been found to be significantly higher in agricultural areas than in undeveloped areas; nitrate concentrations also may be higher in agricultural areas than in residential or urban areas. The Gloucester County Planning Comission is interested in examining the relations between land use and shallow-ground-water quality in the County. Franklin Township is of particular interest because of projected land-use changes are projected there.

OBJECTIVE: The objectives of the study are to (1) determine the relations between selected chemical constituents and land use, and (2) determine whether concentrations of selected chemical constituents that relate to land-use changes exhibit spatial and temporal trends over time.

APPROACH: The approach includes (1) development of a GIS data base consisting of well-construction, water-quality, and land-use information for Franklin Township; and (2) a statistical evaluation of the relation between ground-water quality and land use. Two land-use-map scales (1:4,800 and 1:250,000) and land-use maps from two years (1970 and 1985) will be evaluated.

PROGRESS AND PLANS: The GIS data base, consisting of well-construction, water-quality, and land-use data from 1,200 wells, was constructed by using data collected by the Gloucester County Health Department. Preliminary statistical analysis of the relation between land use and nitrate concentrations in ground water was performed. The effect of land-use-map scale on the relation between ground-water quality and land use was evaluated. Temporal trends in the relation between land use and ground-water quality will be evaluated. Results will be published in a U.S. Geological Survey Water-Resources Investigations Report.

SOMERSET COUNTY FLOOD-MONITORING NETWORK (PHASE 2) (NJ103)



PROJECT CHIEF: Paul Dunne
COOPERATOR(S): Somerset County Board of Chosen Freeholders
PERIOD OF PROJECT: October 1988 to September 1993

PROBLEM: During the last two decades, Somerset County has experienced several severe floods. Flooding of small streams in urban areas has become a significant problem. Eight streamflow-gaging stations and rain gages with telephone telemetry were installed in 1978, but these gages are only useful when telephoned regularly. Although adequate data are provided by these gages upstream from the problem areas, no techniques exist to estimate peak stages at critical points downstream on a real-time basis.

OBJECTIVE: The first objective is to improve the telemetry for real-time collection of stream-stage and rainfall data on small streams in Somerset County. The second objective is to develop techniques for use in estimating peak stages on the same streams in downstream floodprone areas on a real-time basis.

APPROACH: (1) Augment existing gages in the streamflow-gaging network by installing radio-reporting stage gages at 5 downstream flood points, (2) install updated radio-report rain-gage network of 17 rain gages to give real-time rainfall data, (3) make UHF radio link with Passaic Flood Warning System installed just north of Somerset County, and (4) develop a computer model that can be used to estimate peak stages during storms at several flood-prone sites in Somerset County.

PROGRESS AND PLANS: Radio-reporting stage gages at 5 downstream points and an updated radio-report rain-gage network of 17 rain gages have been installed. A UHF radio link with the Passaic Flood Warning System has been made. Hydrographs have been produced for the basins to be modeled. Model testing and implementation with real-time data bases are proceeding. An outline has been approved for the project report. Plans are to improve radio link between the Somerville base station and the USGS, complete model testing and implementation with real-time data for predicting streamflow during floods, and write the final Somerset County Flood Monitoring System report.

OPTIMAL WITHDRAWALS FROM A COASTAL AQUIFER SUBJECT TO SALTWATER ENCROACHMENT: NUMERICAL ANALYSIS AND CASE STUDY (NJ093)

PROJECT CHIEF: Frederick J. Spitz
COOPERATOR(S): City of Cape May, City of Wildwood, and Lower Township
PERIOD OF PROJECT: January 1987 to December 1989

PROBLEM: In coastal areas, ground-water withdrawals typically cause saltwater encroachment into freshwater aquifers . This phenomenon is occurring in the shallow aquifer system on the peninsula of Cape May County, New Jersey, necessitating the abandonment and sealing of formerly productive freshwater wells. The coastal community must determine how to satisfy its water requirements while maintaining acceptable water quality.

OBJECTIVE: To define the geometry of the ground-water system, the distribution of flow and water levels, and the configuration and movement of the saltwater-freshwater interface in the shallow aquifers. Also, to evaluate the response of the ground-water system to withdrawal stresses. Finally, to present the results of the study in a manner that facilitates planning for long-term water-supply needs and design of a monitoring program that provides early warning of saltwater contamination of supply wells.

APPROACH: The shallow aquifer system was simulated by use of a quasi-three-dimensional numerical computer model of freshwater and saltwater flow separated by a sharp interface. The model was calibrated to predevelopment (about 1890) and present (1989) conditions by comparing simulated hydraulic heads in the three aquifers to measured water-level data. Chloride concentrations in well water were used to calibrate interface positions in the model. Hypothetical predictive simulations were tested to investigate the consequences of continued withdrawals at present levels and locations and under various alternative circumstances.

PROGRESS: The project has been completed. Results of model analyses indicate that encroachment of saline ground water on public-supply wells that are screened in the Cohansey aquifer in Cape May City and, possibly, Lower Township is likely. Ground-water withdrawals from farther north, from the peninsular part of Cape May County, or from the unconfined aquifer would greatly reduce the risk of saltwater intrusion.

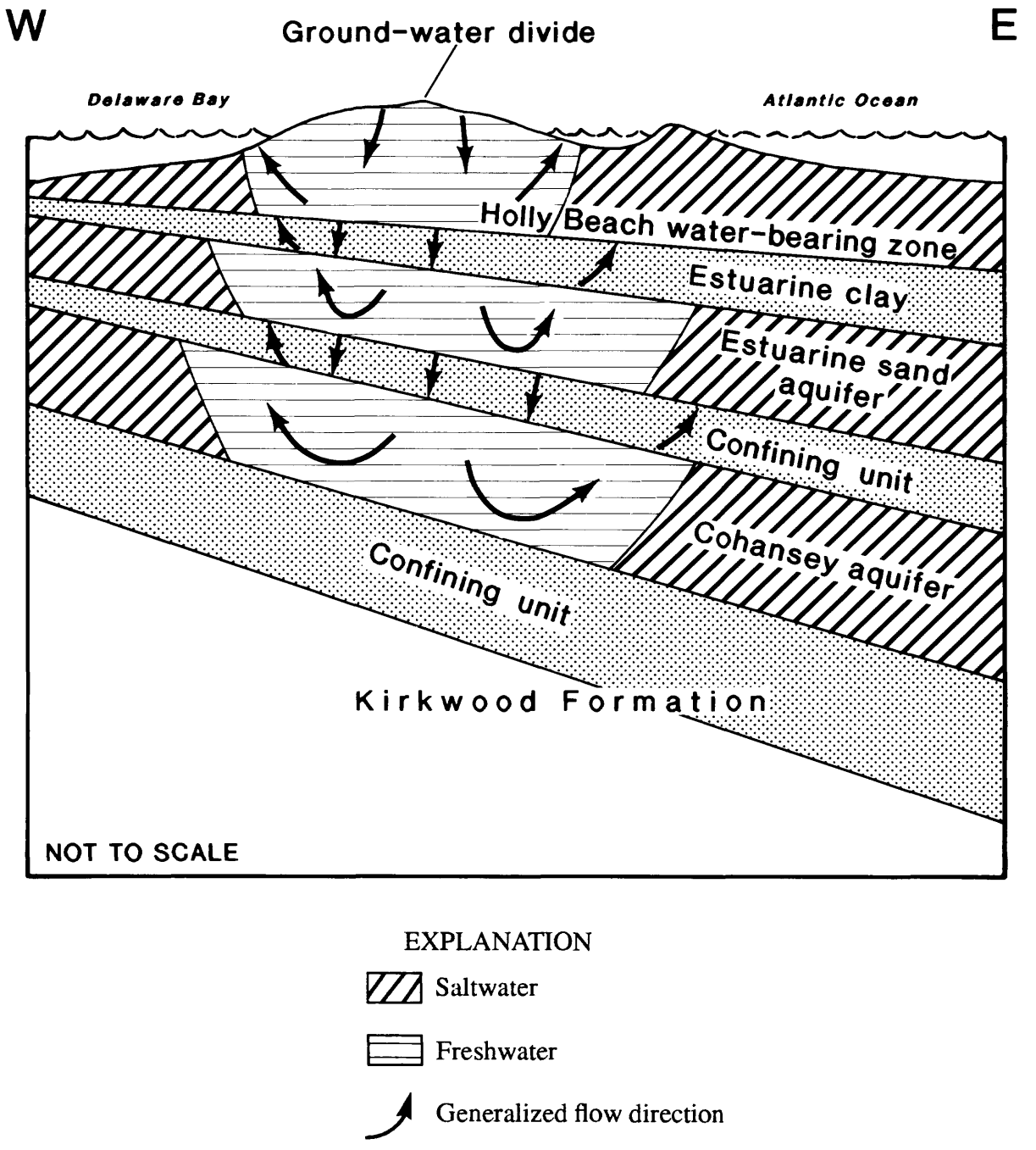
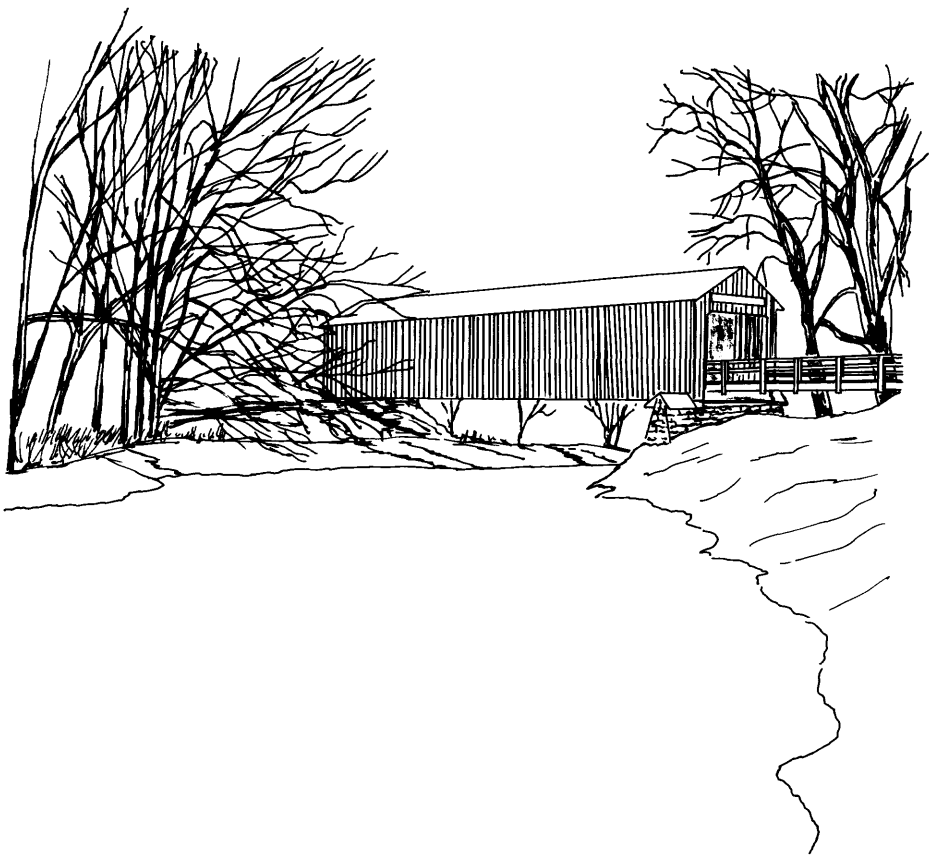


Figure 14.--Diagrammatic section of the shallow aquifer system of Cape May Peninsula after development. (From Spitz, F.J., and Barringer, T.H., 1992, Ground-water hydrology and simulation of saltwater encroachment, shallow aquifer system of southern Cape May County, New Jersey: U.S. Geological Survey Water-Resources Investigations Report 91-4191, fig. 5.)



HYDROLOGIC INVESTIGATIONS (OTHER FEDERAL AGENCY PROJECTS)

Installation of a drive-point water-quality sampler.

HYDROLOGIC FEASIBILITY OF WATER-SUPPLY DEVELOPMENT ALTERNATIVES IN CAPE MAY COUNTY (NJ002b)

PROJECT CHIEF: Frederick J. Spitz
COOPERATOR(S): U.S. Army - Corps of Engineers
PERIOD OF PROJECT: October 1990 to September 1991

PROBLEM: Water demand in Cape May County is seasonal because the economy is resort-oriented. Ground water is the primary source of potable water in the County. The proximity of saltwater bodies to the freshwater aquifers has created a threat of saltwater intrusion as a result of the lowering of water levels in response to withdrawals. Continued growth in the southern part of the County, along with a corresponding increase in water demand, will exacerbate the existing problem.

OBJECTIVE: To investigate the hydrologic feasibility of water-supply development alternatives in Cape May County so as to preserve the shallow-ground-water supply and protect it from saltwater intrusion.

APPROACH: The alternatives will be tested with a calibrated sharp-interface ground-water flow model. The four alternatives are (1) artificial recharge of ground water, (2) conjunctive use of ground and surface waters, (3) use of saltwater-withdrawal wells to create a barrier to saltwater intrusion, and (4) redistribution of withdrawals. The effectiveness of the alternatives to protect the supply and minimize saltwater intrusion will be compared to results of a simulation of continued current withdrawal rates projected over a 60-year planning period.

PROGRESS: Model simulations of water-supply planning alternatives were successfully completed. A draft report comparing results of simulations was written and is in review.

GEOHYDROLOGY AT PICATINNY ARSENAL, MORRIS COUNTY, NEW JERSEY (NJ059)

PROJECT CHIEF: Otto S. Zapecza
COOPERATOR(S): U.S. Army - Picatinny Arsenal
PERIOD OF PROJECT: August 1982 to September 1991

PROBLEM: The presence of contaminated ground water and surface water at Picatinny Arsenal has been documented by the U.S. Army Environmental Hygiene Agency. Both ground water and surface water are used as sources of drinking- and service-water supply. Lake Picatinny and Green Pond Brook discharge into the Rockaway River, a tributary to Boonton Reservoir, which supplies water to a large part of northern New Jersey. The U.S. Army Armament and Research Development Command asked the USGS to help define the rate of movement and extent of the contaminated water.

OBJECTIVE: To (1) conduct a comprehensive study of the geology and hydrology at Picatinny Arsenal to determine the rate of movement and extent of ground-water contaminant plumes near their sources, (2) investigate possible supplemental sources of ground-water supply at the arsenal, and (3) determine the rate of discharge of and extent of surface-water contamination in Green Pond Brook and Lake Picatinny.

APPROACH: Conduct an analysis of the geohydrology at Picatinny Arsenal by compiling geologic information from previously installed wells and new test and observation wells. Measure water levels to determine the configuration of the water table. Conduct aquifer tests to determine hydraulic properties of aquifers. Conduct surface geophysical (electromagnetic, seismic, and resistivity) surveys to help define the configuration of the bedrock surface and determine ground-water quality. Determine the quality of surface water at the arsenal by constructing streamflow-gaging stations and water-quality monitoring stations at selected sites along Green Pond Brook, and by collecting and analyzing surface-water and streambed-sediment samples for inorganic and organic constituents.

PROGRESS: Hydrogeologic reconnaissance studies of the open burning area and Green Pond Brook were completed. Soil-gas sampling and drive-point sampling were performed to determine the extent of contamination in the area of building 410. A ground-water flow model of the Green Pond valley was revised on the basis of comments made by technical reviewers.

GEOPHYSICAL AND WATER-QUALITY RECONNAISSANCE AT THE CIBA-GEIGY SUPERFUND SITE, TOMS RIVER, OCEAN COUNTY, NEW JERSEY (NJ110)

PROJECT CHIEF: Tamara I. Ivahnenko
COOPERATOR(S): U.S. Environmental Protection Agency
PERIOD OF PROJECT: October 1988 to September 1990

PROBLEM: Ground water beneath the Ciba-Geigy Superfund site and vicinity is contaminated with metals and organic compounds. The extent of ground-water contamination has not yet been completely defined, nor have all possible locations of buried drums of waste been identified. In order to determine the directions in which and depths to which contamination may be transported, the hydrogeologic framework at the site needs to be delineated as accurately as possible.

OBJECTIVE: The objective of this reconnaissance study is to provide information that will help the U.S. Environmental Protection Agency (USEPA) to select efficiently the placement and depth of monitoring wells and the placement of trenches for locating buried drums. Specifically, the USGS will (1) determine the lateral and vertical electrical properties of the upper 100 feet of sediments in selected parts of the study area, (2) determine vertical and horizontal contaminant concentration gradients in ground water in selected parts of the study area, (3) locate geophysical anomalies that could be associated with buried drums in the "borrow area," and (4) describe the hydrogeologic framework of selected areas and use this information to aid in interpreting the geophysical data.

APPROACH: The approach includes (1) obtaining borehole geophysical logs of wells and drive points in order to map the aquifer system, (2) collecting surface electromagnetic data to determine the lateral and vertical electrical properties of the upper 100 feet of sediments, (3) collecting drive-point water-quality samples in areas downgradient from the site in order to characterize the leading edge of the plume, and (4) conducting a ground-penetrating-radar and magnetometry survey to identify drums.

PROGRESS: Ground-water contamination at the Ciba-Geigy site had been identified previously; however, this study provided additional information on ground-water quality. Low concentrations of purgeable organic compounds were found in ground water downgradient from the borrow area, an area for which no data previously were available. The definition of the horizontal and vertical extents of ground-water contamination in Winding Brook Park was improved by using results of analyses of water-quality samples from the drive points. These results showed that cadmium and selenium were the only metals whose concentrations exceeded the USEPA maximum contaminant levels. Thirty-six organic compounds were identified,including two compounds not previously found at the site (1,2,3-trichloropropane and 1,2-dichloropropane). Additional work is needed to identify the vertical extent of contamination. High specific-conductance values in the shallow Kirkwood-Cohansey aquifer system approximately coincide with the areal extent of known contaminated water. No new sources of contamination were found. Results of a ground-penetrating-radar survey north of the plant showed an anomalous band trending east-west, which may be a trench or a natural feature. No metal objects were found in the trench. The project has been completed and the final report has been approved for publication.

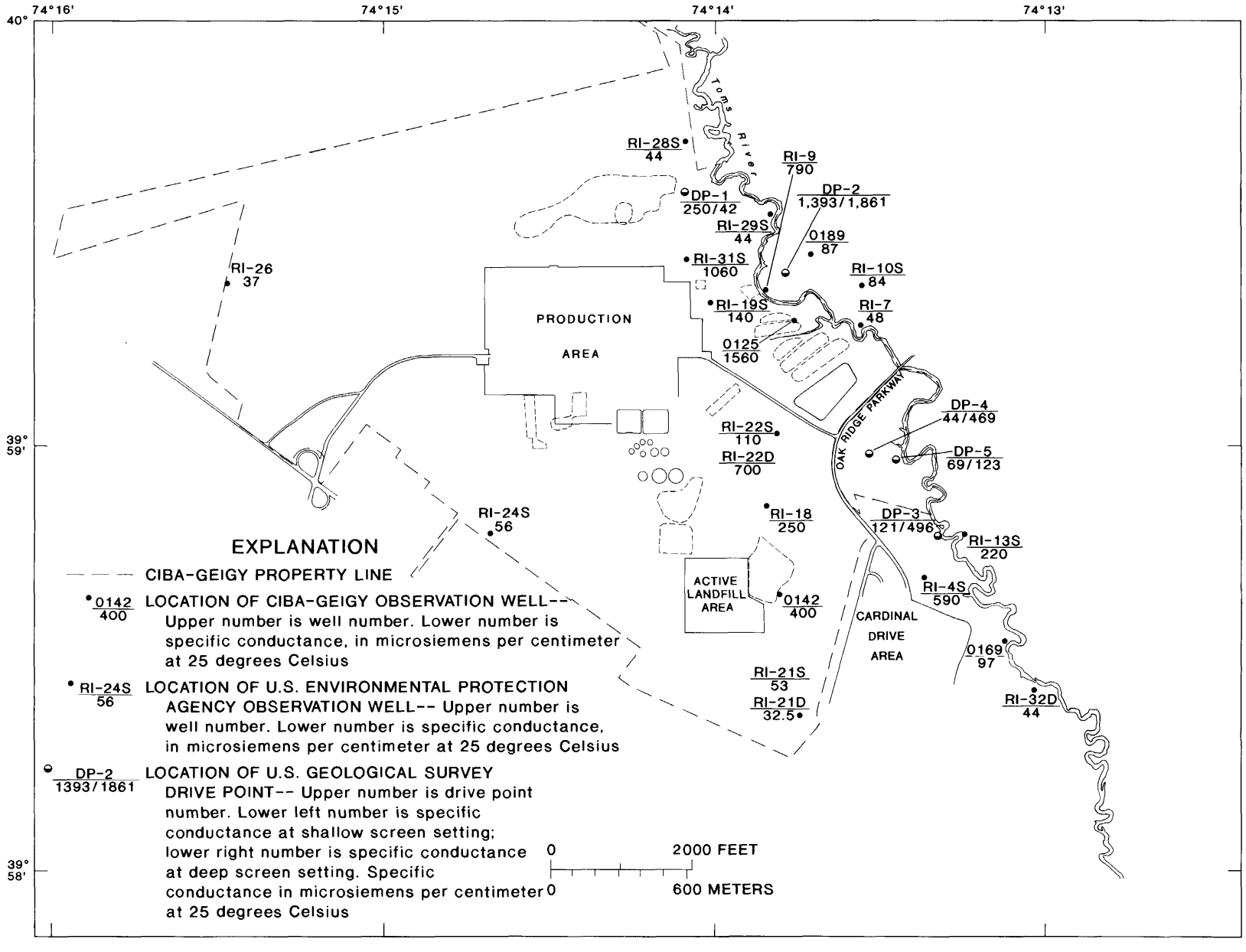
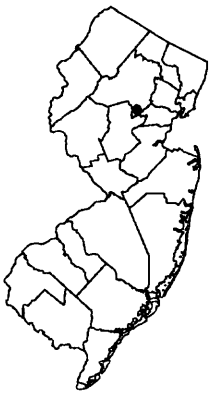


Figure 15.--Specific conductance of ground-water samples from selected wells and drive points in the Ciba-Geigy study area. (From Barton, G.J., and Ivahnenko, Tamara, 1992, Hydrogeologic, geophysical, and ground-water-quality reconnaissance at and near the Ciba-Geigy Superfund Site, Ocean County, New Jersey: U.S. Geological Survey Water-Resources Investigations Report 91-4048, fig. 17.)

ASSESSMENT OF EFFECTS OF ROLLING KNOLL LANDFILL ON NEARBY WATER RESOURCES (NJ111)



PROJECT CHIEF: Kenneth S. Turner
COOPERATOR(S): U.S. Fish and Wildlife Service
PERIOD OF PROJECT: May 1989 to September 1991

PROBLEM: The effects of the Rolling Knoll landfill on the water resources of the Great Swamp National Wildlife Refuge are currently unknown. To obtain information that will assist the U.S. Fish and Wildlife Service in managing the Great Swamp Wildlife Refuge, the nature of the interaction between, and the chemical characteristics of, the ground water and surface water near the Rolling Knoll landfill need to be evaluated.

OBJECTIVE: The objectives of this project are to (1) define the general geohydrology of the Great Swamp around the landfill, (2) install observation wells in appropriate locations around the landfill, and (3) determine the quality of ground water and surface water around the landfill.

APPROACH: The approach will include three phases: (1) reconnaissance of water quality, shallow-ground-water levels, and electromagnetic conductivity around the landfill; (2) siting borehole locations, borehole drilling, and well installation; and (3) periodic sampling of ground water for selected water-quality constituents.

PROGRESS: Reconnaissance water-quality sampling of surface water and shallow ground water was completed. A geophysical survey of the terrain in the Refuge on the eastern and southern sides of the landfill was completed. Observation wells were installed and sampled on a routine basis and the data were transmitted to the U.S. Fish and Wildlife Service. Results of the geophysical survey and water-quality reconnaissance are presented in a report that is currently in review.

HYDROLOGIC INVESTIGATIONS (FEDERAL PROJECTS)

Delaware River at Washington Crossing, Mercer County.

EVALUATION OF FIELD SAMPLING TECHNIQUES AND ANALYTICAL METHODS FOR DETERMINATION OF ORGANIC COMPOUNDS IN GROUND WATER (NJ069)

PROJECT CHIEF: Jacob Gibs
COOPERATOR(S): Federal Program
PERIOD OF PROJECT: July 1983 to September 1990

PROBLEM: Increasing concern about contamination of ground water with organic compounds has raised questions concerning the ability of investigators to obtain representative samples and to satisfactorily identify and determine organic compounds in a ground-water sample. Problems result when organic compounds in trace concentrations undergo sorption, biodegradation, volatilization, and other reactions during sample collection and handling. Exploration of alternatives and refinements to existing sampling and analytical protocols and development of inexpensive but comprehensive screening techniques for organic compounds are necessary to mitigate these problems.

OBJECTIVE: (1) To prepare a guide for conducting studies of organic contamination in ground water for general use by Water Resources Division districts. (2) To evaluate sample-collection and analytical methods for precision and accuracy in obtaining representative samples of organic contaminants in ground water. Methods to be evaluated include surface and downhole sampling systems (including resin extractors) for purgeable organic compounds, sample containers for purgeable organic compounds, extraction analytical methods and field-sample treatment methods for semi- and nonpurgeable organic compounds, and use of the gas chromatograph/flame-ionization detector as a screening technique for organic compounds in ground water.

APPROACH: The investigation will be conducted in four phases. Briefly, these phases include a thorough literature search and preparation of research guidelines, a field-site reconnaissance, and evaluation of the sample-collection and analytical methods listed above. Wells will be selected on the basis of their geologic setting, known contamination problems, and accessibility. Evaluations will incorporate, where possible, a statistically defensible number of replicates.

PROGRESS: One open-file report was published. Another open-file report was approved and the galley proof was received. The project was completed.

GROUND-WATER CONTAMINATION WITH CHLORINATED VOLATILE ORGANIC COMPOUNDS AT PICATINNY ARSENAL, MORRIS COUNTY, NEW JERSEY (NJ090)

PROJECT CHIEF: Thomas E. Imbrigiotta
COOPERATOR(S): Federal Program
PERIOD OF PROJECT: October 1985 to September 1995

PROBLEM: Ground-water contamination by anthropogenic organic substances is a serious environmental problem in the United States. The past and present uses of chlorinated volatile organic compounds (VOC's) as degreasing agents, dry-cleaning solvents, and other industrial solvents have resulted in their wide distribution in the environment. The chemical and physical properties of these compounds make them mobile in the ground-water system.

OBJECTIVE: (1) To improve current understanding of the chemical, physical, and biological processes that affect the movement and fate of chlorinated VOC's, particularly trichloroethylene (TCE), in the subsurface. (2) To develop a predictive model of TCE transport in the subsurface.

APPROACH: Standard and innovative techniques will be used to conduct research in four major areas: (1) distribution, movement, and fate of chlorinated VOC's in ground water; (2) behavior of chlorinated VOC's in the unsaturated zone; (3) geochemistry of ground water; and (4) microbial transformations of chlorinated VOC's.

PROGRESS AND PLANS: Nine papers on various aspects of research at Picatinny Arsenal were written and presented at the Toxic Substances Hydrology Program Technical Meeting in Monterey, California. Degradation rates of TCE and cis-1,2-dichloroethylene were determined from laboratory soil microcosm studies and were found to be consistent with rates estimated on the basis of field data. An interagency agreement to investigate the feasibility of enhanced aerobic biodegradation of TCE at Picatinny Arsenal was implemented. Four methods of sampling soil water for VOC's were compared, and a gas-tight syringe technique was determined to be the most accurate and precise. An artificial infiltration experiment was conducted in the field to determine the effect of infiltration on the net flux of TCE from the aquifer to the soil gas. Laboratory column experiments to determine the rates of TCE desorption from long-time contaminated aquifer sediments were begun. The previously developed multispecies model Saturated-Unsaturated Transport (SUTRA) will be applied to the solute-transport analysis of TCE data from Picatinny Arsenal. Studies to determine the desorption rates of long-time contaminated sediments will be completed. A laboratory study will be run to determine the feasibility of using enhanced aerobic TCE degradation techniques at the Picatinny Arsenal site.

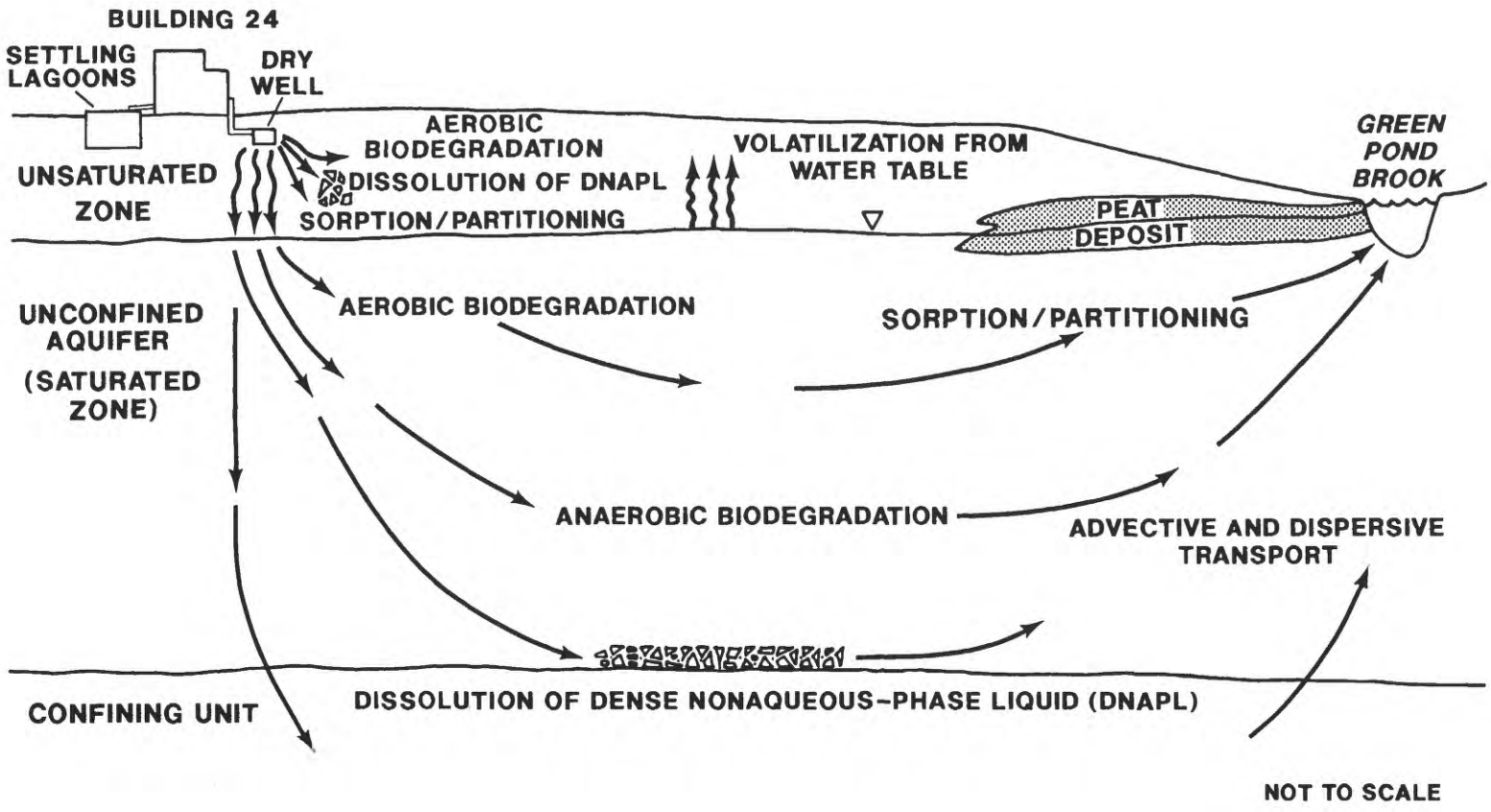


Figure 16.--Conceptual model of processes affecting the fate and transport of chlorinated solvents in the ground-water system at Picatinny Arsenal. (From Imbrigiotta, T.E., and Martin, Mary, 1991, Overview of research activities on the movement and fate of chlorinated solvents in ground water at Picatinny Arsenal, New Jersey, in Mallard, G.E., and Aronson, D.A., eds., U.S. Geological Survey Toxic Substances Hydrology Program--Proceedings of the technical meeting, Monterey, California, March 11-15, 1991: U.S. Geological Survey Water-Resources Investigations Report 91-4034, fig. 4, p. 677.)

POTENTIAL EFFECTS OF CLIMATE CHANGE ON THE WATER RESOURCES OF THE DELAWARE RIVER BASIN (NJ102)

PROJECT CHIEF: Gregory J. McCabe
COOPERATOR(S): Federal Program
PERIOD OF PROJECT: February 1988 to September 1990

PROBLEM: Because of the current consensus that some global atmospheric warming will occur as a result of increasing concentrations of greenhouse gases, water-resources scientists are concerned about the potential effects of climate change on water supplies. Water managers need specific information regarding the extent and magnitude of the hydrologic changes that may occur in order to develop plans to mitigate any anticipated adverse effects of climate change.

OBJECTIVE: This study is an interdisciplinary USGS effort to improve the understanding of the sensitivity of the water resources of the Delaware River basin to the potential effects of climate change. The primary objective is to investigate the hydrologic response of the basin under existing water-management policy and infrastructure conditions to various climate-change scenarios. Specific objectives are to (1) define the temporal and spatial variability of basin hydrology under existing climate conditions, (2) develop climate-change scenarios and evaluate the potential effects and sensitivities of basin water availability to them, and (3) develop analytical tools and scenario evaluations that can be applied to a variety of climate-hydrology analyses in other regions.

APPROACH: To (1) simulate basin climate, (2) develop climate-change scenarios, (3) simulate watershed systems with a water-balance model, (4) assess changes caused by climate change, (5) simulate estuarine salinity dynamics, (6) simulate aquifer/estuary interactions, and (7) assess water use. This project is an intensive systems modeling effort. Because of the size of the basin, geographical information systems will be used extensively.

PROGRESS: The water-balance model was used to (1) predict the position of the saltwater front in the Delaware River on the basis of discharge at Trenton, and (2) simulate reservoir operations while considering the position of the saltwater front. Studies to assess the effects of climate change on the movement of the saltwater front in the river were completed. The final report for the project was written, reviewed, and sent to the Director's office for approval.

METHODOLOGY FOR DEVELOPING WATER-QUALITY-ASSESSMENT STATISTICS (NJ105)

PROJECT CHIEF: Keith W. Robinson
COOPERATOR(S): Federal Program
PERIOD OF PROJECT: October 1988 to December 1991

PROBLEM: States are required to produce statewide, biennial assessments of surface-water quality that typically are often used to direct water-pollution-control activities. These assessments are limited to a small percentage of the total stream mileage and commonly are biased toward problem areas. A statistically based, reliable analysis of surface-water quality is needed for use in these assessments. These statistical analyses also can be applied to surface waters where no monitoring data are available.

OBJECTIVE: The objective is to develop statistical techniques for generating summary information on surface-water quality on a statewide scale that states can incorporate into their biennial assessments. The statistical techniques will be applied to the freshwaters of New Jersey.

APPROACH: Regression techniques will be used to correlate a variety of water-quality measures with spatially detailed information on land use and known pollution sources. A GIS will be used to store and relate data used in the statistical modeling process. The approach will include development of a stream-reach network and subbasin delineations. Digital elevation data also will be used to define topography.

PROGRESS AND PLANS: Logistic and ordinary-least-squares regression models were run and results were analyzed. These models were used to assess concentrations of fecal coliform bacteria and total phosphorus in New Jersey surface waters. Various software packages used in the project have been updated. Other water-quality variables will be tested by using the regression models developed. Extensive data bases on land-cover type, permitted-wastewater discharges, and population have been prepared. Plans are to complete modeling for other water-quality variables, make final improvements on Fortran programs used to summarize input data, and publish project results in a series of journal articles.

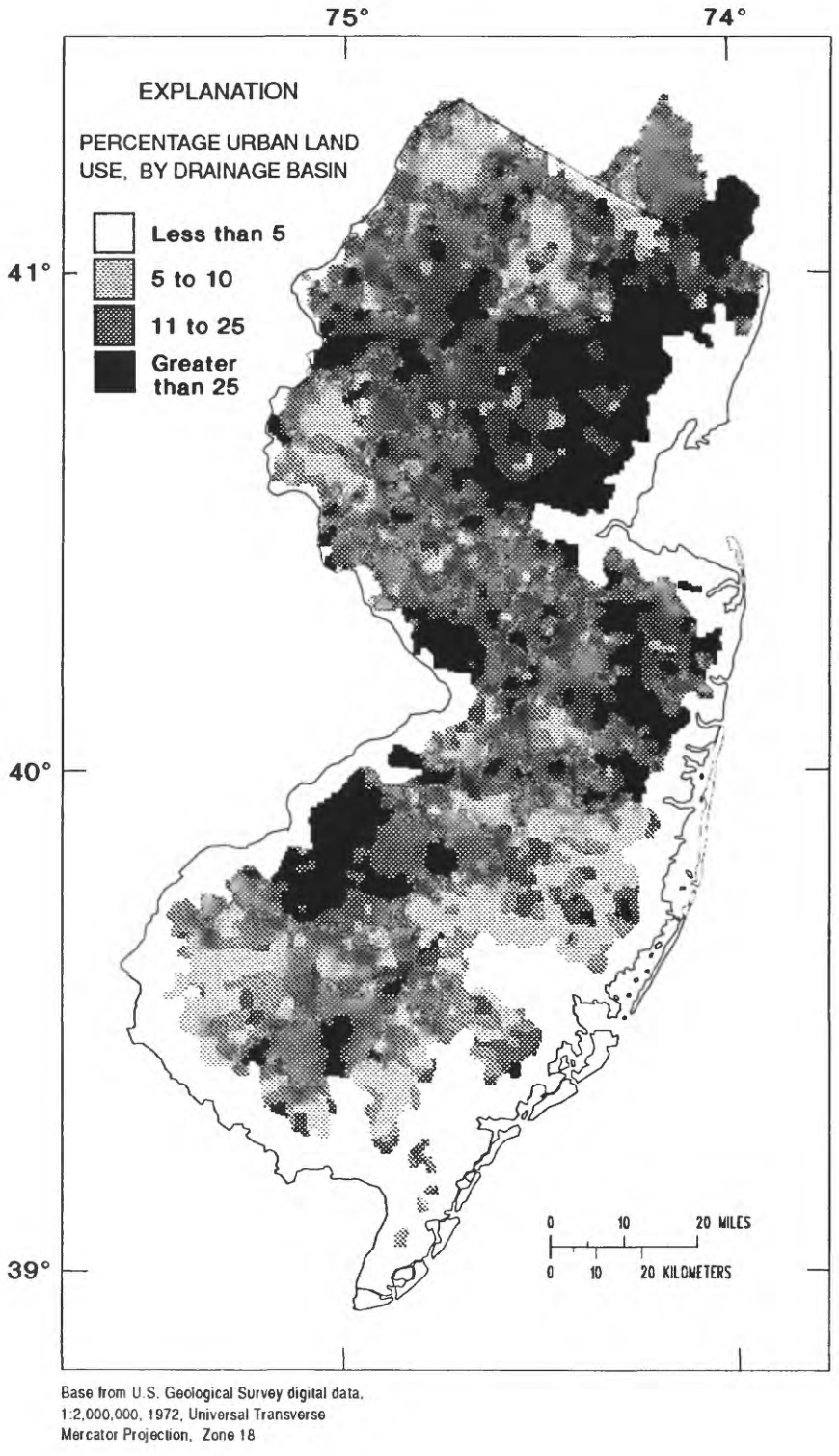


Figure 17.--Percentage of urban land in subbasins in the study area, based on Landsat imagery. (From C.V. Price, U.S. Geological Survey, written commun., 1992.)

GROUND-WATER FLOW IN THE NEWARK BASIN, WEST-CENTRAL NEW JERSEY (NJ107)

PROJECT CHIEF: Jean C. Lewis
COOPERATOR(S): Federal Program
PERIOD OF PROJECT: July 1988 to September 1991

PROBLEM: Population growth, industrial development, and recent droughts have led to increased ground-water pumpage and demand for new water supplies in the Mesozoic Basins of the eastern United States. The processes that control ground-water flow are still poorly understood, however, because the primary aquifers in the basins are composed of fractured rock, and few quantitative studies have been done in the area.

OBJECTIVE: The ground-water flow regime in a 90-square-mile area of the Newark Basin, New Jersey, will be described as part of the USGS Appalachian Valley and Ridge/ Piedmont Regional Aquifer System Analysis Program. The processes and geohydrologic features that control ground-water flow will be defined. A map of the current potentiometric surface will be produced, water budgets will be developed, hydraulic parameters will be estimated, and recharge and discharge regimes will be identified.

APPROACH: Ground-water flow in the study area will be studied in detail as a type area for the northern Mesozoic Basins. A literature and data search will be conducted. The processes that control ground-water flow will be defined, and a qualitative, conceptual model of the ground-water flow system will be developed. A representative part of the Basin will be analyzed by using a three-dimensional digital ground-water flow model.

PROGRESS: Three-dimensional digital models of 1987 and prepumpage conditions were generated and calibrated. Post-processing programs were developed to compare simulated water levels and base flow with measured values. The models, in conjunction with water budgets, geologic data, and stream-discharge data, were used to evaluate the physical controls on the ground-water system, including geology, recharge regime, and ground-water/surface-water relations.

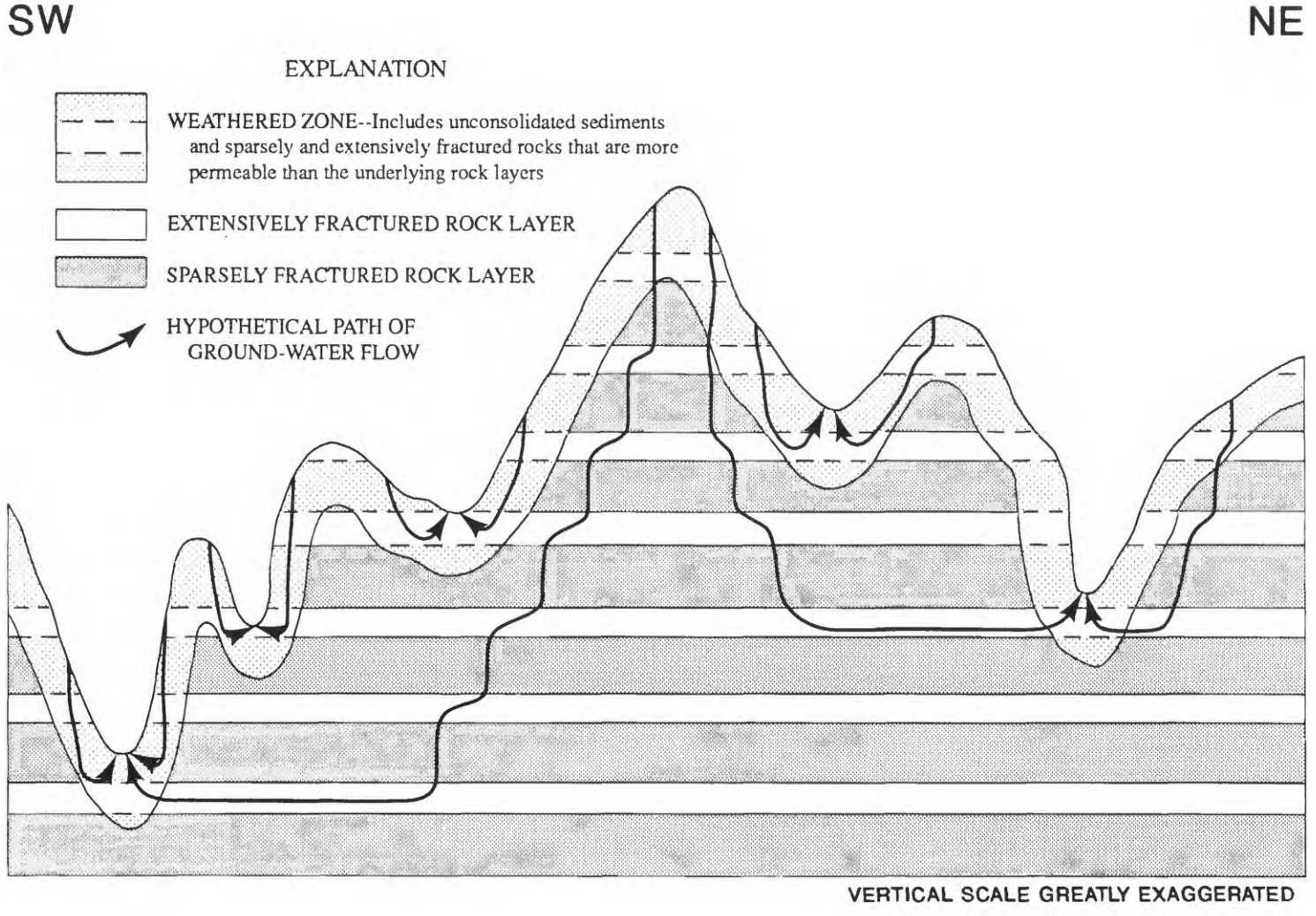


Figure 18.--Hypothetical ground-water flow paths in the Newark Basin of New Jersey. (Section is oriented parallel to the strike of rock layers.) (From Lewis, J.C., 1992, Effect of anisotropy on ground-water discharge to streams in fractured Mesozoic-basin rocks, in Hotchkiss, W.R., and Johnson, A.I., eds., Regional aquifer systems of the United States--Aquifers of the southern and eastern states: Bethesda, Md., American Water Resources Association Monograph Series 17, fig. 5, p. 99.)

COMPOSITIONAL MODELING OF TRANSPORT AND BIODEGRADATION OF ORGANIC COMPOUNDS IN THE UNSATURATED ZONE AND GROUND WATER (NJ109)

PROJECT CHIEF: Arthur L. Baehr
COOPERATOR(S): Federal Program
PERIOD OF PROJECT: October 1988 to September 1994

PROBLEM: Contaminants such as gasoline, crude oil, solvents, and creosote are composed of many constituents. To rigorously simulate the movement and biodegradation of these contaminants, interactions among the organic constituents must be quantified.

OBJECTIVE: (1) To develop a modular, multiphase, and compositional model of volatile organic compound transport and biodegradation for variably saturated media, and to develop numerical solutions for laboratory and field scenarios. (2) To apply the model to estimate rates of movement and biodegradation at selected field sites.

APPROACH: Numerical methods will be applied to solve the model equations, and controlled experiments will be designed for the purpose of testing model assumptions. Field experiments will be designed to evaluate model transport parameters. A gasoline-spill site at Galloway Township, New Jersey, will provide the initial field application.

PROGRESS AND PLANS: Vapor-recovery remediation was operated throughout 1991. During remediation interludes, the re-establishment of contaminant vapor profiles was monitored to quantify microbial degradation rates. Results of the project were presented at the Toxic Substances Hydrology Program Technical Meeting in Monterey, California. Vapor monitoring will continue and vapor-composition data will be analyzed to compute mass-transfer rates.

NONPOINT-SOURCE GROUND-WATER CONTAMINATION, COASTAL PLAIN OF LONG ISLAND, NEW YORK, AND OF SOUTHERN NEW JERSEY (NJ117)

PROJECT CHIEF: Anthony S. Navoy
COOPERATOR(S): Federal Program
PERIOD OF PROJECT: October 1990 to September 1993

PROBLEM: Nonpoint-source contamination is characterized by the presence of compounds whose use is ubiquitous. Additionally, the aggregation of many local, individual contamination problems (point sources) can result in an apparent broad area of contamination. In each of these cases, the definition and control of the source is difficult on a local scale. Understanding the hydrologic basis of nonpoint-source contamination processes is key to limiting the deleterious effects of human-induced contaminants and to the effective management of water resources.

OBJECTIVE: The overall objectives of this investigation are to define the effects of human activities on regional ground-water quality; to investigate the processes affecting the source, integration, transport, and fate of nonpoint-source contaminants in the ground-water system; and to develop methods for addressing nonpoint-source ground-water contamination problems at the regional scale.

APPROACH: The project will focus primarily on two aspects of nonpoint-source ground-water contamination. The first is a characterization of the effects of human activities on shallow-ground-water quality, and the second is an understanding of the processes that govern the fate and transport of nonpoint-source-type contaminants within a regional ground-water system. Several study areas within the Coastal Plain of Long Island, New York, and of southern New Jersey will be selected for detailed investigation. Study areas will be selected on the basis of the availability of high-resolution land-use data, ground-water-quality data, and hydrogeologic information.

PROGRESS AND PLANS: Analysis of ground-water-quality data from Long Island, New York, was undertaken to investigate the persistence of water-quality trends from shallow to deep parts of the aquifer. Water-quality patterns were found to vary widely with depth and among source-area land-use types. Median concentrations of reference constituents in the shallow and intermediate depth intervals were highest in the agricultural and long-term sewered areas and lowest in undeveloped areas. Further work entails relating ground-water quality to detailed land-use data and to flow paths derived from a ground-water flow model. Water-quality data will be analyzed for trends representing large-scale geochemical processes within aquifers.

General Information

The U.S. Geological Survey announces all of its publications in a monthly report, "New Publications of the U.S. Geological Survey." Subscriptions to this report are free upon request to the U.S. Geological Survey, 582 National Center, Reston, VA 22092. U.S. Geological Survey Circular 900, "Guide to Obtaining USGS Information," describes sources of USGS information and shows in tabular form the types of USGS products and where they are available. The "U.S. Geological Survey Yearbook" provides a comprehensive description of the Federal Government's largest earth-science agency, describes the important environmental issues, and includes significant activities and accomplishments during the year. "Selected Papers in the Hydrologic Sciences," first published in 1984, is a journal-type publication in the Water-Supply Paper series aimed at meeting widespread public and professional interests of the hydrologic community for timely results on hydrologic studies derived from the Federal Research program and the Federal-State Cooperative program of the U.S. Geological Survey. A pamphlet entitled "Geologic and Water-Supply Reports and Maps for Pennsylvania and New Jersey" is a bibliography of geologic and water-resources reports for the two States. These four reports are available at cost from Branch of Distribution, U.S. Geological Survey, Box 25286, Federal Center, Denver, CO 80225 (phone (303) 236-7477).

Water-Resources Information

A monthly summary of hydrologic conditions in the United States and southern Canada is presented in the "National Water Conditions." Single copies and subscriptions are free on application from Hydrologic Information Unit, U.S. Geological Survey, 419 National Center, Reston, VA 22092. Records of streamflow, ground-water levels, and quality of water were published for many years in U.S. Geological Survey Water-Supply Papers, as explained below.

Streamflow Records

Records of daily flows of streams prior to 1971 were published in the U.S. Geological Survey Water-Supply Paper series "Surface-Water Supply of the United States," which was released in numbered parts as determined by natural drainage basins. Until 1961, this was an annual series. Monthly and yearly summaries of these data were compiled in two reports: "Compilation of Records of Surface Waters of the United States through 1950," and "Compilation of Records of Surface Waters of the United States, October 1950 to September 1960." For 1961-70, 5-year compilations were published. Data for New Jersey are published in Part 1, Volume 2. Daily streamflow records also were published on a State-boundary basis during 1961-74.

Ground-Water Records

Ground-water levels and artesian pressures in observation wells prior to 1975 were reported by geographic area in a 5-year U.S. Geological Survey Water-Supply Paper series. Data for New Jersey are in "Ground-Water Levels in the United States, Northeastern States."

Quality-of-Water Records

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

Data reports covering the years 1971 through 1974 were published by the U.S. Geological Survey

and archived by the National Technical Information Service, and were retroactively numbered and included in the State Water-Data Report series. Beginning with the 1975 water year, these series were replaced by a new publication series, "U.S. Geological Survey Water-Data Reports." This series combines under one cover streamflow data, water-quality data for surface water and ground water, and ground-water-level data for each State. For New Jersey, the title is "Water Resources Data for New Jersey--Water Year (date)," and was published in two volumes for each water year: Volume 1.--Atlantic Slope Basins, Hudson River to Cape May; and Volume 2.--Delaware River Basin and tributaries to Delaware Bay. Beginning with the 1990 water year, the Water-Data Reports were organized by data type rather than geographic area: Volume 1.--Surface-Water Data, and Volume 2.--Ground-Water Data. A limited supply of current volumes is available from the New Jersey District office. Additional volumes can be purchased from the National Technical Information Service. (Ordering information is given below.)

Flood Information

Reports documenting major floods in New Jersey have been published as U.S. Geological Survey Water-Supply Papers, Hydrologic Atlases, Water-Resources Investigations Reports, and Open-File Reports, and as State Special Reports and Circulars. Methods for estimating the magnitude and frequency of floods for selected streams are given in Stankowski, S.J., 1974, Magnitude and frequency of floods in New Jersey with effects of urbanization: New Jersey Deprtment of Environmental Protection Special Report 38. The U.S. Geological Survey also outlines flood-prone areas on topographic maps as part of a nationwide Federal program for managing flood losses. Parts of these topographic maps that represent urban areas in which flood problems are prevalent have been extracted and published as pamphlets. In New Jersey, 172 topographic maps covering the entire State and 6 urban-area pamphlets have been completed.

Publications of the Water Resources Division

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

The U.S. Geological Survey has published the results of its studies for more than 100 years. The information is multipurpose and, after its initial use, it becomes a basis for future resource evaluation and water-management decisions. The Water Resources Division releases its information through several publication series, explained below, and through computerized systems, accessible through NAWDEX and WATSTORE (see pages 11-12).

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

Water-Supply Paper	Significant interpretive results of hydrologic investigations that are considered to be of broad interest.
Professional Paper	Comprehensive or topical reports on any earth-science subject of interest to multidisciplinary scientific audiences.
Bulletin	Significant interpretive results of earth-science investigations of broad interest, including computer applications.

Circular	Summaries of topical investigations or programs that are of short-term or local interest.
Map Series	Such as Hydrologic Investigations Atlas--Significant results of hydrologic investigations presented in map format.
Techniques of Water-Resources Investigations	Reports on methods and techniques used in collecting, analyzing, and processing hydrologic data for technically oriented audiences.
Geological Survey Yearbook	Significant activities of the Water Resources Division that are summarized each year for general audiences.
Water-Resources Investigations Book and Map Reports	Comprehensive or topical interpretive reports and maps mainly of local or short-term interest for multidisciplinary audiences.
Open-File Book and Map Reports	Compilations of data and preliminary interpretive reports of limited interest or reports that require interim release pending formal publication .
Water-Data Reports	Water-year data on streamflow, ground-water levels, and quality of surface water and ground water for each State, Puerto Rico, Virgin Islands, and the Trust Territories.
National Water Conditions	A monthly news release that summarizes the National water situation for water-resources-oriented audiences.

With the exception of the "National Water Conditions," which is a form of news release, all of the above publication series are listed in three catalogs--"Publications of the Geological Survey, 1879-1961;" "Publications of the Geological Survey, 1962-1970;" and "Publications of the Geological Survey, 1971 through 1981"--and in yearly supplements to these catalogs for 1982 through 1991.

Ordering Information

The New Jersey District has been preparing reports on water resources for several decades. For additional information on the availability of New Jersey reports, please write to:

District Chief
U.S. Geological Survey
Mountain View Office Park
810 Bear Tavern Road
Suite 206
West Trenton, NJ 08628

All publications are for sale unless specifically stated otherwise. Prices, which are subject to change, are not included here. Prepayment is required and information on price and availability should be obtained before placing an order from the contacts listed below. In addition, many items of scientific interest also are

published in technical and scientific journals to make the information readily available to those in related fields of study. Journal articles and the proceedings of technical meetings are available only from the journals or sponsoring organizations. Other reports of local interest prepared by USGS personnel are published by cooperating State agencies and are made available within the State.

PUBLICATION SERIES	CONTACT
U.S. GEOLOGICAL SURVEY INFORMAL REPORTS	
Open-File Reports Water-Resources Investigations Reports	USGS ESIC - Open File Reports Section Box 25286, MS 517 Denver Federal Center Denver, CO 80225 Phone (303) 236-7476
Water-Data Reports	National Technical Information Service U.S. Department of Commerce 5285 Port Royal Road Springfield, VA 22161 Phone (703) 487-4650
U.S. GEOLOGICAL SURVEY FORMAL REPORTS	
Bulletins Circulars Professional Papers Water-Supply Papers Yearbooks	USGS Map Distribution Box 25286, MS 306 Denver Federal Center Denver, CO 80225 Phone (303) 236-7477
U.S. GEOLOGICAL SURVEY MAP REPORTS	
Hydrologic Investigations Atlases Geologic Quadrangle Maps Miscellaneous Investigations Series Maps	USGS Map Distribution Box 25286, Building 810 Denver Federal Center Denver, CO 80225 Phone (303) 236-7477
NEW JERSEY GEOLOGICAL SURVEY	
Bulletins Geological Survey Reports Ground-Water Reports Open-File Reports	Maps and Publications Sales Office Bureau of Revenue CN 417 Trenton, NJ 08625 Phone (609) 777-1038
NEW JERSEY DIVISION OF WATER RESOURCES	
Special Reports Circulars	Maps and Publications Sales Office Bureau of Revenue CN 417 Trenton, NJ 08625 Phone (609) 777-1038

New Jersey District Reports Completed Since 1986

A bibliography of reports, articles, and proceedings prepared by the New Jersey District since 1986 is listed below. A complete bibliography that covers publications before 1986 has been published and is available from the New Jersey District office.

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