United States Geological Survey
Water Data Program

The USGS provides maps, reports, and information to help others meet their needs to manage, develop, and protect America's water, energy, mineral, and land resources. We help find natural resources needed to build tomorrow, and supply scientific understanding needed to help minimize or mitigate the effects of natural hazards and environmental damage caused by human activities. The results of our efforts touch the daily lives of almost every American.

Introduction

Knowledge of surface and ground waters in the United States is essential to ensuring the well-being of our people and the viability of our economy. In virtually all parts of the Nation, the quantity, quality, and distribution of water are becoming increasingly critical to economic growth and people's health, safety, and comfort. Most areas are experiencing increasing demands on water supplies because of population growth, industrial expansion, and additional irrigation of croplands. Many places are subject to floods, and many parts of the country have been severely affected by drought, if not by chronic water shortages. In some locations, deteriorating quality of surface water and, especially, ground water is of major concern. Shifts in population, changes in land use, and transformations in mineral and food-production activities are placing new demands on existing water supplies. Thus, competition for currently available supplies of water of acceptable quality has heightened dramatically among domestic, industrial, and agricultural users. As a result, there is a growing need for reliable hydrologic data to facilitate planning, development, and management of the resource.

Water-data collection is a necessary role of government. The costs and benefits of several alternative funding and management options are examined in table 1. The options shown in the table are funding and operations by a single Federal agency, funding and operations by each agency needing data, and a partnership between a central Federal agency and the major beneficiaries of the data. The third is the system in use in the United States today with the U.S. Geological Survey (USGS) acting as the central Federal agency.

The USGS provides much of the hydrologic information collected in the Nation. The USGS was established March 3, 1879, and began stream gaging in the West in 1888. The fact that the USGS neither designs, builds, nor operates water projects is, in large part, the basis for the impartiality that has characterized USGS work through the years. With time, a framework began to take shape that eventually led to a water program closely attuned to local data needs, yet sufficiently broad to provide the information required to plan and assess regional water-resources development and management.

Data-Collection Activities

The USGS maintains a nationwide system of stream-gaging stations, groundwater observation wells, and water-quality sampling locations for ground and surface waters. The resulting data provide an invaluable foundation for addressing emerging issues and form the basis for water-resources appraisals, environmental impact assessments, and contamination studies. These issues include identification and analysis of potential problems related to movement and storage of toxic wastes, acid precipitation, organic contamination in surface and ground water, agriculture, land-use changes, and hydrologic hazards.

USGS funding support for the hydrologic data program is derived from three major sources—the USGS Federal Program, the Federal–State Cooperative Program, and reimbursements from other Federal agencies. The sources of funds for operation of continuous surface-water discharge stations are shown in figure 1. A wide variety of agencies at Federal, State, and local levels furnish support to the Survey, and activities at a single data-collection site commonly are funded by a combination of sources. More than 600 agencies provide funding to the USGS for the operation of continuous-record stream-gaging stations.

Personnel assigned to USGS offices throughout the 50 States, Guam, and Puerto Rico currently (1995) collect data at many sites (table 2): more than 12,000 surface-water stage and discharge stations, about 32,000 wells where groundwater level and (or) pumpage data are collected annually or more frequently, and about 3,100 surface-water stations and 6,900 wells where water-quality information is collected.

Surface-Water Data

Surface-water-discharge (flow) data were collected by the USGS at 10,240 stations in 1994. At 7,426 of these stations, continuous discharge was computed, which means that the flow can be determined for any moment of any day. At 2,814 other stations, partial records were collected. For example, at stations where there is an interest only in peak flows, data are collected and recorded only at stages above a predetermined level. At all stations where discharge was computed, a record of the stage (water-surface elevation) was maintained either continuously or during certain events at partial-record stations. In addition, information on stage only was collected by the USGS at 991 stream-gaging stations. Stage data were also collected at 1,057 stations on lakes and reservoirs.

Ground-Water Data

Water-level fluctuations are indicators of the stresses placed on aquifers, their ability to yield water, and the quantity of water in storage beneath the Earth's surface. The USGS collected information on ground-water levels at 32,031 sites in 1994. Ground-water level data were collected at 26,303 stations to assess long-term trends. When special areal studies were conducted, water-level data occasionally were collected on a short-term basis to supplement the information available in the area from the long-term stations. In 1994, ground-water level data were collected at 5,728 stations for these investigations.

Table 1. Options to fund and manage a national water data program; **Option C** is used at present

Evaluation criteria	A. Funding and operations in a single Federal agency	B. Funding and operations centered in each agency that needs the data	C. Funded as partnership between a central Federal agency and a variety of major beneficiaries. Federal agency operates the network
Operational efficiency	High—Single system of data collecting, processing, and dissemination; equipment testing; and training of staff	Low—Many organizations need to create their own duplicate capabilities	High—Single system of data collection, processing, and dissemination; equipment testing; and training of staff
Responsiveness to needs of major users	Moderate—Users do not have much influence over network	High—Network totally paid for by major users	High—Network design negotiated with major users
Accessibility of information to secondary users or future users	High—Data available in a single data base; free to all users, including users many years after data have been collected	Low—No assurance that data will be entered into widely available data bases	High—Data available in a single data base; free to all users, including users many years after data have been collected
Quality Assurance	High—National training and quality assurance can be required	Uncertain quality and variable methodologies	High—National training and quality assurance can be required
Likelihood of innovative research and development to improve effectiveness or accuracy of program	High—Funded as small percentage of network cost; successes quickly applied throughout entire network	Low—Large percentage of program cost to invest in research and development, resulting in isolated development and application	High—Funded as small percentage of network cost; successes quickly applied throughout entire network
Ability to respond to emergencies (e.g. floods)--rapid deployment of trained staff to other parts of the country	High—Technology and methods consistent; all staff work for same agency	Low—Technology and methods differ among States. Deployment of staff unlikely because of interstate work and travel restrictions	High—Technology and methods consistent; all staff work for same agency
Usefulness of data for adjudication of water rights or settlement of disputes	High—Data are trusted because the agency collecting them is a credible, disinterested third party	Low—Data would be associated with one of the parties and may be distrusted by others	High—Data are trusted because the agency collecting them is a credible, disinterested third party
Cost to Federal Government	High—Whole program funded by Federal Government	Low—Cost covered by the major beneficiaries—State and local government plus Federal water management agencies	Medium—Cost shared by Federal Government and State and local governments
Total cost	Medium—Single infrastructure nationwide (computer systems and data-base structure). Network coordinated across State lines	High—Duplication of infrastructure and need to duplicate measurements on either side of a jurisdictional boundary	Medium—Single infrastructure nationwide (computer systems and data-base structure). Network coordinated across State boundaries
Cost to major beneficiaries	Low—Users are not asked to pay any of the cost directly	High—Major beneficiaries pay the whole cost	Medium—Major beneficiaries pay a share of the cost
Conclusions	High efficiency—High cost to Federal Government, medium customer responsiveness, consistent data available to all	Low efficiency—Low cost to Federal Government, high customer responsiveness, inconsistent data availability	High efficiency—Medium cost to Federal Government, high customer responsiveness, consistent data available to all

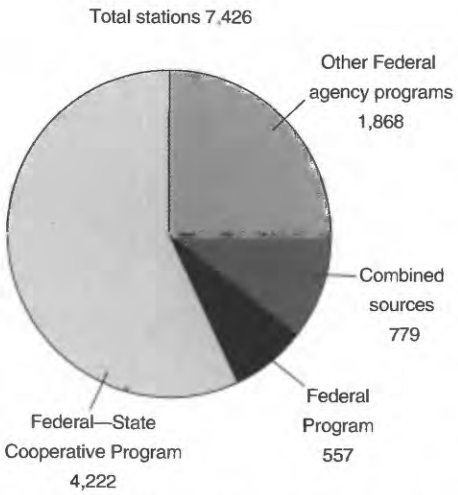

Figure 1. Number of continuous-record surface-water-discharge stations operated by the USGS and sources of funding support in 1994.

Water-Quality Data

In 1994, stream and lake samples were collected at 3,098 stations nationwide and analyzed for water-quality characteristics. The types of water-quality characteristics measured vary from site to site. A continuous record was maintained at 771 of these sites. At 2,018 stream sites, water-quality data were collected as part of a scheduled long-term operation. At 1,080 stations, samples were collected for short-term projects.

Ground water was sampled and analyzed at 6,856 stations in 1994. To maintain information on the changes in quality of critical ground-water bodies, samples were collected at 2,756 stations as part of a scheduled long-term operation. Ground-water quality data also were collected at 4,100 stations to provide information needed for short-term studies.

Uses of Water Data

Data from USGS stations are used for many purposes, including the following:

- Enhancing the public safety by providing current data for forecasting and managing floods
- Identifying and managing flood plains
- Operating and designing multipurpose reservoirs
- Managing releases of treated water or mitigating the effects of pollution
- Designing highway bridges and culverts
- Determining and monitoring instream flow needs
- Developing or operating recreation facilities
- Producing power
- Designing, operating, and maintaining navigation facilities
- Allocating water for municipal, industrial, and irrigation uses
- Characterizing current water-resource conditions (quantity and quality)
- Administering compacts or resolving conflicts on interstate rivers
- Defining and apportioning the water resources at the borders with Canada and Mexico

Stream-gaging stations provide information to assist water managers in making daily operational decisions on water requirements for municipal, industrial, and agricultural use; hydroelectric power generation; and space in reservoirs for flood control. For example, data from many USGS stations are used by the U.S. Army Corps of Engineers (COE), the Bureau of Reclamation, and others to operate more than 2,000 flood control, navigation, and water-supply reservoirs. More than 3,000 of the stations operated by the USGS are used in the National Weather Service's (NWS) flood-forecasting system.

Today, more than one-half of currently operating stream-gaging stations use automated earth-satellite telemetry equipment for the transmission of data from the collection site. Data are transmitted around the clock by means of two geostationary satellites operated by the National Oceanic and Atmospheric Administration. These data then are retransmitted through a domestic satellite, and the resulting data are received by the USGS and other users. The automated telemetry provides water-data users with provisional information in a time frame that meets water management needs. This system gives the USGS the capability to continuously monitor the operation of the hydrologic stations so that visits to the stations (for maintenance, instrument calibration, selective data collection) can be planned with maximum effectiveness.

During the 1993 Mississippi River floods, USGS personnel made more than 2,000 visits to stream-gaging stations in the flood-affected areas to verify that the instruments were working properly and to make direct measurements of the streamflow. Data from these stations were provided continuously to the NWS and the COE and formed the basis for flood forecasts that allowed people to be evacuated from areas about to be inundated. It also enabled the COE and others to focus flood-fighting activities where they were most needed. The USGS was able to move staff from other locations into the disaster area. These hydrologists and technicians were already familiar with the equipment and procedures so they could begin work immediately upon arrival.

Surface- and ground-water and water-quality data commonly are closely related. For example, water-quality sampling and analysis provide information on the concentrations of chemical constituents in the water. Some water-quality sampling is done only within pre-specfied ranges of discharge as determined by stream-gaging stations. These stations also generate the flow data needed to convert concentrations to loads (the total

Table 2. Number of USGS data-collection stations operated in 1994, by source of funds

Types of stations	Federal Program	Federal-State Cooperative Program	Other Federal Agency Program	Combined support	Total
Surface water:					
Discharge	638	6,419	2,219	964	10,240
Stage-only--streams, lakes, and reservoirs.	47	968	850	183	2,048
Quality	778	1,666	426	228	3,098
Ground water:					
Water levels	2,344	27,029	2,421	237	32,031
Quality	691	4,602	1,347	216	6,856

amount of the material transported by the water), which is required to characterize the movement and fate of the material in the stream. Because ground water at times either discharges to or is recharged by streams, knowledge of the overall hydrologic system is necessary to the understanding of water quality in that system. A few specific examples of uses of ground-water and water-quality data are as follows:

- Water levels are measured semi-annually at more than 1,000 wells in west-central Florida to document the potentiometric surface of the Floridan aquifer. This information is used to update ground-water-flow models of the Florida Water Management Districts.
- Water-quality stations are operated in the Delaware River estuary to monitor the location of the freshwater/saltwater interface. This information is used to protect the water supplies of southwestern New Jersey.
- Utilities in South Carolina and other States use realtime water-temperature and conductance data to manage the release of effluent from power-generation plants.
- Specific conductance and chloride concentrations are measured at many coastal locations to monitor the movement of saltwater into freshwater aquifers.

Quality Assurance and Credibility

To meet local and national data needs, the USGS cooperates with State and local governments and other Federal agencies in conducting investigations and research on the availability, quality, and utilization of surface- and ground-water resources. This work depends on the systematic nationwide program of data collection, analysis, and dissemination. Over the years, the Water-Data Program has achieved a high degree of credibility because the resulting information has been used and tested by many organizations and individuals in government and private sectors. In large measure, this credibility is the result of continuous efforts to ensure that data are collected, analyzed, and disseminated through thoroughly proven methods and techniques under rigorous standards of quality control.

Viewed from today's perspective of environmental concerns, technologic change, resource depletion, and population stress, the USGS's Water-Data Program is the foundation for many decisions involving water and water-related resources. The success of the Program in anticipating and responding to changing priorities and emergencies stems directly from its effective blending of Federal, State, and local inputs. The Program shares with Federal and non-Federal cooperators the cost and the responsibility for the design and management of the system. As a result of these and other characteristics, the Water-Data Program has acquired an unusual record of scientific objectivity, which is especially significant in assessing the environmental and legal aspects of water-resource developments and control measures.

Reporting and Availability of Data

The USGS publishes hydrologic data in a series of annual reports for each State and catalogs these reports in a monthly list of USGS publications. Beginning with the 1990 water year, water data reports also are available on Compact Disk–Read Only Memory (CD–ROM). The Water-Data Reports and the CD–ROM are distributed to participating agencies and to libraries; they are also available for sale by the Books and Open-File Reports Section, USGS, Denver, Colorado. In 1994, the USGS began moving more and more of these data to online accessibility over the Internet, thus making their availability virtually instantaneous and free.

The data are stored in the USGS's National Water Data Storage and Retrieval System (WATSTORE), which includes a Daily Values File that contains 300 million observations of streamflow, water quality, sediment-discharge, and ground-water-level data; a Water Quality File that contains 4.1 million surface- and ground-water analyses; a Peak Flow File that contains nearly 600,000 observations of annual peaks of streamflow and river stage; and a Ground Water Site Inventory File that contains information for more than 1.4 million wells.

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Additional earth science information can be found by accessing the USGS "Home Page" on the World Wide Web at http://www.usgs.gov", or by calling 1-800-H20-9000 (1-800-426-9000)

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