Fact Sheet

United States Geological Survey
Federal-State Cooperative Water-Resources 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.

Reliable supplies of suitable quality water are necessary to the health and well-being of America's people, cities, and businesses. Numerous Federal, State, regional, and local agencies share keen interests in appraising the Nation's water resources and seeking solutions to water-related problems. Because of their varying missions and areas of responsibility, these many agencies hold diverse perceptions of approaches, needs, and priorities. The U.S. Geological Survey's (USGS) Federal-State Cooperative Program accommodates this diversity through joint planning and funding (50:50 matching) of systematic studies of water quantity, quality, and use on a national basis. The Cooperative Program has contributed to water-resources knowledge for 100 years. From its earliest days, the Program has been responsible directly for the development of procedures for streamgaging, concepts of surface-water and ground-water flow, and analytical techniques for investigations of water quality.

The Federal-State Cooperative Program, a partnership between the USGS and State and local agencies, provides information that forms the foundation for many of the Nation's water-resources management and planning activities. In addition, the information may function as an early warning of emerging water problems. The fundamental characteristic of the Program is that local and State agencies provide at least one-half the funds, but the USGS does most of the work. Having the USGS do the work results in consistent techniques of data collection and archiving, with the information stored in a common data base readily available to all. The knowledge gained in the studies is published and added to the growing body of information about the hydrology of the region or area.

Most work in the Cooperative Program is directed toward potential and emerging long-term problems, such as water supply, waste disposal, ground-water quality, effects of agricultural chemicals, floods, droughts, and environmental protection. Standardized methods are used so that study results are transferable to similar problems in other areas and contribute to issues that have interstate, regional, or international significance. Data collected by USGS and the results of its studies are accepted by parties on both sides of disputes and furnish the basis required for interstate and international compacts, Federal law and court decrees, congressionally mandated studies, regional and national water-resources assessments, and planning activities.

A comprehensive and forward-looking program of hydrologic data collection and investigations is needed to provide the information necessary for the wise development and use of the Nation's water resources. The jointly planned and funded Cooperative Program provides assurance that the information needed to meet national and local needs will be produced and shared. Because rivers and aquifers cross jurisdictional lines, studies and data collected in one county or one State have great value in adjacent counties or States. It is therefore effective to have one agency involved in these studies so that the information can be shared and is comparable from one jurisdiction to the next. The USGS can respond to major floods with crews from all over the Nation who bring to bear common knowledge of streamgaging technology and procedures. This versatile response capability would not be possible if State agencies had to act alone in flood emergencies.

Program priorities are developed in response to mutual Federal, regional, State, and local requirements. Thus, the USGS and cooperating agencies work together in a continuing process that leads to adjustments in the program each year. During 1994, cooperative water studies were conducted by USGS personnel in every State, in Puerto Rico, and several territories. About 1,100 cooperators participated in the program (see table 1). These cooperators include State, county, and municipal agencies, as well as interstate compact organizations, conservation districts, water-supply districts, sanitary districts, drainage districts, flood-control districts, and similar organizations. Through the pooling of support, the USGS is able to conduct studies that lead to an improved understanding of the Nation's water resources to the mutual benefit of all levels of government--at substantial financial savings.

Within the Cooperative Program, typically about half of the funds support the collection of hydrologic data; the remaining half support hydrologic investigations and research. In 1994, the Federal-State Cooperative Program served as the sole source of funding for the operation of more than 4,200 continuous streamflow stations and partially funded an additional 650 continuous streamflow stations. These stations constitute about 67 percent of the continuous streamflow stations operated by the USGS. The Program also provided funds for the collection of ground-water levels at approximately 27,300 wells and the collection of water-quality data at about 1,900 surface-water stations and 4,800 ground-water well and spring stations. These data provide information necessary for the determination of the suitability of water for various uses, identification of trends in water quality, and evaluation of the effects of stresses on the Nation's surface- and ground-water resources. Since the early 1970's, there has been an increase in the number of investigations that have emphasized water-quality issues, such as aquifer contamination, river quality, storm-runoff quality, and the effects of acid rain, mining, and agricultural chemicals and practices on the hydrologic system.

Table 1. Number of cooperators in the 1994 Federal-State Cooperative Program.

	State	County	Municipal	Indian	Other	Total
Alabama	5	4	10	--	1	20
Alaska	7	--	5	--	1	13
Arizona	4	3	2	6	6	21
Arkansas	7	2	3	--	1	13
California	6	28	17	4	20	75
Colorado	6	13	27	1	30	77
Connecticut	2	--	4	--	2	8
Delaware	2	--	--	--	1	3
District of Columbia	--	--	2	--	1	3
Florida	3	14	23	--	12	52
Georgia	6	10	14	--	2	32
Hawaii	3	5	--	--	--	8
American Samoa	2	--	--	--	--	2
Guam	1	--	--	--	--	1
Northern Marianas	1	--	1	--	--	2
Trust Territory	4	--	--	--	--	4
Idaho	2	2	1	2	7	14
Illinois	5	7	8	--	4	24
Indiana	3	1	3	--	1	8
Iowa	3	--	9	--	3	15
Kansas	6	3	4	4	5	22
Kentucky	3	2	6	--	4	15
Louisiana	5	2	1	--	4	12
Maine	5	1	2	--	3	11
Maryland	4	2	2	--	--	8
Massachusetts	6	--	1	--	3	10
Michigan	2	6	17	2	3	30
Minnesota	4	5	3	6	4	22
Mississippi	5	3	1	--	4	13
Missouri	4	2	4	--	2	12
Montana	6	2	1	4	3	16
Nebraska	4	--	2	--	15	21
Nevada	6	5	2	4	4	21
New Hampshire	1	--	1	--	--	2
New Jersey	4	5	6	--	4	19
New Mexico	4	1	7	3	8	23
New York	4	13	9	1	3	30
North Carolina	3	2	12	--	3	20
North Dakota	5	--	3	2	1	11
Ohio	3	7	5	--	4	19
Oklahoma	5	--	1	3	1	10
Oregon	5	4	8	1	4	22
Pennsylvania	6	4	13	--	7	30
Puerto Rico	6	--	--	--	--	6
Rhode Island	3	--	1	--	1	5
South Carolina	6	1	7	--	6	20
South Dakota	8	3	4	5	7	27
Tennessee	5	4	21	--	2	32
Texas	5	7	19	--	28	59
Utah	5	2	3	--	5	15
Vermont	2	--	--	--	--	2
Virginia	3	2	4	--	4	13
Virgin Islands	1	--	--	--	--	1
Washington	4	12	7	9	--	32
West Virginia	5	--	2	--	--	7
Wisconsin	5	5	30	4	26	70
Wyoming	7	3	4	--	6	20
TOTAL	237	197	342	61	266	1,103

All data and results of analytical studies are made available to cooperating agencies and to the public through published reports, and through computerized data bases. Hydrologic data can be accessed through USGS offices in every State and will soon be available over the Internet. The benefits of the program are demonstrated by the extent to which other agencies apply the information produced. For example, the National Weather Service uses streamflow and water-level information from some 3,000 USGS-operated gaging stations for their flood-forecasting systems.

Many Cooperative Program activities provide information necessary for making water-management decisions. Investigations are undertaken in response to a specific need but produce information and/or techniques that are applicable to other situations in related settings. Several examples follow.

California—*Contaminant Transport in Fractured Rock, Penn Mine*

The USGS is conducting a study, in cooperation with the California State Water Resources Control Board and the East Bay Municipal Utility District, to verify ground-water flow paths and quantify ground-water flow in the fractured rock aquifer that connects unlined mining waste-water ponds to Camanche Reservoir; to quantify the water-rock interactions that control the geochemistry of the ground-water system; and to quantify transport of major chemical constituents and trace elements along ground-water flow paths from the mine to the reservoir. This study represents one of the first attempts at modeling contaminant transport in fractured rock, and will serve to advance the understanding of fractured-rock hydrogeology. This knowledge will be used to solve contamination problems in other fractured-rock environments.

Delaware, Maryland, and Virginia—*Bridge Scour Studies*

The undermining (scouring) of bridge-pier and abutment foundations by erosive action of water can result in structural failure of bridges. The numerous equations that have been developed to predict scour produce a wide range of estimates for the same set of conditions. However, field data to test the validity of these equations are sparse. The USGS, in cooperation with State Highway Departments in Delaware, Maryland, and Virginia, is developing techniques for measuring scour continuously at bridge piers to improve the predictive equations. The results of these and other similar USGS studies are being used by engineering firms, State departments of transportation, and the Federal Highway Administration to determine the risk of and to prevent bridge failure. Bridges identified as having high risk for destructive scour are investigated in detail by private or State engineers who devise ways to safeguard the bridge.

Florida—*Development of Flow Models for Wetlands, Dade County*

The USGS has developed numerous computer techniques to simulate both ground-water flow and surface-water flow. These models are now in use by State and local agencies, consulting firms, and universities throughout the Nation. The USGS, in cooperation with the South Florida Water Management District, is investigating methods of combining the capabilities of ground-water and surface-water models to study the effects of water-management alternatives in ecologically sensitive wetlands that commonly are in direct connection with the ground-water system. Hydrologic data collected in Dade County will be used to construct and calibrate models of the Biscayne aquifer that will include simulations of the interactions between surface water, ground water, and wetlands. This study will help improve the understanding of the hydrologic relations in the South Florida Everglades area, and will provide improved analytical tools to the water-resources community.

Illinois—*Improved Techniques for Predicting Flood Risks*

Understanding the relation between rainfall and resulting runoff is important for accurate prediction of the risk of flooding. Many computer-based models have been developed to simulate this relation, but they need significant improvement to better describe how factors such as land use, soil properties, and rainfall distribution affect runoff. The USGS, in cooperation with the Illinois Department of Transportation, is using geographic information system technology to improve the way that models handle the various factors involved. Improved model simulations will provide better predictions of runoff and enable forecasters to provide more accurate flood information.

Damage caused by floods is especially acute in highly urbanized watersheds. Yet the predictive tools used to estimate the potential effects of flooding are least accurate in urban areas because of rapidly changing land-use activities. The USGS, in cooperation with DuPage County and the Illinois Department of Water Resources, is improving statistical methods used to estimate peak flood levels and volumes in densely-populated, rapidly-changing areas around Chicago. The methods will provide better information for protecting existing structures and for planning future development.

These studies and similar work nationwide have resulted in a USGS report that provides the means by which to estimate the magnitude and frequency of floods at ungaged sites on streams. The equations in this report are widely used by consulting engineers and government agencies for flood prediction.

Iowa, Kansas, Minnesota, Missouri, North and South Dakota, and Nebraska—*Midwest Floods, 1993*

During the 1993 Mississippi River floods, USGS field personnel made more than 2,000 visits to streamgaging stations in the flood-affected areas to verify that the instruments were working and communicating properly, to make repairs as needed, and to make direct measurements of the streamflow. Approximately 70 percent of the USGS streamgaging stations were operated in cooperation with various State and local agencies. The data from the gaging stations were provided continuously to the National Weather Service and the U.S. Army Corps of Engineers and formed the basis for flood forecasts that allowed people and personal property to be evacuated from areas about to be inundated. It also enabled the Corps of Engineers and others to focus flood-fighting activities where they would be most useful. Without the long-standing gaging station network and well-developed communications systems, accurate forecasts could not have been made and loss of life and damage to property would have been far greater than it was (47 lives were lost, and property damages totaled $16 billion). This same experience with the real-time use of USGS gaging station data is repeated several times each year as catastrophic floods strike various sections of the Nation. In addition, the hydrologic information is used by transportation planners to design safe bridges and roadways and to establish valid zoning and insurance regulations that protect people and property during future floods.

Kansas—*Effects of Soil- and Cropping-Management on Atrazine Movement*

Contamination of surface water by atrazine and other herbicides may pose a serious problem for public water supplies. Experiments conducted at the Kansas River Valley Experimental Field near Topeka, Kansas, as part of a USGS-Kansas State University cooperative study, reveal that some simple improvements in farming techniques can greatly reduce herbicide loss from fields. A farming technique that results in considerable reduction in herbicide concentrations in runoff from cultivated fields is the incorporation of the herbicide into the soil. Runoff from experimental plots in which the herbicides were incorporated into the soil during application had initial concentrations of herbicides 10 to 100 times less than initial concentrations in runoff from plots in which the herbicides were applied directly to the soil surface. Other experiments showed that encapsulated herbicides help reduce herbicide loss, especially when incorporated into the soil. These findings are significant in light of a common farming practice of spraying herbicides on the surface of minimum-tilled fields. The additional crop residue on the surface of such fields reduces soil erosion, but the surface application of the herbicides clearly contributes a large amount of herbicide to surface water. This study brought together the University's expertise in agricultural systems and soils with the USGS capability in water-quality monitoring and organic chemistry. The information produced by the study is of great benefit to the Nation's agricultural community in making decisions with respect to techniques for herbicide application.

Louisiana—*Flooding on the Lower Pearl River*

Severe flooding on the lower Pearl River in the vicinity of Slidell, Louisiana, occurred in April of 1979, 1980, and 1983. Each flood approached or exceeded a 100-year frequency of recurrence. The chance for three such floods happening within a 4-year span is about 1 in 10,000. Following the 1980 flood, the USGS, in cooperation with the Louisiana Department of Transportation and Development, Office of Highways, began a study of river flow at the I-10 Interstate Highway crossing of the Pearl River near Slidell. The USGS developed a mathematical model to simulate flow conditions through the existing bridge openings. The model also can be used to simulate conditions without I-10 in place, the effects of alternative bridge designs, or modifications to the existing bridge. After further development, the model has been adopted by the Federal Highway Administration, many State departments of transportation, and consulting engineers to analyze complex streamflow situations at existing or proposed bridge crossings. The information from the model results in safer and more cost-effective bridge design.

South Carolina—*Rates of Petroleum Hydrocarbon Degradation*

The USGS, in cooperation with the South Carolina Water Resources Commission, is investigating an extensively contaminated shallow water-table aquifer underlying a fuel-tank farm in Hanahan, South Carolina. Data collected to date have revealed that petroleum hydrocarbons in the aquifer are being degraded in a complex pattern of zones dominated by chemically distinct conditions that change dynamically in time and space. Future studies are planned to determine relative rates of hydrocarbon degradation under these conditions and how degradation rates are affected by changes in conditions. This information will benefit the evaluation and design of low-cost bioremediation strategies at this and similar sites nationwide.

Texas—*Areas of High Risk from Contamination, Edwards Aquifer*

The USGS, in cooperation with the Edwards Underground Water District in San Antonio, Texas, mapped outcrops of the Edwards aquifer in northern Bexar, Comal, and Hays counties. The Edwards aquifer is the sole source of water for 1.5 million people in San Antonio and the surrounding area. The resulting hydrogeologic maps indicate areas of the aquifer most susceptible to contamination by surface sources, such as spills or stormwater runoff from residential or commercial development on or adjacent to the aquifer outcrops. This information is essential for land-use planning to protect the Edwards aquifer in the rapidly urbanizing outcrop area. In addition, the hydrogeologic maps are useful for determining relative fault displacement, which, when combined with the defined "most sensitive to pollution" areas, aids in inferring the path of ground-water flow from the outcrop into the aquifer. USGS investigations of the Edwards aquifer led to enactment of a Federal law to protect aquifers that are the sole source of public water supplies.

For more information contact any of the following:

Office of the Regional Hydrologist, NR
U.S. Geological Survey
433 National Center
Reston, Virginia 22092
(703) 648-5817

Conn., Del., D.C., Ill, Ind., Ky., Maine, Md., Mass., Mich., N.H., N.J., N.Y., Ohio, Pa., R.I., Vt., Va., W.Va., and Wis.

Office of the Regional Hydrologist, SR
U.S. Geological Survey
Spalding Woods Office Park
3850 Holcomb Bridge Road, Suite 160
Norcross, Georgia 30092-0223
(404) 409-7701

Ala., Ark., Fla., Ga., La., Miss., Mo., N.C., P.R., S.C., Tenn., and V.I.

Office of the Regional Hydrologist, CR
U.S. Geological Survey
Mail Stop 406, Box 25046
Denver Federal Center
Lakewood, Colorado 80225
(303) 236-5920

Colo., Iowa, Kans., Minn., Mont., Nebr., N. Mex., N. Dak., Okla., S. Dak., Tex., and Wyo.

Office of the Regional Hydrologist, WR
U.S. Geological Survey
345 Middlefield Road, Mail Stop 470
Menlo Park, California 94025-3591
(415) 329-4414

Alaska, Ariz., Calif., Guam, Hawaii, Idaho, Nev., Oreg., Utah, and Wash.

Additional earth science information can be found by accessing the USGS "Home Page" on the World Wide Web at "http://www.usgs.gov".

For more information on all USGS reports and products (including maps, images, and computerized data), call 1-800-USA-MAPS.

U.S. Department of the Interior
U.S. Geological Survey
Fact Sheet FS-052-95

☆ U.S. GOVERNMENT PRINTING OFFICE: 1995—647-039