WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN WYOMING, OCTOBER 1989 THROUGH SEPTEMBER 1991

Compiled by K.E. Wilson

U.S. GEOLOGICAL SURVEY

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CONVERSION FACTORS

Multiply	By	To obtain
foot	0.3048	meter
cubic foot per second	0.02832	cubic meter per second
gallon per minute	0.06308	liter per second
mile	1.609	kilometer
square mile	2.590	square kilometer
acre-foot per year	1,233	cubic meter per year

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN WYOMING, OCTOBER 1989 THROUGH SEPTEMBER 1991

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ABSTRACT

This report describes the water-resources activities of the U.S. Geological Survey (USGS), Wyoming District. The activities are classified as data-collection programs and water-resources-appraisal projects. Much of the work is done in cooperation with other agencies. During fiscal years 1990 and 1991, cooperators included 8 State agencies, 4 counties, 3 cities, 1 town, 1 irrigation district, 1 city-county board, 1 tribal co-op, 2 Native American tribes, and 8 Federal agencies. This report serves both as a biennial progress report to the cooperating agencies and the general public, and as one means of coordinating water-resources activities with other agencies.

Lists and location maps are included for 204 streamflow stations, 16 reservoir stations, 110 surface-water-quality stations, 44 fluvial-sediment stations, 90 ground-water-level observation wells, and 97 ground-water-quality sites that were in operation during fiscal year 1990 or 1991. During fiscal years 1990 and 1991, 5 streamflow stations, 23 surface-water-quality stations, 2 sediment stations, and 3 ground-water-level observation wells were discontinued. During fiscal year 1990 and through the first quarter of fiscal year 1991, 13 streamflow stations, 9 surface-water-quality stations, and 26 sediment stations were established or reactivated.

Descriptions, location maps, and progress statements are given for 4 data-collection projects and 22 water-resources-appraisal projects that were active (funded) during fiscal year 1990 or 1991. Also included are lists of 8 projects that were completed during fiscal years 1990 and 1991 and 6 projects for which funding ended prior to 1990 and that are completed except for the final report(s). The final section is a bibliographic listing of reports by USGS authors about the water resources of Wyoming.

INTRODUCTION

The U.S. Geological Survey (USGS) is the Federal agency responsible for appraising the quantity, quality, and distribution of the Nation's surface-water and ground-water resources. Through its Water Resources Division, the USGS maintains data-collection networks, conducts interpretive studies, and supports hydrologic research in every state, the Commonwealth of Puerto Rico, and the American Trust Territories. It also works through cooperative programs with State, local, and other Federal agencies to help evaluate regional and local water problems. Results of these activities provide a basis for many major water-management decisions.

The purpose of this report is to describe the water-resources activities in Wyoming. The report also provides information to cooperating officials and the public about the accomplishments in the various appraisal projects during fiscal year 1990 (October 1, 1989 through September 30, 1990) and planned work for fiscal year 1991. The report is one phase of an effort to coordinate the water-resources activities of the USGS with other water-related organizations.

Cooperating State, local, and other Federal agencies are identified throughout this report. The activities are classified into two groups: (1) data-collection programs (projects), and (2) water-resources-appraisal projects.

The data-collection programs include (1) collecting records of streamflow and reservoir storage, (2) sampling and chemical analysis of water from streams and ground-water wells, (3) sampling and analysis of sediment in surface water, and (4) measuring water levels in wells. This report contains tables describing monitoring sites for these four data-collection programs in water year 1991 and sites discontinued in water years 1989 and 1990. All four types of data also are collected as part of many water-resources-appraisal projects; these short-term sites are not included in the tables in this report.

Water-resources-appraisal projects described in this report include the projects conducted during fiscal years 1990 and 1991. Projects completed prior to fiscal year 1990, but for which final reports were in preparation at the end of fiscal year 1990, are listed separately. An extensive listing of reports of results from previous activities is provided at the back of this report.

United States Department of the Interior
GEOLOGICAL SURVEY

Water Resources Division
2617 East Lincolnway, Suite B
Cheyenne, Wyoming 82001

MESSAGE FROM THE DISTRICT CHIEF

The Wyoming District, Water Resources Division, U.S. Geological Survey, contributes to the understanding of Wyoming's water resources by monitoring and appraising the water resources of the State. The work we do not only benefits Wyoming, but the Nation as well, because water, whether aboveground in streams and lakes or below ground in aquifers, follows no political boundaries.

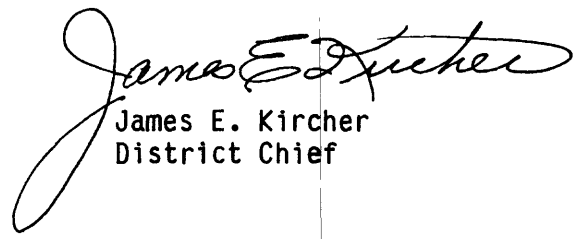
As you can see in the pages that follow, our work consists of two groups of interrelated activities: (1) monitoring of water quantity and quality at specific sites, and (2) studies of the hydrology of specific areas and the hydrologic consequences of human activities. The information gathered in both types of activities, including any scientific interpretations of the information, is made available to the public as a basis for long-term as well as immediate use in managing Wyoming's finite water resources.

Over the years, our work has changed in response to changes in needs for water-resources information. Our monitoring-network operations have been and will continue to be the foundation upon which problem-oriented, multi-disciplinary hydrologic studies are based. Recent activities include the expansion of our statewide network for monitoring ground-water quality, operation of a network of flood-monitoring stations in and around Cheyenne, and assessments of contamination of ground and surface water by organic compounds and trace elements in selected areas.

Our capacity to carry out investigations is greatly enhanced by our partnerships with State, local, and other Federal agencies. For example, under the unique Federal-State Cooperative Water Resources Program, the Wyoming State Engineer has been our partner in hydrologic-network activities since 1915 and in interpretive studies since the 1940s; this cooperation is continuing. The many other agencies that co-sponsor the work we do are identified throughout this report. Needless to say, the USGS values these partnerships highly.

The next few years will see substantial changes in the field of water-resources investigations as the public becomes more concerned about hazardous wastes and toxic substances in the environment. We will be challenged to develop and use more advanced sampling and analytical techniques to measure chemicals in trace quantities in both ground and surface water. Intrastate water-allocation issues among private, State, and Federal users will require quantification of ground and surface water, even in the absence of detailed studies or long-term records.

These issues and others will demand attention despite the severe budget constraints imposed by declining State revenues and despite the Federal deficit. Clearly, increased cooperation between agencies will be essential if we are to meet our obligations. We look forward to the promise of technically challenging programs and stronger cooperative relationships.



James E. Kircher
District Chief

ORIGIN OF THE U.S. GEOLOGICAL SURVEY

The USGS was established by an act of Congress on March 3, 1879, providing 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 expanded 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 mapmaking 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:

- Conducting detailed assessments of the energy and mineral potential of the Nation's land and offshore area.
- Investigating and issuing warnings of earthquakes, volcanic eruptions, landslides, and other geologic and hydrologic hazards.
- Conducting research on the geologic structure of the Nation.
- Studying the geologic features, structure, processes, and history of the other planets of our solar system.
- Conducting topographic surveys of the Nation, preparing topographic and thematic maps and related cartographic products.
- Developing and producing digital cartographic data bases and products.
- Collecting data on a routine basis to determine the quantity, quality, and use of surface and ground water.
- Conducting water-resource appraisals in order to describe the consequences of alternative plans for developing land and water resources.
- Conducting research in hydraulics and hydrology, and coordinating most Federal water-data acquisition.
- Using remotely sensed data to develop new research techniques in cartography, geology, and hydrology for natural-resources planning and management.
- Providing earth-science information through an extensive publications program.

Along with its continuing commitment to meet the expanding 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 to the public.

MISSION OF THE WATER RESOURCES DIVISION

The mission of the Water Resources Division is to provide the hydrologic information and technical evaluation needed for the optimum use 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:

- 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.
- Conducting analytical and interpretive water-resource appraisals describing the occurrence, availability, and the physical, chemical, and biological characteristics of surface and ground water.
- Conducting basic and problem-oriented research in hydraulics, hydrology, and related fields of science to improve the scientific knowledge for investigations and measurement techniques.
- Disseminating the water data and the results of these investigations and research through reports, maps, computerized information services, and other forms of public releases.
- Coordinating the activities of Federal agencies in the acquisition of water data for streams, lakes, reservoirs, estuaries, and ground water.
- Providing scientific and technical assistance in hydrologic fields to State, local, and other Federal agencies, to licensees of the Federal Power Commission, and to international agencies on behalf of the U.S. Department of State.

ORIGIN OF THE WYOMING DISTRICT

The Water Resources Division of the USGS, of which the Wyoming District is a part, has its roots in the Irrigation Survey of 1888-90. The Sundry Civil Appropriation Act of 1888 established an Irrigation Survey as a part of the USGS "for the purpose of investigating the extent to which the arid region of the United States can be redeemed by irrigation * * *."[1] In 1888, the Washington, D.C. office of the USGS paid the installation costs for the first streamflow-gaging station in Wyoming, Laramie River at Woods Landing. The station was constructed and operated by the Territorial Engineer, Elwood Mead. Between 1895 and 1901, the USGS paid operating expenses for additional stations operated by the Wyoming State Engineer. A.J. Parshall became the first resident hydrographer for the USGS in Wyoming in 1901.

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[1]U.S. Statutes at Large, 1887-89, The Sundry Civil Appropriations Act of 1888: Washington, v. 25, chap. 1069, p. 526.

These early activities were forerunners of the Federal-State Cooperative Water-Resources Program, first funded by Congress in 1905, and given formal recognition by Congress in 1927. The Cooperative Program is a partnership among the USGS and State and local agencies for water-resources investigations.

Surface-water investigations in cooperation with the State Engineer have continued without interruption since 1915. Early Federal cooperators included the Reclamation Service (about 1902), the Indian Service (1908), and the Forest Service (1910). A flood-investigations program was started in 1959 in cooperation with the Wyoming Highway Department; this successful program was completed in 1988.

Surface-water activities in Wyoming were directed from Washington until 1903, when the Colorado District was established under M.C. Hinderlider. Between 1903 and 1961, Wyoming was part of the Colorado District, with local offices at various times in Kemmerer, Sheridan, and Casper. The Wyoming District, Surface Water Branch, was established in 1961, with L.A. Wiard as District Engineer.

The earliest known ground-water studies by the USGS in Wyoming were done between 1901 and 1917 by G.I. Adams in Goshen Hole area; N.H. Darton and others in the Great Plains, Bighorn Mountains, Laramie Range, and Black Hills; and O.E. Meinzer in Lodgepole Valley. Investigations in cooperation with State agencies have been carried out since 1940, when the Wyoming Planning and Water Conservation Board sponsored a study of the Egbert-Pine Bluffs area by T.W. Robinson. Cooperation on hydrologic studies with the State Engineer has continued since 1945.

Ground-water work in Wyoming was directed from Washington until 1945, when Wyoming became a part of the Colorado District under S.W. Lohman. The local geologist in charge was A.M. Morgan. In 1951 the Wyoming District, Ground Water Branch, was established with H.M. Babcock as District Geologist.

Surface-water quality work in Wyoming began with the establishment of an office and sediment laboratory in Worland in March 1946, with T.F. Hanly in charge. The program was directed by P.C. Benedict, Regional Engineer, in Lincoln, Nebraska. During 1948, chemical-quality or sediment stations were in operation in the North Platte River basin under the Missouri River basin program of the U.S. Department of the Interior.

In February 1956, the office in Worland was designated as a District Office, Quality of Water Branch, with T.F. Hanly as District Engineer. The first sediment station in the State cooperative program was established on Rock Creek near Atlantic City with the Wyoming Natural Resources Board in 1957. A cooperative chemical-quality program with the State Engineer was started in 1959 to evaluate the effects of the Kendrick Project on the North Platte River. Since 1965, the Wyoming Department of Agriculture has been the principal State cooperator for chemical quality, and the State Engineer for sediment data. The Branch Districts in Wyoming were combined into a single Water Resources Division District in February 1967 with L.A. Wiard as District Chief.

DISTRICT ORGANIZATION

The water-resources activities of the Wyoming District Office are carried out by two operating sections (fig. 1) and two support sections. The Hydrologic Surveillance and Data Management Section designs, constructs, operates, and maintains the District's hydrologic-data stations and manages the collection, analysis, publication, and storage of hydrologic data. The Hydrologic Investigations Section plans and executes water-resources investigations Statewide, including mathematical modeling of ground-water systems, application of open-channel hydraulics to surface-water problems, water-resources appraisals, hazardous-waste investigations, and evaluation of the hydrologic effects of human activities such as irrigation of croplands or surface mining of coal. Administrative Services Section provides support to the rest of the District in the form of program planning and management, budgeting, accounting, personnel management, property inventory, travel records, vehicle management, and related services. The Computer Support Unit designs and maintains the computer systems and provides computer services to the rest of the District. The Publications Support Unit is part of the Hydrologic Investigations Section and is responsible for adequacy of publications and adherence to Survey and Division policy and format; the Unit assists the District staff in the design, preparation, and processing of publications. All reports also are reviewed by the Reports Specialist for technical correctness and adherence to policy.

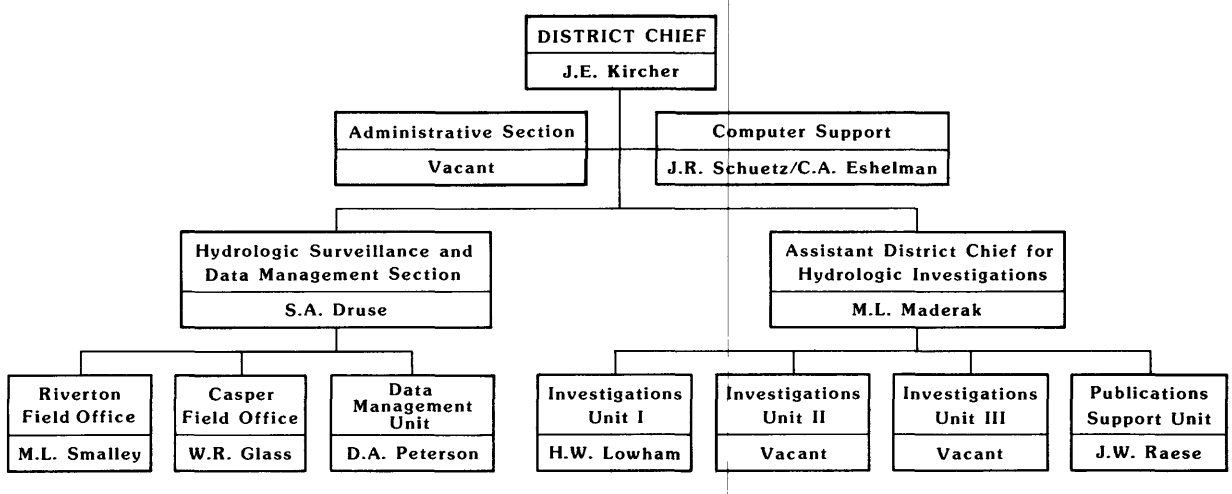


Figure 1.--Wyoming District organization.

The District Office is in Cheyenne, with Field Offices in Casper and Riverton (inside front cover and fig. 2). Personnel of the Field Offices perform most of the hydrologic-data collection; the Casper office is responsible for eastern Wyoming, and the Riverton office is responsible for western Wyoming.

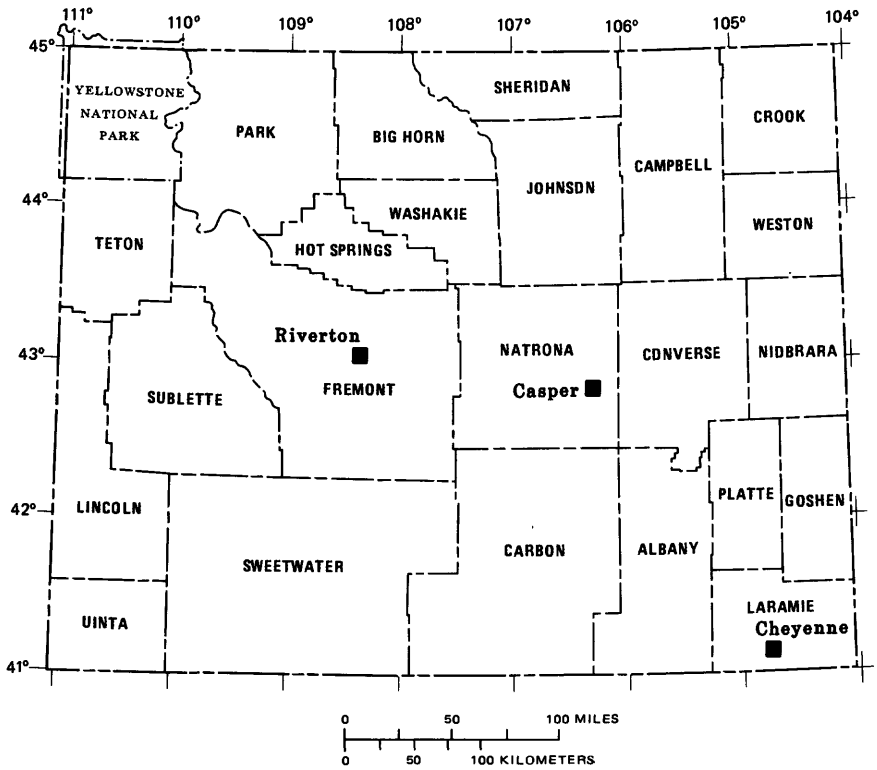


Figure 2.-Location of U.S. Geological Survey, Water Resources Division offices in Wyoming.

SOURCES OF FUNDING

Funds for carrying out the water-resources investigations of the U.S. Geological Survey (USGS) in Wyoming are provided by many agencies. The agencies are classified by three major categories: (1) State and local agencies that provide funds or services, or both, generally matched on a 50-50 (percent) basis by USGS funds (cooperative program); (2) other Federal agencies that transfer funds to the USGS (OFA program); and (3) USGS funds received by direct appropriation for activities that are national in scope (Federal program). The distribution of these funds in Wyoming by major category for fiscal years 1990 and 1991 is shown in figure 3. During fiscal year 1990, about 50 percent of the funds were used for collection of hydrologic data and about 50 percent for interpretive hydrologic studies, while in 1991 the distribution is 30 percent hydrologic data and 70 percent hydrologic studies.

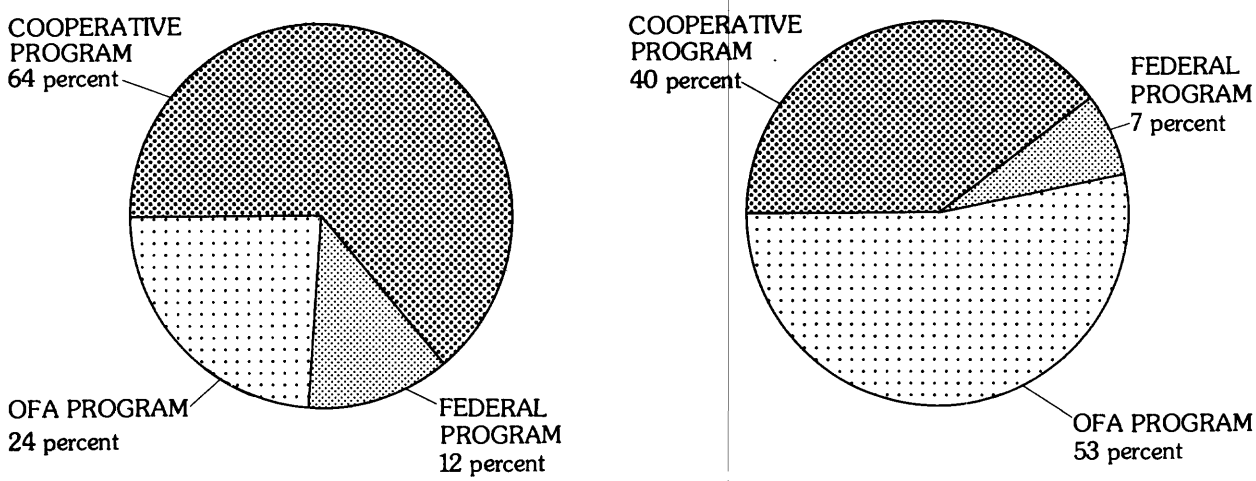


Figure 3.--Sources of funding.

SUMMARY OF HYDROLOGIC CONDITIONS DURING WATER YEAR 1990

Drought conditions persisted throughout most of Wyoming during water year 1990, with only extreme eastern and extreme northwestern Wyoming having near normal conditions. The Weekly Weather and Crop Bulletin, prepared and published by the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Department of Agriculture Joint Agricultural Weather Facility, reported little change from 1989 in the area affected by severe and extreme drought during the summer months. The July 7 report showed the area of extreme drought included all of Wyoming except extreme eastern and extreme northwestern Wyoming, and this condition prevailed through their September report. Water year 1990 was the third consecutive year of drought throughout most of Wyoming.

Precipitation

Precipitation during water year 1990 was greater than during the previous year; most of the State received more than 85 percent of the 1951-80 average. Precipitation and departures from normal (1951-80 average) for the major divisions (drainage basins) are published by NOAA. The Bighorn and Lower [North] Platte basins received greater-than-average precipitation--the Bighorn basin in northwestern Wyoming received 108 percent and the Lower [North] Platte basin in eastern Wyoming received 125 percent. The Green River and Bear River basins in southwestern Wyoming received the least--77 percent.

Basins in eastern and north-central Wyoming received greater-than-average precipitation during the autumn and winter months (October through March), and the remainder of the basins recorded less-than-average precipitation during the period. The spring months (April through June) were dry throughout the State, with all basins recording less than average precipitation. Precipitation increased to near average or greater than average during the summer months (July through September); only the Powder River, Little Missouri River, and Tongue River basins in northeastern Wyoming recorded less than near average precipitation.

Precipitation in the mountains, as snow, provides most of Wyoming's annual water supply. For the third consecutive year, the snowpack in the mountains throughout most of the State was less than average. The U.S. Soil Conservation Service noted in the May 1, 1990 issue of Basin Outlook Reports that only the Bighorn Mountains had a snowpack that was near or slightly above average. The remainder of the State's mountains had snowpacks that were below average. Most were 75 to 90 percent of average; however, the Black Hills had a snowpack that was only 19 percent of average, mountains along the southwest edge had snowpacks that were 16 to 29 percent of average, and mountains in the upper Green River basin had snowpacks that were 55 percent of average. The report also noted that melting of the snowpacks started 2 1/2 to 3 weeks earlier than normal.

Streamflow

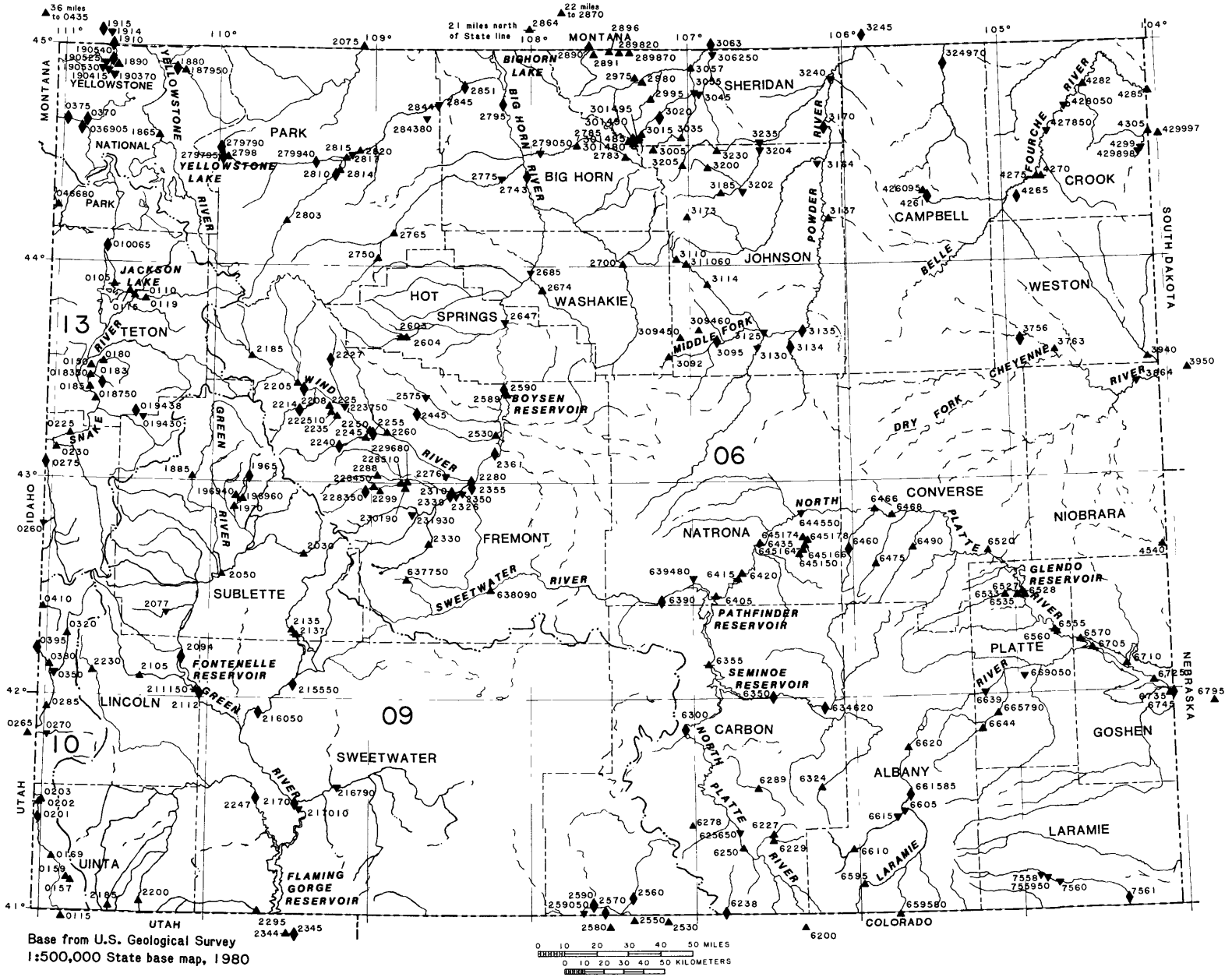
Monthly and annual discharge in most streams reflected the drought conditions that were prevalent in a large part of the State. The annual average discharges at most of these stations were at or below the 25th percentile. Some stations recorded average flows for water year 1990 that were near the minimum for the period of record, but generally exceeded the average discharge for water year 1989, when several stations recorded new minimums.

Floods

Flooding, particularly from snowmelt, was moderate throughout the State during water year 1990. The moderate maximum discharges generally reflected the continuing drought and the earlier-than-normal snowmelt. Summer thunderstorms, however, caused locally severe flooding in several streams. Of particular significance was the flood on Sybille Creek in Platte County on August 20. Maximum discharges of record were recorded at station 06664400, Sybille Creek above Mule Creek, near Wheatland (19,900 cubic feet per second) and at station 06665790, Sybille Creek above Canal No. 3, near Wheatland (6,900 cubic feet per second). The flood at station 06664400 was six times greater than the theoretical 100-year flood as determined from station discharge records, and the flood at station 06665790 was three times greater. Damage was limited to roads and bridges, agricultural land, and livestock. Only one rural home was known to have sustained damage. The location of the stations is shown in figure 4.

Chemical Quality of Surface Water

Specific conductance of streamflow during water year 1990 was not significantly different from that of the previous 10 years, on the basis of data from five of seven water-quality stations selected to represent the major drainages of Wyoming. Specific conductance was chosen as an indicator of dissolved-solids concentration in water because the conductance varies directly with the concentration and species of ions in the water. At station 06317000, Powder River at Arvada, and station 09217000, Green River near Green River, the mean specific conductance for water year 1990 was significantly different from the mean of the previous 10 years. The specific conductance in the Powder River was smaller in 1990 than in previous years, probably because of change in discharge from Salt Creek, a tributary upstream from station 06317000. Before 1990, about 25 to 30 percent of the dissolved solids of the Powder River came from Salt Creek according to a report from the Wyoming Department of Environmental Quality, Wyoming 1988 Water Quality Assessment by D.W. Hogan. During 1990, discharges from oil and gas production along Salt Creek were substantially reduced (John Wagner, Wyoming Department of Environmental Quality, oral commun., 1990). The mean specific conductance of the Green River also was smaller in 1990 than in previous years, for unknown reasons. The location of surface-water-quality stations is shown in figure 4.



EXPLANATION

TWO-DIGIT BASIN NUMBER FOR MAJOR DRAINAGE BASIN

- 06 Missouri River Basin (Yellowstone, Cheyenne, Niobrara and Platte River basins)
- 09 Upper Colorado River Basin (Green River basin)
- 10 The Great Basin (Bear River basin)
- 13 Snake River Basin
- MAJOR DRAINAGE DIVIDE

- ▲6200 STREAMFLOW STATION AND NUMBER
- ▼259050 SURFACE-WATER-QUALITY AND (OR) SEDIMENT STATION AND NUMBER
- ◆6238 STREAMFLOW AND SURFACE-WATER-QUALITY AND (OR) SEDIMENT STATION AND NUMBER
- ▲6355 RESERVOIR STATION AND NUMBER

Station numbers are abbreviated by not showing two-digit basin number and last two digits if zero.

Figure 4.--Location of streamflow, reservoir, surface-water-quality, and sediment stations, water year 1991.

Ground-Water Levels

Water levels in most wells in the statewide observation-well network declined during water year 1990. Most of the 90 wells in the observation-well network are in areas of extensive ground-water withdrawal--mainly in southeastern Wyoming (fig. 5). Water in Niobrara, Goshen, and eastern Laramie Counties is withdrawn from the High Plains aquifer for irrigation; water in Platte County is withdrawn from alluvium for irrigation. Water in central Laramie County is withdrawn from the High Plains aquifer for domestic use.

The rate of decline during 1990 was less than that of 1989, attributed largely to the greater-than-average precipitation during the summer in eastern Wyoming. Water levels in all but one of the network wells in Goshen County declined from the previous year; declines ranged from 0.3 foot to about 1.7 feet. The water level in one well declined 2.0 feet. Changes in water levels in Niobrara County ranged from a 0.3-foot rise in one well to declines of 1.9 feet or less in others. Measured changes in 18 network wells in Laramie County ranged from a rise of about 3.0 feet to a decline of 5.0 feet; the median change for all network wells in Laramie County was a decline of 0.6 foot. Water levels in 11 network wells in Platte County ranged from a 3.0-foot rise from the previous year to a decline of about 5 feet; the median change from 1989 levels was a decline of 0.8 foot.

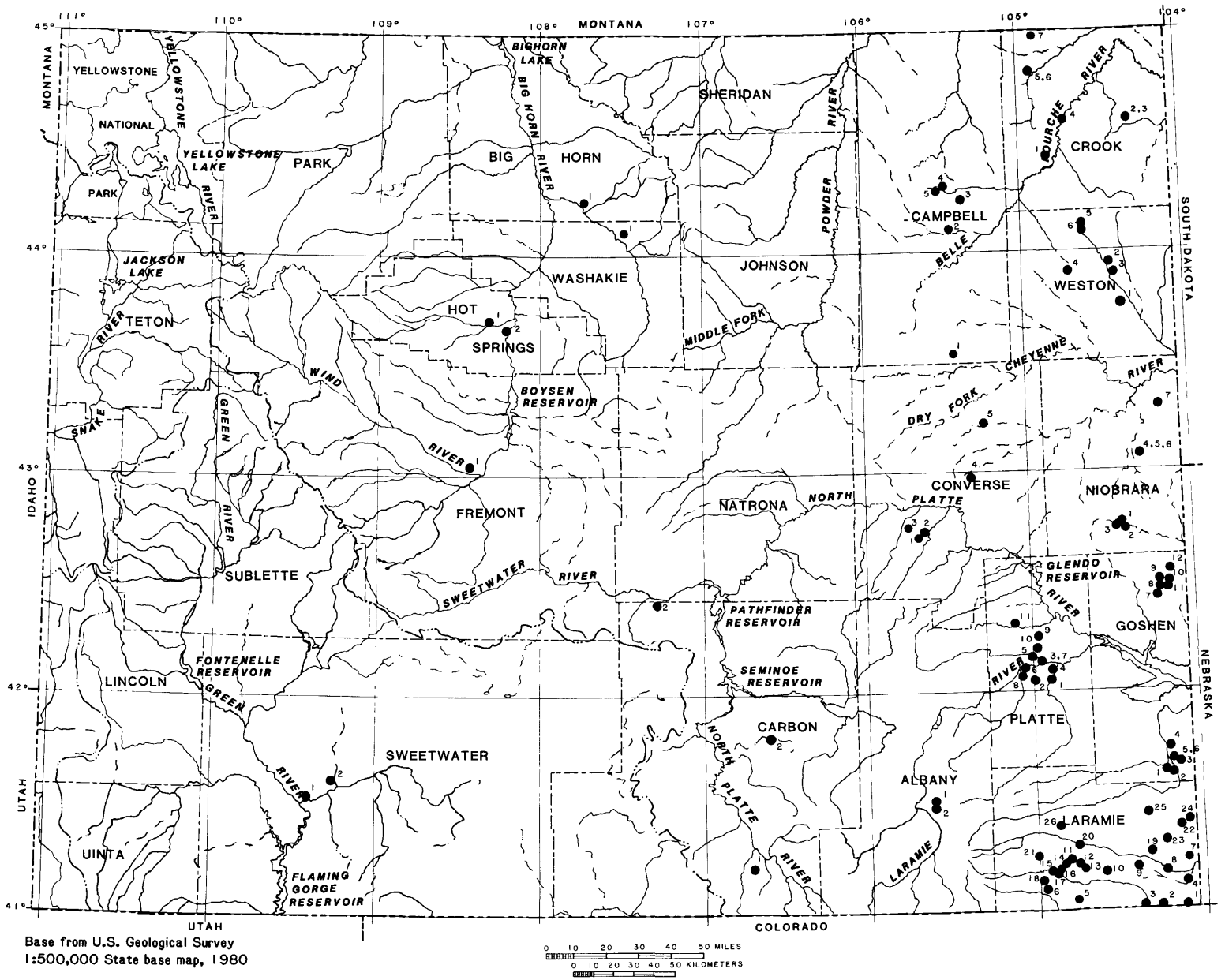
The location of all wells in the observation-well network and hydrographs of water levels are published in separate reports by the USGS. The most recent water-level report Ground-Water Levels in Wyoming, 1980 Through September 1989, by Hugh I. Kennedy and Sharon L. Green, is available for inspection at the USGS office in Cheyenne.

Ground-Water Quality

The quality of ground water ordinarily changes slowly; therefore, for most general purposes, one annual sampling, or only a few samples, taken at selected sites at infrequent intervals during the year, is sufficient to define ground-water quality. The location of ground-water-quality sites for 1986-91 is shown in figure 6. All wells sampled are pumped long enough to assure the water collected is representative of the aquifer.

WYOMING WATER ISSUES

Wyoming's economy is dominated by agriculture, recreation, tourism, and the minerals industry; consequently, water issues tend to focus on the traditional agricultural base of the economy, the quality of recreation resources, and the development of oil and gas, coal, uranium, and other minerals. Major water issues by category are summarized below.



Base from U.S. Geological Survey
1:500,000 State base map, 1980

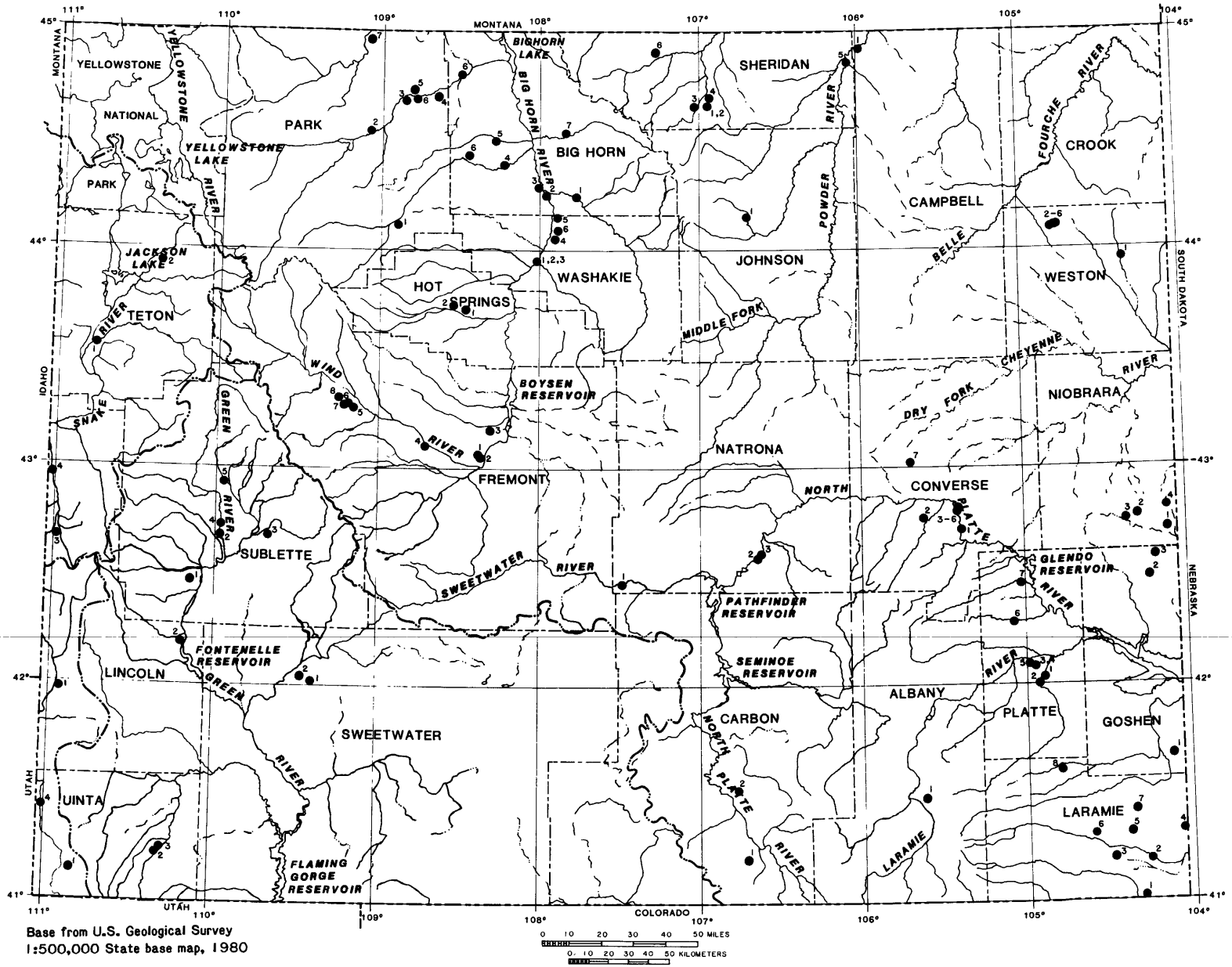
0 10 20 30 40 50 MILES
0 10 20 30 40 50 KILOMETERS

EXPLANATION

●² GROUND-WATER-LEVEL OBSERVATION WELL AND MAP NUMBER--Wells are numbered sequentially in each county and are listed in table 4.

——·—— MAJOR DRAINAGE DIVIDE

Figure 5.--Location of ground-water-level observation wells, water year 1991.



Base from U.S. Geological Survey
1:500,000 State base map, 1980

EXPLANATION

● WELL SAMPLED FOR GROUND-WATER QUALITY--Wells are numbered sequentially in each county and are listed in table 5.

——·—— MAJOR DRAINAGE DIVIDE

Figure 6.--Location of ground-water-quality sites, water years 1986-91.

Surface-Water Issues

Most of the surface water in the State is committed under provisions of interstate compacts and court decrees; unused water is allowed to flow to downstream states. Surface water is abundant in some parts of the State and is scarce in others. The uneven distribution of surface water areally and throughout the year is a constraint on agricultural and industrial development, and results in competition for available surface-water supplies. Most competition for supplies is among agricultural, municipal, and industrial users on the water-short plains. New storage and diversion structures are being planned to meet future surface-water needs.

Many irrigation projects in Wyoming were developed with inadequate provisions for drainage. As a consequence, ground-water levels in some areas have risen to the land surface and caused wetlands that are untillable during parts of the year or have become alkaline because of the accumulation of salts. Thousands of acres of formerly irrigated farmlands are unsuitable for cultivation because of the accumulation of alkaline deposits. The wetlands created by irrigation practices are a loss to agriculture but locally provide wildlife habitats.

Surface-Water-Quality Issues

Surface-water-quality issues include salinity, suspended sediment, nutrients, and pesticides. New emphasis is being placed on monitoring and abatement of nonpoint-source pollution, such as from natural runoff and from agriculture. Salinity is a problem in the Green River basin. Irrigation return flows from the Big Sandy River have increased the average dissolved-solids load by 49 percent. Changing irrigation practices in the Big Sandy irrigation area from direct application to pivot-sprinkler systems is a method being tested to reduce dissolved-solids loads by the elimination of return flows. Phosphorus, primarily from natural sources, is enriching the water and bottom sediment in many of the larger reservoirs in the State. The adverse effects of eutrophication are most noticeable in Flaming Gorge Reservoir in southwestern Wyoming.

Two other surface-water-quality issues are acid precipitation and elevated selenium concentrations. Studies such as the glacial ice-core project have focused primarily in the high elevations of the Wind River Range. Lakes and streams in the mountain areas are susceptible to acidification because of the lack of alkaline soils to neutralize acid precipitation. Studies have been conducted to evaluate large concentrations of selenium in samples from water, bottom sediment, and biota in irrigation areas near Riverton and Casper.

Ground-Water Issues

In many parts of the State, ground water is the only source of water because surface water is absent, unreliable, or already appropriated. Most of the State's population is served by ground water, and most ground water is used for irrigation and industrial supplies. Depending on location in the State, most important issues are related to availability and the hydrologic

effects of energy-resource development. Development of coal methane from shallow coal aquifers has the potential of depleting ground-water resources near areas of development. Declining water levels associated with irrigation and residential use in the southeastern part of the State might require conservation measures that restrict future development. In many places, ground water in shallow aquifers, particularly alluvium, is connected hydraulically to adjacent streams. Because of this connection, the development of shallow ground-water supplies is likely to be constrained by the potential effects on previously appropriated surface water.

Ground-Water-Quality Issues

Ground-water quality differs greatly between and within aquifers throughout Wyoming. Dissolved-solids concentrations commonly are large. Where dissolved-solids concentrations are large, usually the concentration of sulfate and chloride are large also. Naturally occurring large concentrations of fluoride, selenium, iron, manganese, radionuclides, and hardness are also common to many areas of the State. Much of the ground water is naturally hard. Large concentrations of nitrate mostly are associated with human activities and are most common in water from alluvial aquifers or from other aquifers at shallow depths. Large concentrations of fluoride generally are found in water from basin-type aquifers at depth. Concentrations of toxic metals, such as dissolved arsenic, barium, cadmium, chromium, lead, and mercury, are present in most aquifers, but generally do not limit the use of water in Wyoming. Large concentrations of iron and manganese, which are objectionable for esthetic and economic reasons, are fairly common in ground water used for domestic supplies.

Despite the small population density, ground water has been contaminated in localized areas by human activities associated with waste disposal, agriculture, mineral extraction and processing, and urbanization. Hazardous wastes have been or are being disposed of at sites in five counties. At some sites, soils, ground water, or both have been contaminated by chemicals such as benzene, ethylbenzene, toluene, xylene, chloride, sulfate, and phenol. Irrigation can increase the concentration of dissolved solids in shallow aquifers. Salts accumulate in the soil after evapotranspiration has consumed the water. Some of the applied irrigation water transports these salts down to the water table. Contamination by nitrate is common in agricultural areas. Nitrates are leached from corrals and feedlots into ground water. Nitrate fertilizer used on crops also may increase nitrate concentrations in ground water. Large nitrate concentrations have been detected in ground-water samples in wells in six counties.

Large dissolved-solids concentrations in ground water have been associated with spoil material at coal mines and tailings and at disposal sites at trona mines. Concentrations of dissolved solids in spoil water at mine sites generally are larger than concentrations in water from nearby stock and domestic wells, but some ground water from spoil material is acceptable for use by livestock. Experimental underground coal-gasification burns and oil-shale retort sites have contaminated ground water locally in four counties. Increased concentrations of dissolved solids, sulfate, chloride,

radionuclides, and trace metals generally are associated with mineral extraction and processing. Complex hydrocarbon compounds are associated with oil and gas exploration, development, and refining processes.

Sources of ground-water contamination in urban areas include leaking underground petroleum-product storage tanks and septic-tank leach fields. Leaking gasoline and diesel fuel storage tanks in or near urban areas and various small communities have contaminated local ground water. In many urban areas, wells have been contaminated as a result of too many septic tanks, or disposal systems are too small for the number of individuals served. Nitrate is a major ground-water contaminant.

DATA-COLLECTION SITES

Data-collection sites and the hydrologic data being collected at each are given as follows: table 1, streamflow and reservoir stations; table 2, surface-water-quality stations; table 3, sediment stations; table 4, ground-water-level observation wells; and table 5, ground-water-quality sites. The data-collection sites that were discontinued during water years 1989 and 1990 are listed in tables 6-9.

Water year is one of three types of time measurement used in this report: the calendar year is from January 1 to December 31 of a particular year; the water year and the fiscal year are identical, from October 1 through September 30; the numerical designation of a water year or fiscal year is the year of completion of the time period. Stations listed in tables 1-4 are in operation during water year 1991; however, the period of record given is in calendar years. The period of record for the stations listed in tables 5-9 is in water years.

Station numbers for stations listed in tables 1-3 conform with the standard downstream order for listing stations within each major river basin. The first two digits of the assigned eight-digit number, such as 06207500, identifies the major river basin in which the stream resides. For example, digits "06" refer to the Missouri River basin. The remaining six digits identify the relative position of the station, with numbers increasing in the downstream direction.

The local well numbers listed in tables 4 and 5 are based on the Federal system of land subdivision. A detailed explanation of this system can be found preceding tables 4 and 5. The wells are listed in numerical order by county.

Abbreviations and codes are used to indicate other information about the operation of the data-collection sites. Explanations of the abbreviations and codes precede each table.

The location of streamflow, reservoir, surface-water-quality, and sediment stations is shown in figure 4. The station numbers are abbreviated by not showing the two-digit number and the last two digits if zero. The location of ground-water-level observation wells is shown in figure 5. The location of ground-water-quality sites is shown in figure 6.

Table 1.--Streamflow and reservoir stations

Explanation of abbreviations and codes used in table 1

Period of record: The dates given are the calendar years in which records began or ended.

Gage equipment:

D	digital recorder	T	telemark
G	graphic recorder	W	well gage
M	manometer gage		
P	satellite-relay platform		

Data frequency:

S	seasonal operation (no winter records)
Y	full-year operation

Field office:

C	Casper	NE	Nebraska District
CH	Cheyenne	R	Riverton
CO	Colorado District	S	Wyoming State
ID	Idaho District	SD	South Dakota District
MT	Montana District	UT	Utah District

Funding agency:

BRUC	Bureau of Reclamation, Colorado Region
BRUM	Bureau of Reclamation, Missouri Region
CE	Corps of Engineers
MRB	U.S. Geological Survey, support for other Interior Agencies
GILL	City of Gillette
MID	Midvale Irrigation District
SJPB	Sheridan Area Water Supply-Joint Powers Board
TC	Teton County
UC	Uinta County
USFS	Forest Service
USGS	U.S. Geological Survey, Federal Program
WDEQ	Wyoming Department of Environmental Quality
WRIR	Wind River Indian Reservation, Northern Arapaho and Shoshone Tribes
WSE	Wyoming State Engineer
WWDC	Wyoming Water Development Commission
WWRC	Wyoming Water Research Center
--	Not funded through Wyoming District

Remarks:

HBM	hydrologic benchmark station
NASQAN	national stream-quality accounting network station
QW	also water-quality station
SED	also sediment station
USBR	furnished by U.S. Bureau of Reclamation

Table 1.--Streamflow and reservoir stations

Station number	Station name	Period of record	Gage equip-ment	Data fre-quency	Field office	Funding agency	Remarks
		YELLOWSTONE RIVER BASIN					
06036905	Firehole River near West Yellowstone, Montana	1983-	--	Y	MT	--	QW
06037000	Gibbon River near West Yellowstone, Montana	1913-16, 1983-	--	Y	MT	--	QW
06037500	Madison River near West Yellowstone, Montana	1913-73 1983-86 1988-	--	Y	MT	--	QW
06043500	Gallatin River near Gallatin Gateway, Montana	1889-94 1930-69 1971-81 1984-	--	Y	MT	--	
06186500	Yellowstone River at Yellowstone Lake outlet, Yellowstone National Park	1922-86 1988-	--	Y	MT	--	
06187950	Soda Butte Creek near Lamar Ranger Station, Yellowstone National Park	1988-	--	Y	MT	--	QW
06188000	Lamar River near Tower Falls Ranger Station, Yellowstone National Park	1922-69, 1985-86 1988-	--	Y	MT	--	QW,SED
06189000	Blacktail Deer Creek near Mammoth, Yellowstone National Park	1937-45 1988-	--	Y	MT	--	
06190530	Clematis Creek at Mammoth, Yellowstone National Park	1990-	--	Y	MT	--	
06190540	Hot River at Mammoth, Yellowstone National Park	1988-	--	Y	MT	--	QW
06191000	Gardner River near Mammoth, Yellowstone National Park	1938-72, 1984-	--	Y	MT	--	QW
06191500	Yellowstone River at Corwin Springs, Montana	1889-93, 1910-		Y	MT	--	QW,SED

Table 1.--Streamflow and reservoir stations--Continued

Station number	Station name	Period of record	Gage equip-ment	Data fre-quency	Field office	Funding agency	Remarks
	YELLOWSTONE RIVER BASIN--Continued						
06207500	Clarks Fork Yellowstone River near Belfry, Montana	1921-	--	Y	MT	--	
06218500	Wind River near Dubois	1945-	D,W	Y	R	WSE	
06220500	East Fork Wind River near Dubois	1950-57, 1975-	D,M	Y	R	MRB	
06220800	Wind River above Red Creek, near Dubois	1990-	D,M,P	Y	R	WRIR	QW
06221400	Dinwoody Creek above lakes, near Burris	1957-78, 1988-	D,M	Y	R	WRIR	QW
06222500	Dry Creek near Burris	1921-40, 1988-	D,G,M	Y	R	WRIR	
06222510	Dry Creek Canal at headgate, near Burris	1989-	G,W	Y	R	WRIR	
06222700	Crow Creek near Tipperary	1962-	D,G,M	Y	R	MRB	QW
06223500	Willow Creek near Crowheart	1909, 1921-23, 1925-40, 1988-	D,G,M	Y	R	WRIR	
06224000	Bull Lake Creek above Bull Lake	1941-53, 1966-	D,M,P	Y	R	MRB	QW
06224500	Bull Lake near Lenore	1938-	P	--	--	MRB, BRUM	USBR
06225000	Bull Lake Creek near Lenore	1918-	G,M,P,T	Y	R	BRUM	
06225500	Wind River near Crowheart	1945-	G,M,P,T	Y	R	BRUM	QW,SED
06226000	Wyoming Canal near Lenore	1941-45, 1949-82, 1988-	W,P	S	R	MRB, MID	
06228000	Wind River at Riverton	1906-08, 1911-	G,M,T,P	Y	R	CE	NASQAN, QW,SED
06228350	South Fork Little Wind River above Washakie Reservoir, near Fort Washakie	1976-	D,P,W	Y	R	WRIR	QW

Table 1.--Streamflow and reservoir stations--Continued

Station number	Station name	Period of record	Gage equip-ment	Data fre-quency	Field office	Funding agency	Remarks
		YELLOWSTONE RIVER BASIN--Continued					
06228450	South Fork Little Wind River below Washakie Reservoir, near Fort Washakie	1988-	D,G,M	Y	R	WRIR	
06228510	Ray Canal at headworks, near Fort Washakie	1989-	G,W	S	R	WRIR	
06228800	North Fork Little Wind River near Fort Washakie	1988-	D,G,M	Y	R	WRIR	
06229680	Sage Creek above Norkok Meadows Creek, near Fort Washakie	1991-	D,W	Y	R	WRIR	
06229900	Trout Creek near Fort Washakie	1990-	D	Y	R	WRIR	
06230190	Mill Creek above Ray Lake outlet canal, near Fort Washakie	1990-	D	Y	R	WRIR	
06231000	Little Wind River above Arapahoe	1906-09, 1911-18, 1979-	D,M	Y	R	WRIR	QW
06233000	Little Popo Agie River near Lander	1946-	G,W	S	S	WSE	
06233900	Popo Agie River near Arapahoe	1979-	D,M	Y	R	WRIR	QW
06235500	Little Wind River near Riverton	1941-	D,M,P	Y	R	CE, WRIR	QW,SED
06236100	Wind River above Boysen Reservoir, near Shoshoni	1990-	D,P,W	Y	R	WRIR	QW
06244500	Fivemile Creek above Wyoming Canal, near Pavillion	1949-75, 1988-	D,M	Y	R	WRIR	QW,SED
06253000	Fivemile Creek near Shoshoni	1941-42, 1948-83, 1988-	D,G,M	Y	R	MRB	
06258900	Boysen Reservoir	1951-	--	--	--	MRB	USBR
06259000	Wind River below Boysen Reservoir	1951-	D,M,P	Y	R	BRUM	QW
06260300	Anchor Reservoir	1960-	--	--	--	MRB	USBR
06260400	South Fork Owl Creek below Anchor Reservoir	1959-	D,G,W	S	R	BRUM	

Table 1.--Streamflow and reservoir stations--Continued

Station number	Station name	Period of record	Gage equip-ment	Data fre-quency	Field office	Funding agency	Remarks
		YELLOWSTONE RIVER BASIN--Continued					
06267400	East Fork Nowater Creek near Colter	1971-	D,M	Y	R	WSE	
06270000	Nowood River near Tensleep	1938-43, 1950-55, 1972-	D,G,M	Y	R	WSE	
06274300	Bighorn River at Basin	1983-	D,M	Y	R	WDEQ	QW,SED
06275000	Wood River at Sunshine	1945-	D,G,M	Y	R	WSE	
06276500	Greybull River at Meeteetse	1897, 1903, 1920-	G,M	S	S	WSE	
06278300	Shell Creek above Shell Reservoir	1956-	D,W	Y	R	WSE	
06278500	Shell Creek near Shell	1940-	G,W	S	S	WSE	
06279500	Bighorn River at Kane	1928-	G,M,P	Y	R	CE,MRB	QW,SED
06279790	Jones Creek at mouth, near Pahaska	1989-	G,M,P	S	R	USFS, WDEQ, USGS	QW,SED
06279795	Crow Creek at mouth, at Pahaska	1989-	G,M	S	R	USFS, WDEQ, USGS	QW,SED
06279800	North Fork Shoshone River at Pahaska	1989-	G,M,P	S	R	USFS	
06279940	North Fork Shoshone River at Wapiti	1989-	M,P	Y	R	MRB	
06280300	South Fork Shoshone River near Valley	1956-	D,M	Y	R	USGS	
06281000	South Fork Shoshone River above Buffalo Bill Reservoir	1903, 1905-08, 1921-26, 1973-	D,M,P	Y	R	WSE, BRUM	QW
06281400	Diamond Creek near mouth, near Cody	1980-	D,W	Y	R	MRB	
06281500	Buffalo Bill Reservoir	1909-	--	--	--	MRB	USBR
06282000	Shoshone River below Buffalo Bill Reservoir	1921-	D,W,P	Y	R	BRUM	

Table 1.--Streamflow and reservoir stations--Continued

Station number	Station name	Period of record	Gage equip-ment	Data fre-quency	Field office	Funding agency	Remarks
	YELLOWSTONE RIVER BASIN--Continued						
06285100	Shoshone River near Lovell	1966-	D,G,M	Y	R	MRB	QW
06286400	Bighorn Lake near St. Xavier, Montana	1965-	--	--	--	MRB	USBR
06287000	Bighorn River near St. Xavier, Montana	1934-	--	Y	MT	--	
06289000	Little Bighorn River at State Line, near Wyola, Montana	1939-	--	Y	MT	--	
06289100	Red Canyon Creek near Parkman	1982-	G,M	Y	C	WSE	
06289600	West Pass Creek near Parkman	1982-	D,W	Y	C	WSE	
06289820	East Pass Creek near Dayton	1982-	D,W	Y	C	WSE	
06289870	Twin Creek near Parkman	1982-	D,W	Y	C	WSE	
06297500	Highline Ditch near Dayton	1919-23, 1940-	G,W	S	C	WSE	
06298000	Tongue River near Dayton	1918-29, 1940-	D,W,P	Y	C	WSE	
06299500	Wolf Creek at Wolf	1945-	G,W	S	S	WSE	
06300500	East Fork Big Goose Creek near Big Horn	1953-	G,M	S	S	WSE	
06301480	Coney Creek above Twin Lakes, near Big Horn	1991-	D,W	Y	C	SJPB	
06301485	Lost Lake Creek near Big Horn	1991-	D,G,M,W	Y	C	SJPB	
06301490	Snail Creek near Big Horn	1991-	D,G,M	Y	C	SJPB	
06301495	Coney Creek below Twin Lakes, near Big Horn	1991-	D,W	Y	C	SJPB	
06301500	West Fork Big Goose Creek near Big Horn	1953-	G,M	S	S	WSE	
06302000	Big Goose Creek near Sheridan	1929-	G,W	S	S	WSE	QW,SED
06303500	Little Goose Creek in canyon, near Big Horn	1941-	G,W	S	S	WSE	
06305700	Goose Creek near Acme	1984-	D,W	Y	C	WSE	
06306300	Tongue River at State Line, near Decker, Montana	1960-	--	Y	MT	--	QW
06309200	Middle Fork Powder River near Barnum	1961-	D,W	Y	C	WSE	

Table 1.--Streamflow and reservoir stations--Continued

Station number	Station name	Period of record	Gage equip-ment	Data fre-quency	Field office	Funding agency	Remarks
		YELLOWSTONE RIVER BASIN--Continued					
06309500	Middle Fork Powder River above Kaycee	1949-70, 1984-	D,W	Y	C	WWDC	QW
06311000	North Fork Powder River near Hazelton	1946-	D,G,M	Y	C	WSE	
06311060	North Fork Powder River below Bull Creek, near Hazelton	1974-	D,W	Y	C	WSE	
06311400	North Fork Powder River below Pass Creek, near Mayoworth	1973-	D,W	Y	C	WSE	
06313400	Salt Creek near Sussex	1976-81 1982-	D,G,M	Y	C	WDEQ, WWDC	QW
06313500	Powder River at Sussex	1938-40, 1950-57, 1977-84, 1985-	D,G,M	Y	C	WWDC	QW
06313700	Dead Horse Creek near Buffalo	1971-	G,M	Y	C	WSE	
06317000	Powder River at Arvada	1919-	G,M	Y	C	WSE	QW,SED
06318500	Clear Creek near Buffalo	1894, 1896-99, 1917-27, 1938-	D,W	Y	C	WWDC	
06320000	Rock Creek near Buffalo	1941-	G,W	S	S	WSE	
06320500	South Piney Creek at Willow Park	1945-57, 1959-	G,W	S	S	WSE	
06323000	Piney Creek at Kearny	1902-06, 1910-17, 1919-23, 1940-	G,W,P	Y	S	WSE	
06324500	Powder River at Moorhead, Montana	1929-72, 1974-	G,W	Y	MT	--	QW

Table 1.--Streamflow and reservoir stations--Continued

Station number	Station name	Period of record	Gage equip-ment	Data fre-quency	Field office	Funding agency	Remarks
		YELLOWSTONE RIVER BASIN--Continued					
06324970	Little Powder River above Dry Creek, near Weston	1972-	D,G,M	Y	C	WSE	QW
		CHEYENNE RIVER BASIN					
06375600	Little Thunder Creek near Hampshire	1977-81, 1988-	D,G,M	Y	C	USGS	QW,SED
06376300	Black Thunder Creek near Hampshire	1972-	D,G,M	Y	C	WSE	
06394000	Beaver Creek near Newcastle	1943-	D,G,W	Y	C	USGS	
06395000	Cheyenne River at Edgemont, South Dakota	1903-06, 1928-33, 1946-	--	Y	SD	--	
06426095	Burlington Lake ditch at Gillette	1988-	G,W	S	C	GILL	
06426100	Stonepile Creek at Gillette	1988-	D,W	S	C	GILL	QW,SED
06426500	Belle Fourche River below Moorcroft	1943-70 1975-83, 1985-87, 1990-	D,G,M	Y	C	USGS	NASQAN, QW,SED
06427000	Keyhole Reservoir near Moorcroft	1952-	--	--	--	MRB	USBR
06427500	Belle Fourche River below Keyhole Reservoir	1951-	G,M	Y	C	WSE	
06428200	Belle Fourche River near Alva	1988-	G,M	S	S	WSE	
06428500	Belle Fourche River at Wyoming-South Dakota State line	1946-	P	Y	SD	--	
06429997	Murray Ditch above headgate at Wyoming-South Dakota State line	1987-	--	Y	SD	WSE	

Table 1.--Streamflow and reservoir stations--Continued

Station number	Station name	Period of record	Gage equip-ment	Data fre-quency	Field office	Funding agency	Remarks
		CHEYENNE RIVER BASIN--Continued					
06430500	Redwater Creek at Wyoming-South Dakota State line	1929-31, 1936-37, 1954-	G,W	Y	SD	WSE	
		NIOBRARA RIVER BASIN					
06454000	Niobrara River at Wyoming-Nebraska State line	1955-	D,W	Y	NE	--	
		PLATTE RIVER BASIN					
06620000	North Platte River near Northgate, Colorado	1904, 1915-	D,M,P	Y	C	USGS	
06622700	North Brush Creek near Saratoga	1960-	D,M	Y	C	WSE	
06622900	South Brush Creek near Saratoga	1960-74, 1976-	G,W	S	S	WSE	
06623800	Encampment River above Hog Park Creek, near Encampment	1964-	G,M	Y	C	USGS	HBM,QW, SED
06625000	Encampment River at mouth, near Encampment	1940-	D,W	Y	C	WSE	
06627800	Jack Creek above Coyote Draw, near Saratoga	1990-	D,W	S	C	WSE	
06628900	Pass Creek near Elk Mountain	1957-	G,M	Y	C	WSE	
06630000	North Platte River above Seminoe Reservoir, near Sinclair	1939-	G,W,P,T	Y	C	WSE	NASQAN, QW,SED
06632400	Rock Creek above King Canyon Canal, near Arlington	1965-	G,M	Y	C	WSE	
06634620	Little Medicine Bow River at Boles Spring, near Medicine Bow	1984-	D,M	Y	C	WSE	

Table 1.--Streamflow and reservoir stations--Continued

Station number	Station name	Period of record	Gage equipment	Data frequency	Field office	Funding agency	Remarks
	PLATTE RIVER BASIN--Continued						
06635000	Medicine Bow River above Seminoe Reservoir, near Hanna	1939-	G,W,P,T	Y	C	WSE	QW
06635500	Seminoe Reservoir near Leo	1939-	--	--	--	MRB	USBR
06637750	Rock Creek above Rock Creek Reservoir	1962-	D,W	Y	R	WSE	
06638090	Sweetwater River near Sweetwater Station	1973-	D,M	Y	R	WSE	
06639000	Sweetwater River near Alcova	1913-24, 1938-	W,P,T	S	S	WSE	QW
06640500	Pathfinder Reservoir near Alcova	1909-	--	--	--	MRB	USBR
06641500	Alcova Reservoir at Alcova	1938-	--	--	--	MRB	USBR
06642000	North Platte River at Alcova	1904-05, 1934-	D,W,G	Y	C	WSE	
06643500	North Platte River near Goose Egg	1917-19, 1924, 1947, 1950-60, 1983-84, 1988-	G,M	Y	C	USGS	
06645150	Smith Creek above Otter Creek, near Casper	1974-79 1987-	G,M	Y	C	WSE	
06645164	Otter Creek at mouth, near Casper	1987-	G,M	Y	C	WSE	
06645166	Smith Creek below Otter Creek, near Casper	1987-	D,G,M	Y	C	WSE	
06645174	Beaver Creek above Pole Creek, near Casper	1987-	D,W	Y	C	WSE	
06645178	Pole Creek near Casper	1987-	G,M	Y	C	WSE	
06646000	Deer Creek in canyon, near Glenrock	1946-51, 1985-	D,G,M	Y	C	WWDC	QW, SED
06646600	Deer Creek below Millar Wasteway, at Glenrock	1961-	D,G,M	Y	C	WSE	

Table 1.--Streamflow and reservoir stations--Continued

Station number	Station name	Period of record	Gage equip-ment	Data fre-quency	Field office	Funding agency	Remarks
		PLATTE RIVER BASIN--Continued					
06646800	North Platte River near Glenrock	1959-	D,W,P	Y	C	CE,WSE	
06647500	Box Elder Creek at Boxelder	1946-51, 1961-67, 1971-	D,W	Y	C	WSE	
06649000	La Prele Creek near Douglas	1919-	G,W	S	S	WSE	
06652000	North Platte River at Orin	1895-99, 1917-18, 1924, 1958-	D,G,P,T, W	Y	C	WSE	
06652700	Glendo Reservoir near Glendo	1957-		--	--	MRB	USBR
06652800	North Platte River below Glendo Reservoir	1957-	D,G,W,T	Y	C	WSE	
06653300	Horseshoe Creek near Cassa	1961-68, 1988-	D,G,M	Y	C	WSE	
06653500	Horseshoe Creek near Glendo	1916-18, 1921-24, 1928-33, 1935-70, 1988-	D,W	Y	C	WSE	
06655500	Guernsey Reservoir near Guernsey	1928-	--	--	--	MRB	USBR
06656000	North Platte River below Guernsey Reservoir	1900-	D,W,T	Y	C	WSE	
06657000	North Platte River below Whalen Diversion Dam	1909-	G,M,P	Y	C	WSE	
06659500	Laramie River and Pioneer Canal near Woods	1912-24, 1926-27, 1931-	G,W	S	S	WSE	
06659580	Sand Creek at Colorado-Wyoming State line	1968-	G,W	S	S	WSE	

Table 1.--Streamflow and reservoir stations--Continued

Station number	Station name	Period of record	Gage equip-ment	Data fre-quency	Field office	Funding agency	Remarks
		PLATTE RIVER BASIN--Continued					
06661000	Little Laramie River near Filmore	1902-03, 1911-26, 1932-	G,W	S	S	WSE	
06661585	Laramie River near Bosler	1972-	G,W	Y	S	WSE	QW,SED
06662000	Laramie River near Lookout	1912-17, 1921-27, 1932-	G,W	S	S	WSE	
06664400	Sybille Creek above Mule Creek, near Wheatland	1974-	G,W	S	S	WSE	
06665790	Sybille Creek above Canal No. 3, near Wheatland	1980-	G,W	S	S	WSE	
06670500	Laramie River near Fort Laramie	1915-	G,M,P,T	Y	C	CE,WSE	
06671000	Rawhide Creek near Lingle	1928-	G,W	S	S	WSE	
06672500	Cherry Creek Drain near Torrington	1931-32, 1935-	G,W	S	S	WSE	
06673500	Katzer Drain near Henry, Nebraska	1928-	G,W	S	S	WSE	
06674500	North Platte River at Wyoming-Nebraska State line	1929-	D,G,W,P	Y	C	CE,WSE	QW
06679500	North Platte River at Mitchell, Nebraska	1901-13, 1916-18, 1920-	D,G,W	Y	NE	--	
06756100	Crow Creek near Carpenter	1990-	D,W	Y	CH	WWDC	QW
		GREEN RIVER BASIN					
09188500	Green River at Warren Bridge, near Daniel	1931-	M,P	Y	R	WSE	
09196500	Pine Creek above Fremont Lake	1954-	D,W,P	Y	R	USGS	QW
09196940	Fremont ditch near Pinedale	1985-86, 1988-	D,W	S	R	WSE	

Table 1.--Streamflow and reservoir stations--Continued

Station number	Station name	Period of record	Gage equip-ment	Data fre-quency	Field office	Funding agency	Remarks
		GREEN RIVER BASIN--Continued					
09196960	Highland ditch near Pinedale	1985-86, 1988-	D,W	S	R	WSE	
09197000	Pine Creek below Fremont Lake	1910-12, 1915-18, 1985-86, 1988-	D,M	Y	R	WSE	
09203000	East Fork River near Big Sandy	1938-	D,M	Y	R	WSE	
09205000	New Fork River near Big Piney	1954-	M,P	Y	R	WSE	
09209400	Green River near La Barge	1963-	D,M,P	Y	R	WSE	NASQAN, QW,SED
09210500	Fontenelle Creek near Herschler Ranch, near Fontenelle	1951-	D,M	Y	R	USGS	
09211150	Fontenelle Reservoir near Fontenelle	1964-	--	--	--	--	USBR
09211200	Green River below Fontenelle Reservoir	1963-	G,M,P	Y	R	BRUC	QW
09213500	Big Sandy River near Farson	1914-17, 1920-24, 1926-34, 1953-	D,M,P	S	R	WSE	
09213700	Big Sandy Reservoir near Farson	1987-	P	Y	R	BRUC	
09215550	Big Sandy River below Farson	1981-	D,M	Y	R	WSE	QW
09216050	Big Sandy River at Gasson Bridge, near Eden	1972-	D,M	Y	R	WSE	QW,SED
09217000	Green River near Green River	1951-	G,M,P	Y	R	USGS	QW,SED
09218500	Blacks Fork near Millburne	1939-	D,M	Y	R	WSE	
09220000	East Fork of Smiths Fork near Robertson	1939-	G, W	S	S	WSE	
09223000	Hams Fork below Pole Creek, near Frontier	1952-	M,P	Y	R	USGS	
09224700	Blacks Fork near Little America	1962-	D,M,P	Y	R	USGS	QW
09229500	Henrys Fork near Manila, Utah	1928-	D,M,P	Y	R	USGS	

Table 1.--Streamflow and reservoir stations--Continued

Station number	Station name	Period of record	Gage equip-ment	Data fre-quency	Field office	Funding agency	Remarks
		GREEN RIVER BASIN--Continued					
09234400	Flaming Gorge Reservoir at Flaming Gorge Dam, Utah	1962-	--	Y	--	--	USBR
09234500	Green River near Greendale, Utah	1950-	--	Y	UT	--	QW
09253000	Little Snake River near Slater, Colorado	1942-74, 1950-	--	Y	CO	--	
09255000	Slater Fork near Slater, Colorado	1910-12, 1931-	--	Y	CO	--	
09256000	Savery Creek near Savery	1941-72, 1985-	D,G,M	Y	C	WWDC	QW,SED
09257000	Little Snake River near Dixon	1910-23, 1938-	G,M,P	S	C	WSE	
09258000	Willow Creek near Dixon	1953-	--	Y	CO	--	
09259000	Muddy Creek near Baggs	1915-16, 1918, 1987-	G,M	Y	C	WWRC	
		BEAR RIVER BASIN					
10011500	Bear River near Utah-Wyoming State line	1942-	--	Y	UT	--	
10015700	Sulphur Creek above reservoir, below La Chapelle Creek, near Evanston	1957-	--	Y	UT	--	
10015900	Sulphur Creek below reservoir, near Evanston	1958-	--	Y	UT	--	
10016900	Bear River at Evanston	1984-	D,G,M	S	R	UC	
10020100	Bear River above reservoir, near Woodruff, Utah	1961-	--	Y	UT	--	QW,SED
10020200	Woodruff Narrows Reservoir near Woodruff, Utah	1965-	--	--	--	--	

Table 1.--Streamflow and reservoir stations--Continued

Station number	Station name	Period of record	Gage equip-ment	Data fre-quency	Field office	Funding agency	Remarks
		BEAR RIVER BASIN--Continued					
10020300	Bear River below reservoir, near Woodruff, Utah	1961-	--	Y	UT	--	
10028500	Bear River below Pixley Dam, near Cokeville	1941-43, 1952-56, 1958-	--	S	UT	--	
10032000	Smiths Fork near Border	1942-	--	Y	UT	--	
10038000	Bear River below Smiths Fork, near Cokeville	1954-	--	Y	UT	--	
10039500	Bear River at Border	1937-	--	Y	UT	--	NASQAN, QW,SED
10041000	Thomas Fork near Wyoming-Idaho State line	1949-	--	Y	UT	--	
		SNAKE RIVER BASIN					
13010065	Snake River above Jackson Lake, at Flagg Ranch	1983-	--	Y	ID	--	QW,SED
13010500	Jackson Lake near Moran	1908-79, 1984-	--	Y	ID	--	USBR
13011000	Snake River near Moran	1903-	--	Y	ID	--	
13011500	Pacific Creek at Moran	1906, 1917-18, 1944-75, 1978-	--	Y	ID	--	QW,SED
13011900	Buffalo Fork above Lava Creek, near Moran	1965-	--	Y	ID	--	
13015000	Gros Ventre River at Zenith	1917-18, 1987-	--	S	ID	--	
13018000	Flat Creek near Jackson	1933-41, 1989-	D,M	S	R	TC	

Table 1.--Streamflow and reservoir stations--Continued

Station number	Station name	Period of record	Gage equipment	Data frequency	Field office	Funding agency	Remarks
		SNAKE RIVER BASIN--Continued					
13018300	Cache Creek near Jackson	1962-	D,W	Y	R	USGS	HBM,QW, SED
13018350	Flat Creek below Cache Creek, near Jackson	1989-		S	R	TC	
13018500	Flat Creek near Cheney	1917-18, 1989-	D,M	S	R	TC	
13018750	Snake River below Flat Creek, near Jackson	1975-	--	Y	ID	--	
13019438	Little Granite Creek at mouth, near Bondurant	1981-	--	Y	ID	--	QW,SED
13022500	Snake River above reservoir, near Alpine	1937-39, 1953-	--	Y	ID	--	
13023000	Greys River above reservoir, near Alpine	1917-18, 1937-39, 1953-	--	Y	ID	--	
13027500	Salt River above reservoir, near Etna	1953-	--	Y	ID	--	QW,SED
13046680	Boundary Creek near Bechler Ranger Station	1984-	--	Y	ID	--	

Table 2.--Surface-water-quality stations

Explanation of abbreviations and codes used in table 2

Period of record: The dates given are the calendar years in which records began or ended.

Data frequency:

BM	bimonthly
C	continuous (recorder)
D	daily
HL	high and low flow samples only
HML	high flow, midsummer, low flow
L	low flow
M	every six weeks plus two events
Q	quarterly
R	rising, falling, peak stage, and low flow
SS	sample during spraying season (frequency determined in late spring)
T	every 2 weeks during ice-free season
W	three during winter, monthly May-September

Analysis schedule:

1	salinity (major constituents)
2	specific conductance
3	daily temperature (observed or recorder)
4	suspended and dissolved organic carbon
5	field determinations of two or more: pH, specific conductance, dissolved oxygen, temperature, or turbidity
6	fecal coliform, and (or) fecal streptococcus
7	nutrients
8	trace elements
9	pesticides
10	radiochemical
11	specific conductance and temperature (continuous monitors)
12	selenium

Field office:

C	Casper
CH	Cheyenne
ID	Idaho District
MT	Montana District
R	Riverton
UT	Utah District

Funding agency:

BRUC	Bureau of Reclamation, Colorado Region
GILL	City of Gillette
MRB	USGS, support for other Interior Agencies
USFS	Forest Service
USGS	U.S. Geological Survey, Federal Program
WDA	Wyoming Department of Agriculture
WDEQ	Wyoming Department of Environmental Quality
WRIR	Wind River Indian Reservation, Northern Arapaho and Shoshone tribes

WSE	Wyoming State Engineer
WWDC	Wyoming Water Development Commission
--	Not funded through Wyoming District

Remarks:

HBM	hydrologic benchmark station
NASQAN	national stream-quality accounting network station
SED	also sediment station
SW	also streamflow station

Table 2.--Surface-water-quality stations

Station number	Station name	Period of record	Data frequency	Analysis schedule	Field office	Funding agency	Remarks
		YELLOWSTONE RIVER BASIN					
06036905	Firehole River near West Yellowstone, Montana	1983-	--	--	MT	--	SW
06037000	Gibbon River near West Yellowstone, Montana	1983-	--	--	MT	--	SW
06037500	Madison River near West Yellowstone, Montana	1983-86, 1989-	--	--	MT	--	SW
06187950	Soda Butte Creek near Lamar Ranger Station, Yellowstone National Park	1988-	--	--	MT	--	SW
06188000	Lamar River near Tower Falls Ranger Station, Yellowstone National Park	1985-86,	--	--	MT	--	SW
06190370	Gardner River above Mammoth Springs outflow, near Mammoth, Yellowstone National Park	1988-	--	--	MT	--	
06190415	Mammoth Springs outflow at Mammoth, Yellowstone National Park	1988-	--	--	MT	--	
06190525	Gardner River sinkhole diversion near Mammoth, Yellowstone National Park	1988-	--	--	MT	--	
06190540	Hot River at Mammoth, Yellowstone National Park	1988-	--	--	MT	--	SW
06191000	Gardner River near Mammoth, Yellowstone National Park	1988-	--	--	MT	--	SW
06191400	La Duke (Corwin) Hot Springs near Corwin Springs, Montana	1988-	--	--	MT	--	
06191500	Yellowstone River at Corwin Springs, Montana	1965, 1969-74, 1977-81, 1984-	--	--	MT	--	SW

Table 2.--Surface-water-quality stations--Continued

Station number	Station name	Period of record	Data frequency	Analysis schedule	Field office	Funding agency	Remarks
			YELLOWSTONE RIVER BASIN--Continued				
06220800	Wind River above Red Creek, near Dubois	1986-	BM	1	R	WRIR	SW
			HL	8		WRIR	
			SS	9		WRIR	
06221400	Dinwoody Creek above lakes, near Burris	1988-	Q	1	R	WRIR	SW
			L	8			
06222700	Crow Creek near Tipperary	1974-	M	5	R	MRB	SW
06223750	Wind River above Bull Lake Creek, near Crowheart	1990-	T	5	R	MRB	SED
06224000	Bull Lake Creek above Bull Lake	1974-	Q	1	R	WRIR	SW
			M	5		MRB	
			L	8		WRIR	
06225500	Wind River near Crowheart	1986-	BM	1	R	WRIR	SW,SED
			L	8		WRIR	
			SS	9		WRIR	
06227600	Wind River near Kinnear	1985-	L	10	R	WRIR	SED
			T	5			
06228000	Wind River at Riverton	1947-50, 1953, 1965-	BM	1,5,6,7	R	USGS	NASQAN,
			Q	8		USGS	SW,SED
			L	10		WRIR	
06228350	South Fork Little Wind River above Washakie Reservoir, near Fort Washakie	1976-	BM	1,5	R	WRIR	SW
			L	8			
06231000	Little Wind River above Arapahoe	1966-	BM	1	R	WRIR	SW
			W	6,7			
			L	10		WRIR	
			HL	8		WRIR	
			SS	9		WRIR	
06232600	Popo Agie River at Hudson Siding, near Hudson	1984-	SS	9	R	WDEQ	

Table 2.--Surface-water-quality stations--Continued

Station number	Station name	Period of record	Data frequency	Analysis schedule	Field office	Funding agency	Remarks
		YELLOWSTONE RIVER BASIN--Continued					
06233900	Popo Agie River near Arapahoe	1980-	BM	1	R	WRIR	SW
			L	8,10		WRIR	
			SS	9		WRIR	
			SS	9		WDA	
06235000	Beaver Creek near Arapahoe	1950-53, 1968-81, 1984-	L	10	R	WRIR	SED
			R	12		WDEQ	
06235500	Little Wind River near Riverton	1949-58, 1960-64, 1966-	L	10	R	WRIR	SW,SED
			R	5,6,12		WDEQ	
						WDEQ	
06236100	Wind River above Boysen Reservoir, near Shoshoni	1974-	SS	9,12	R	WDEQ	SW
06244500	Fivemile Creek above Wyoming Canal	1949-58, 1961-75, 1987-	BM	1	R	WRIR	SW,SED
			L	8		WRIR	
			SS	9		WRIR	
06257500	Muddy Creek near Pavillion	1949-58, 1961-73, 1988-	BM	1	R	WRIR	
			L	8		WRIR	
			SS	9		WRIR	
06259000	Wind River below Boysen Reservoir	1953-54, 1960-	BM	8	R	MRB	SW
06264700	Bighorn River at Lucerne	1966-	Q	5,6,7,12	R	WDEQ	SED
06268500	Fifteenmile Creek near Worland	1978-81, 1990-	M	1	R	WDEQ	SED
06274300	Bighorn River at Basin	1984-	Q	5,6,7,9	R	WDEQ	SW,SED
			SS	9		WDEQ	
06277500	Greybull River near Basin	1951-53, 1965-	Q	1	R	WDEQ	SED
			SS	9		WDA	
06279050	Shell Creek at Porter Gulch, near Greybull	1982-	Q	5	R	WDEQ	

Table 2.--Surface-water-quality stations--Continued

Station number	Station name	Period of record	Data frequency	Analysis schedule	Field office	Funding agency	Remarks
		YELLOWSTONE RIVER BASIN--Continued					
06279500	Bighorn River at Kane	1947-53, 1955-57, 1960-	BM SS	5,8 9	R	MRB WDA	SW,SED
06279790	Jones Creek at mouth, near Pahaska	1989-	M C BM	7,8 11 1	R	USFS, WDEQ, USGS	SW,SED
06279795	Crow Creek at mouth, at Pahaska	1989-	M C BM	1,7,8 11 1	R	USFS, WDEQ USGS	
06281000	South Fork Shoshone River above Buffalo Bill Reservoir	1981-	C M	3 7	R	MRB MRB	SW
06281700	Shoshone River above Demaris Hot Springs, near Cody	1987-	M	1,5,7	R	MRB	
06284380	Roan Wash near Garland	1984-	SS	9	R	WDA	
06284400	Shoshone River near Garland	1974-	SS	9	R	WDA	
06284500	Bitter Creek near Garland	1951-53, 1958-61, 1969-	SS	9	R	WDA	
06285100	Shoshone River near Lovell	1966-	M R	5 12	R	USGS WDEQ	SW,SED
06302000	Big Goose Creek near Sheridan	1988-	Q	6	C	WDEQ	SW,SED
06304500	Little Goose Creek near Sheridan	1979-	Q SS	6 9	C	WDEQ WDA	SED
06305500	Goose Creek below Sheridan	1959-65, 1967-	Q	5,6,7	C	WDEQ	SED
06306250	Prairie Dog Creek near Acme	1976-	SS	9	C	WDA	

Table 2.--Surface-water-quality stations--Continued

Station number	Station name	Period of record	Data frequency	Analysis schedule	Field office	Funding agency	Remarks
		YELLOWSTONE RIVER BASIN--Continued					
06306300	Tongue River at State line, near Decker, Montana	1965-	R HL	1 8	C	WDEQ	SW
06309500	Middle Fork Powder River above Kaycee	1949-54, 1984-	M	1,5,6,7	C	WWDC	SW
06312500	Powder River near Kaycee	1968-	BM	1	C	WWDC	
06313400	Salt Creek near Sussex	1949, 1952, 1968-81, 1982-	BM Q	1 1,8	C	WWDC WDEQ	SW
06313500	Powder River at Sussex	1949-53, 1967-68, 1976-	BM Q	1 1,8	C	WWDC WDEQ	SW
06316400	Crazy Woman Creek at upper station, near Arvada	1966-	HML SS	12 9	C	WDEQ WDA	SED
06317000	Powder River at Arvada	1946-57, 1967-	M BM Q	2 1 1	C	USGS WWDC WDEQ	SW
06320200	Clear Creek below Rock Creek, near Buffalo	1975-	SS	9	C	WDA	
06320400	Clear Creek at Ucross	1975-81, 1983-	SS	9	C	WDA	
06323500	Piney Creek at Ucross	1975-	SS	9	C	WDA	
06324000	Clear Creek near Arvada	1949-54, 1966-	SS	9	C	WDA	
06324500	Powder River near Moorhead, Montana	1951-53, 1956-57, 1969-72, 1975-	SS	9	MT	WDA	SW

Table 2.--Surface-water-quality stations--Continued

Station number	Station name	Period of record	Data frequency	Analysis schedule	Field office	Funding agency	Remarks
		YELLOWSTONE RIVER BASIN--Continued					
06324970	Little Powder River above Dry Creek, near Weston	1975-82, 1985-	Q	1	C	WDEQ	SW
		CHEYENNE RIVER BASIN					
06375600	Little Thunder Creek near Hampshire	1977-81, 1987-	Q	1,4,5,8	C	MRB	SW,SED
06386400	Cheyenne River near Riverview	1951-54, 1969-70, 1972-	SS	9	C	WDA	
06426100	Stonepile Creek at Gillette	1988-	Q BM,Q	5,6,7 1,5,6,7, 8	C	GILL USGS	SW,SED
06426500	Belle Fourche River below Moorcroft	1947-57, 1975-	SS	9	C	WDA	NASQAN, SW,SED
06427850	Belle Fourche River at Devils Tower	1967-	SS	9	C	WDA	
06428050	Belle Fourche River below Hulett	1981-	SS	9	C	WDA	
06429898	Sand Creek above Ranch A, near Beulah	1987-	SS	9	C	WDA	
06429900	Sand Creek at Ranch A, near Beulah	1987-	SS	9	C	WDA	
		PLATTE RIVER BASIN					
06623800	Encampment River above Hog Park Creek, near Encampment	1967-	Q Q HL	1,5,6,7, 8 10	C	USGS USGS USGS	HBM,SW, SED
06625650	North Platte River at Highway 130, north of Saratoga (formerly 412117106433201)	1977-78, 1984-	SS	9	C	WDA	

Table 2.--Surface-water-quality stations--Continued

Station number	Station name	Period of record	Data frequency	Analysis schedule	Field office	Funding agency	Remarks
			PLATTE RIVER BASIN--Continued				
06630000	North Platte River above Seminoe Reservoir, near Sinclair	1960-	BM Q	1,5,6,7 8	C	USGS USGS	NASQAN, SW,SED
06635000	Medicine Bow River above Seminoe Reservoir, near Hanna	1965-	R	10,12	C	WDEQ	SW,SED
06639000	Sweetwater River near Alcova	1964-	R	10,12	C	WDEQ	SW
06639480	Horse Creek at Highway 220, near Alcova	1983-	SS	9	C	WDA	
06644550	North Platte River at Casper	1971-	SS	9	C	WDA	
06646000	Deer Creek in canyon, near Glenrock	1985-	M HML	1,5,6,7 12	C	WWDC WWDC	SW,SED
06660500	Laramie River at Two Rivers	1966-	SS	9	CH	WDA	
06661500	Little Laramie River at Two Rivers	1965-87, 1990-	SS	9	CH	WDA	
06661585	Laramie River near Bosler	1990-	R	12	CH	WDEQ	SW,SED
06663900	Laramie River below Luman Creek, near Wheatland	1990-	SS	9	CH	WDA	
06669050	Wheatland Creek below Wheatland	1983-	Q	5,6,7	CH	WDEQ	
06674500	North Platte River at Wyoming-Nebraska State line	1965-	M	5	C	USGS	SW
06755800	Crow Creek at Roundtop Road, near Cheyenne	1986-	SS	9	CH	WDA	
06755950	Crow Creek at F.E. Warren AFB	1983-	Q SS	5,6,7,8 9	CH	WDEQ WDA	
06756000	Crow Creek near Cheyenne	1983-	Q SS	5,6,7,8 9	CH	WDEQ WDA	
06756100	Crow Creek near Carpenter	1990-	L	7,8,9	CH	WWDC	SW

Table 2.--Surface-water-quality stations--Continued

Station number	Station name	Period of record	Data frequency	Analysis schedule	Field office	Funding agency	Remarks
		GREEN RIVER BASIN					
09196500	Pine Creek above Fremont Lake	1975-77, 1987-	C	3	R	USGS	SW
09207700	Dry Piney Creek near Big Piney	1990-	Q	1,5	R	WDEQ	SED
09209400	Green River near La Barge	1963-	BM	1,5,6,7	R	USGS	NASQAN,
			Q	8		USGS	SW,SED
09211200	Green River below Fontenelle Reservoir	1967-	M	1,7	R	BRUC	SW
09215550	Big Sandy River below Farson	1981-	M	1,5	R	WSE	SW
09216050	Big Sandy River at Gasson Bridge, near Eden	1981-	M	1,5	R	WSE	SW,SED
09216790	Bitter Creek above Killpecker Creek, at Rock Springs	1983-	Q	6,12	R	WDEQ	SED
09217000	Green River near Green River	1951-	D	2,3	R	USGS	SW,SED
			BM	1,5		BRUC	
09217010	Green River below Green River	1973-	BM	7	R	BRUC	
09224700	Blacks Fork near Little America	1951-	C	11	R	USGS	SW
			M	1		USGS	
09234500	Green River near Greendale, Utah	1956-	--	--	UT	--	SW
09256000	Savery Creek near Savery	1985-	M	1,5,6,7	C	WWDC	SW,SED
			HML	12		WWDC	
09259050	Little Snake River below Baggs	1981-	R	1	C	WDEQ	SED
			SS	9		WDA	
		BEAR RIVER BASIN					
10020100	Bear River above reservoir, near Woodruff, Utah	1968-	R	1,12	R	WDEQ	SW,SED

Table 2.--Surface-water-quality stations--Continued

Station number	Station name	Period of record	Data frequency	Analysis schedule	Field office	Funding agency	Remarks
		BEAR RIVER BASIN--Continued					
10027000	Twin Creek at Sage	1968-71, 1975-81, 1990-	M	1	R	WDEQ	SED
10035000	Smiths Fork near Cokeville	1983-	R	12	R	WDEQ	SED
10039500	Bear River at Border	1966-	--	--	UT	--	NASQAN, SW,SED
		SNAKE RIVER BASIN					
13010065	Snake River above Jackson Lake, at Flagg Ranch	1986-	--	--	ID	--	SW,SED
13018300	Cache Creek near Jackson	1965-	BM Q HL	1,5,6,7 8 10	R	USGS USGS USGS	HBM,SW, SED
13019430	Granite Creek near Bondurant	1983-	--	--	ID	--	SW,SED
13019438	Little Granite Creek at mouth, near Bondurant	1982-	--	--	ID	--	SW,SED
13026000	Stump Creek near Auburn	1990-	M HL	1,5,7,8 10	R	WDEQ WDEQ	
13027500	Salt River above reservoir, near Etna	1965-	R	1,6,7	R	WDEQ	SW,SED

Table 3.--Sediment stations

Explanation of abbreviations and codes used in table 3

Period of record: The dates given are the calendar years in which records began or ended.

Data frequency:

BM	bimonthly
D	daily (observer)
HML	high, medium, and low flow samples only
I	infrequent, whenever enough sediment in suspension to do analysis
M	every six weeks plus two events
Q	quarterly
R	rising, falling, peak stage, and low flow
T	every two weeks during ice-free season

Analysis schedule:

1	suspended-sediment concentration
2	particle-size distribution
3	0.062-millimeter sieve analysis

Field office:

C	Casper
CH	Cheyenne
ID	Idaho District
R	Riverton
UT	Utah District

Funding agency:

GILL	City of Gillette
MRB	USGS, support for other Interior Agencies
USFS	Forest Service
USGS	U.S. Geological Survey, Federal Program
WDEQ	Wyoming Department of Environmental Quality
WWDC	Wyoming Water Development Commission

Remarks:

HBM	hydrologic benchmark station
NASQAN	national stream-quality accounting network station
QW	also water-quality station
SW	also streamflow station
WWRC	Record furnished by Wyoming Water Research Center

Table 3.--Sediment stations

Station number	Station name	Period of record	Data frequency	Analysis schedule	Field office	Funding agency	Remarks
		YELLOWSTONE RIVER BASIN					
06223750	Wind River above Bull Lake Creek, near Crowheart	1990-	T	1	R	MRB	QW
06225500	Wind River near Crowheart	1990-	T	1	R	MRB	SW,QW
06227600	Wind River near Kinnear	1990-	T	1	R	MRB	QW
06228000	Wind River at Riverton	1986-	BM	1,3	R	USGS	NASQAN, SW,QW
06231930	Baldwin Creek below Dickinson Creek, at Lander	1990-	R	1	R	WDEQ	
06235000	Beaver Creek near Arapahoe	1990-	R	1	R	WDEQ	QW
06235500	Little Wind River near Riverton	1990-	R	1	R	WDEQ	SW,QW
06244500	Fivemile Creek above Wyoming Canal, near Pavillion	1949-58, 1961-75, 1990-	R	1	R	WDEQ	SW,QW
06264700	Bighorn River at Lucerne	1990-	Q	1	R	WDEQ	QW
06268500	Fifteenmile Creek near Worland	1951-73, 1979-86, 1990-	M	1	R	WDEQ	QW
06274300	Bighorn River at Basin	1990-	Q	1	R	WDEQ	SW,QW
06277500	Greybull River near Basin	1990-	R	1	R	WDEQ	QW
06279500	Bighorn River at Kane	1946-64,	M	1	R	MRB	SW,QW
		1969-	I	2		MRB	
06279790	Jones Creek at mouth, near Pahaska	1989-	D	1	R	USFS, WDEQ, USGS	SW,QW
06279795	Crow Creek at mouth, at Pahaska	1989-	D	1	R	USFS WDEQ USGS	SW,QW
06285100	Shoshone River near Lovell	1972-82, 1990-	R	1	R	WDEQ	SW,QW

Table 3.--Sediment stations--Continued

Station number	Station name	Period of record	Data frequency	Analysis schedule	Field office	Funding agency	Remarks
		YELLOWSTONE RIVER BASIN--Continued					
06302000	Big Goose Creek near Sheridan	1990-	Q	1	C	WDEQ	SW,QW
06304500	Little Goose Creek at Sheridan	1990-	Q	1	C	WDEQ	QW
06305500	Goose Creek below Sheridan	1971-82, 1990-	Q	1	C	WDEQ	QW
06316400	Crazy Woman Creek at upper station, near Arvada	1975-81, 1990-	HML	1	C	WDEQ	QW
		CHEYENNE RIVER BASIN					
06375600	Little Thunder Creek near Hampshire	1978-81, 1988-	Q	1,2,3	C	MRB	SW,QW
06426100	Stonepile Creek at Gillette	1988-	M	1	C	GILL	SW,QW
06426500	Belle Fourche River below Moorcroft	1990-	BM	1,3	C	USGS	NASQAN, SW,QW
		PLATTE RIVER BASIN					
06623800	Encampment River above Hog Park, near Encampment	1964-	Q	1,3	C	USGS	HBM,SW, QW
06630000	North Platte River above Seminoe Reservoir, near Sinclair	1986-	BM	1,3	C	USGS	NASQAN, SW,QW
06646000	Deer Creek in canyon, near Glenrock	1985-	M	1	C	WWDC	SW,QW
			I	2		WWDC	
06661585	Laramie River near Bosler	1990-	R	1	CH	WDEQ	SW,QW

Table 3.--Sediment stations--Continued

Station number	Station name	Period of record	Data frequency	Analysis schedule	Field office	Funding agency	Remarks
		GREEN RIVER BASIN					
09207700	Dry Piney Creek near Big Piney	1990-	Q	1,2	R	WDEQ	QW
09209400	Green River near LaBarge	1986-	BM	1,3	R	USGS	NASQAN, SW,QW
09216050	Big Sandy at Gasson Bridge, near Eden	1975-84, 1990-	R	1	R	WDEQ	SW,QW
09216790	Bitter Creek above Killpecker Creek, at Rock Springs	1990-	R	1	R	WDEQ	QW
09217000	Green River near Green River	1951-	D	1	R	USGS	SW,QW
			I	2		USGS	
			M	1		USGS	
09256000	Savery Creek near Savery	1985-	M	1	C	WWDC	SW,QW
			I	2		WWDC	
09259000	Muddy Creek near Baggs	1988-	D	1	--	--	WWRC
09259050	Little Snake River below Baggs	1990-	R	1	C	WDEQ	QW
		BEAR RIVER BASIN					
10020100	Bear River above reservoir, near Woodruff, Utah	1990-	R	1	R	WDEQ	QW
10027000	Twin Creek at Sage	1975-81, 1990-	M	1	R	WDEQ	QW
10035000	Smith Fork at Cokeville	1990-	R	1	R	WDEQ	QW
10039500	Bear River at Border	1966-	--	--	UT	--	NASQAN, SW,QW
		SNAKE RIVER BASIN					
13010065	Snake River above Jackson Lake, at Flagg Ranch	1986-	--	--	ID	--	SW,QW

Table 3.--Sediment stations--Continued

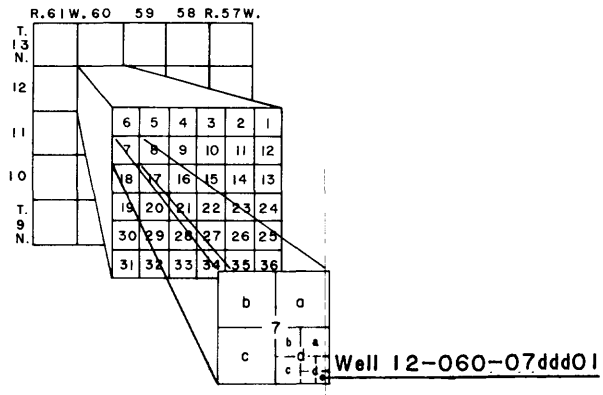
Station number	Station name	Period of record	Data frequency	Analysis schedule	Field office	Funding agency	Remarks
		SNAKE RIVER BASIN--Continued					
13018300	Cache Creek near Jackson	1968-	Q	1,3	R	USGS	HBM,SW, QW
13019438	Little Granite Creek at mouth, near Bondurant	1982-	--	--	ID	USGS	SW,QW
13027500	Salt Creek above reservoir, near Etna	1990-	R	1	R	WDEQ	SW,QW
13019430	Granite Creek near Bondurant	1983-	--	--	ID	--	

Table 4.--Ground-water-level observation wells

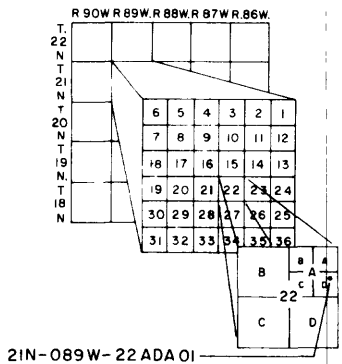
Explanation of abbreviations and codes used in table 4

Site number: Sequential number (by county) used to show location of well in figure 5.

Local well number: The locations of most wells in this report are based on the Federal system of land subdivision. The first number denotes the township north of the 40th Parallel Base Line, the second number denotes the range west of the Sixth Principal Meridian, and the third number denotes the section. A section is divided into quarters of 160 acres each; each quarter is designated a, b, c, or d in a counterclockwise direction, beginning in the northeast quarter. Each quarter is divided into quarters of 40 acres each and again into quarters (10-acre tracts). Alphabetical designations also are assigned to the subsequent subdivisions. A numeral appearing after the letters distinguishes that well from other numbered wells within the same 10-acre tract. The following illustration shows the location of well 12-060-07ddd01 in Laramie County:



Observation wells on the Wind River Indian Reservation and adjacent area in Fremont County are located similarly; however, they are in a land subdivision that is referenced as the Wind River Base Line and Meridian. The uppercase letter that begins the number designates the quadrant of the system. The quadrants are lettered A, B, C, and D in a counterclockwise direction beginning with A in the northeast quadrant. Otherwise, the well numbers are the same as in the preceding paragraph:



Explanation of abbreviations and codes used in table 4--Continued

Period of record: The dates given are the calendar years in which records began or ended. A record consists of one or more measurements during a calendar year.

Geologic source code: The following codes have been retrieved from the Water Data Storage and Retrieval System (WATSTORE) of the USGS and may not follow the current usage of the Survey.

Erathem	System	Series	Geologic source code	Formation name
Cenozoic	Quaternary	Holocene	ALVM	Alluvium
			TRRC	Terrace deposits
	Tertiary	Pliocene and Miocene	NRPK	North Park Formation
		Miocene	OGLL	Ogallala Formation
			ARKR	Arikaree Formation
		Oligocene	BRUL	Brule Formation
			WRVR	White River Formation or Group
		Eocene	WDRV	Wind River Formation
		Eocene and Paleocene	WSTC	Wasatch Formation
		Paleocene	LEBO	Lebo Member of Fort Union Formation
Mesozoic	Cretaceous	Upper Cretaceous	FXHL	Fox Hills Sandstone
		Lower Cretaceous	LKOT	Lakota Formation
Paleozoic	Permian	Upper and Lower Permian	PRKC	Park City Formation
		Lower Permian, Upper and Middle Pennsylvanian	CSPR	Casper Formation
		Lower Permian and Pennsylvanian	MNLS	Minnelusa Formation
		Lower Permian, Upper and Middle Pennsylvanian	TSLP	Tensleep Sandstone
	Mississippian	Upper and Lower Mississippian	MDSN	Madison Limestone
		Lower Mississippian	PHSP	Pahasapa Limestone
	Cambrian	Middle Cambrian	FLTD	Flathead Sandstone

Data frequency:

C	continuous (graphic or digital recorder)
M	monthly (12 visits per year)

Field office:

C	Casper	P	Project Personnel
CH	Cheyenne Hydrologic Surveillance Section	R	Riverton
		S	Wyoming State Engineer

Funding agency:

SE	Wyoming State Engineer with support from Wyoming Economic Development and Stabilization Board
USGS	U.S. Geological Survey, Federal Program

Local name: Indicates a reference name of the well

Table 4.--Ground-water-level observation wells

Site No.	Station No.	Local well No.	Period of record	Geologic source code	Data frequency	Field office	Funding agency	Local name
				ALBANY COUNTY				
1	411751105312701	15-073-01dba01	1977-	CSPR	C	S	SE	Huntoon #1
2	411703105314001	15-073-12dbb01	1978-	CSPR	C	S	SE	Huntoon #2
				BIG HORN COUNTY				
1	441351107434701	49-91-12dba01	1988-	MDSN	C	R	USGS	Worland-1
				CAMPBELL COUNTY				
1	433438105225401	42-071-35aaa01	1988-	WSTC	C	S	SE	ECH-8
2	440602105273701	48-072-36bba01	1988-	WSTC	C	S	SE	ECH-1
3	441117105192901	49-070-31bbb01	1983-	FXHL	C	S	SE	Hampshire-1
4	441748105323301	50-072-20cab01	1985-	LEBO	C	S	SE	Dickinson
5	441819105305701	50-072-21aba01	1983-	WSTC	C	S	SE	Gillette H-13
				CARBON COUNTY				
1	411234106424601	14-083-03cab01	1980-	NRPK	C	C	USGS	Helmer South
2	422338107145001	28-087-16cca01	1981-	ARKR	C	C	SE	Split Rock #2
				CONVERSE COUNTY				
1	424413105365801	32-073-16ccc01	1986-	CSPR	C	S	SE	Natural Bridge Prod.
2	424420105364201	32-073-16cdb01	1986-	CSPR	C	S	SE	Natural Bridge East
3	424520105440501	32-074-08dbc01	1980-	MDSN	C	C	SE	Barber Ranch
4	425902105210701	35-071-23ccd01	1986-	FXHL	C	S	SE	Panhandle Eastern
5	431140105151901	37-070-10cbb01	1986-	WSTC	C	S	SE	Bill #6

Table 4.--Ground-water-level observation wells--Continued

Site No.	Station No.	Local well No.	Period of record	Geologic source code	Data frequency	Field office	Funding agency	Local name
				CROOK COUNTY				
1	442540104493501	51-066-06dcb01	1981-	MDSN	C	S	SE	Madison M-8
2	442734104215001	52-063-25dcd01	1982-84, 1989-	MDSN	M	S	SE	Cole Well 3-A
3	442734104215002	52-063-25dcd02	1984-85, 1987-	MDSN	M	S	SE	Cole Well 3-B
4	443453104425602	53-065-18bbd02	1962-	PHSP	M	C	SE	Park Service
5	444854104534501	56-067-28aab01	1982-	MDSN	C	S	SE	Cole #41 Madison
6	444854104534502	56-067-28aab02	1983-	MDSN	C	S	SE	Cole #41 Minnelusa
7	445542104383701	57-065-15dac01	1986-	MDSN	C	S	SE	USGS M-1
				FREMONT COUNTY				
1	430205108243201	1N-4E-28acc01	1983-	WDRV	M	R	SE	Brentwood
				GOSHEN COUNTY				
1	413852104115801	19-061-04abc01	1972-	ALVM	C	S	SE	F. Sanders
2	413810104102301	19-061-10aab01	1980-	BRUL	C	S	SE	LaGrange #1
3	414049104074501	20-060-30bbb01	1978-	BRUL	C	S	SE	LaGrange #2
4	414348104101301	20-061-03dad01	1980-	WRVR	C	S	SE	LaGrange #3
5	414128104094502	20-061-23bdb02	1978-	BRUL	C	S	SE	Rain Station
6	414051104100701	20-061-23ccc01	1972-	ALVM	C	S	SE	Curt Meier
7	422519104095101	28-061-02ccd01	1986-	ARKR	C	S	SE	Prairie Center #6
8	422512104135501	28-061-06aba01	1979-	ARKR	C	S	SE	Goshen County #2
9	422928104121401	29-061-17aad01	1980-	ARKR	C	S	SE	Prairie Center #4
10	422849104090801	29-061-23abb01	1979-	ARKR	C	S	SE	Goshen County #1
11	422730104094801	29-061-26cbb01	1980-	ARKR	C	S	SE	Prairie Center #3
12	423549104120901	30-061-09bbb01	1980-	ARKR	C	S	SE	Prairie Center #5

Table 4.--Ground-water-level observation wells--Continued

Site No.	Station No.	Local well No.	Period of record	Geo-logic source code	Data fre-quency	Field office	Funding agency	Local name
			HOT SPRINGS COUNTY					
1	434136108183301	43-095-18cba01	1983-	TSLP	C	R	SE	Thermopolis GTW-1
2	433933108121901	43-095-25cdd01	1983-	PRKC	C	R	SE	Thermopolis GTW-3
			LARAMIE COUNTY					
1	410059104072401	12-060-07ddd01	1978-	WRVR	C	S	SE	Laramie #1
2	410100104160301	12-062-13baa01	1975-	TRRC	C	S	SE	SE Carpenter
3	410111104233102	12-063-15aaa02	1971-	BRUL	C	S	SE	SW Carpenter
4	410703104071201	13-060-05ccb01	1969-	BRUL	M	S	SE	Elmer Glantz
5	410324104481701	13-066-32bbd01	1986-	OGLL	C	S	SE	Laramie #14
6	410530104574001	13-068-13ccc01	1942-50, 1969-	OGLL	C	CH	SE	Borie
7	411238104070801	14-060-05bcb01	1957-	BRUL	C	S	SE	C.C. Gross
8	411022104141201	14-061-18ddd01	1977-	WRVR	C	S	SE	Laramie #2
9	411114104242501	14-063-15aaa01	1977-	ARKR	C	S	SE	Laramie #3
10	411005104355001	14-064-19bcc01	1977-	OGLL	C	S	SE	Laramie #9
11	411147104490501	14-066-07add01	1984-	OGLL	C	S	SE	Nat'l Land #1
12	411210104452001	14-066-10aba01	1977-	OGLL	C	S	SE	Laramie #8
13	410940104435701	14-066-23ddd01	1986-	OGLL	C	S	SE	Laramie #15
14	411213104501401	14-067-12abb01	1984-	OGLL	C	S	SE	Laramie #10
15	411034104554001	14-067-18ddc01	1956-	OGLL	C	CH	SE	Bell #14
16	410930104524701	14-067-27bac01	1986-	OGLL	C	S	SE	Laramie #13
17	410838104530401	14-067-34bbc01	1986-	OGLL	C	S	SE	Laramie #11
18	410757104582302	14-068-35ddc02	1969-	OGLL	C	CH	SE	King #3
19	411531104194701	15-062-20aaa01	1977-	OGLL	C	S	SE	Laramie #4
20	411725104454601	15-066-10bab01	1977-	OGLL	C	S	SE	Laramie #7
21	411400104595901	15-068-27ccc01	1984-	OGLL	C	S	SE	MX West
22	412227104081401	16-060-07bbb02	1983-	OGLL	C	S	SE	SW of Albin
23	411136104125301	16-061-17aaa01	1977-	OGLL	C	S	SE	Laramie #5

Table 4.--Ground-water-level observation wells--Continued

Site No.	Station No.	Local well No.	Period of record	Geologic source code	Data frequency	Field office	Funding agency	Local name
			LARAMIE COUNTY--Continued					
24	412343104053101	17-060-33cbb01	1975-	OGLL	C	S	SE	South of Albin
25	412605104203001	17-062-17ccc01	1982-	OGLL	C	S	SE	Laramie #6A
26	412400104533901	17-067-33baa01	1984-	OGLL	C	S	SE	MX North
			NIOBRARA COUNTY					
1	424709104194101	32-062-05baa01	1979-	ARKR	C	S	SE	Niobrara #1
2	424244104202001	32-062-32bbb01	1970-	ARKR	C	C	USGS	Node Well
3	424544104260601	32-063-08daa01	1979-	ARKR	C	S	SE	Niobrara #2
4	430422104183201	36-062-28ab01	1974-	MDSN	C	C	USGS	ETSI T-2
5	430422104183202	36-062-28ab02	1974-	LKOT	C	C	SE	ETSI O-2
6	430421104200701	36-062-28bbd01	1983-	MNLS	C	S	SE	ETSI T-1
7	431321104090001	38-061-35dca01	1983-	MNLS	C	S	SE	ETSI M-1
			PLATTE COUNTY					
1	420237104532101	24-067-21aab01	1979-	ALVM	C	S	SE	Preuit
2	420246104590301	24-068-22aab02	1988-	ARKR	C	S	SE	Platte #1A
3	420718104553901	25-067-19dda01	1979-	ARKR	C	P	SE	Ed Wilhelm
4	420524104530201	25-067-34ccd01	1980-	ARKR	C	S	SE	Platte #2
5	420859104565001	25-068-12dda01	1980-	ARKR	C	S	SE	Platte #4
6	420840105000401	25-068-15bbd01	1980-	ARKR	C	S	SE	Platte #6
7	420748104565051	25-068-24aad01	1980-	ARKR	C	S	SE	Platte #3
8	420613105024401	25-068-31aaa01	1979-	ARKR	C	P	SE	Platte #7
9	421443104574601	26-068-12cbd01	1980-	ARKR	C	S	SE	E. Rutherford
10	421128104575801	26-068-36bbb01	1981-	ARKR	C	S	SE	Platte #5
11	421722105042401	27-069-25abc01	1981-	WRVR	C	S	SE	Cottonwood Creek #1

Table 4.--Ground-water-level observation wells--Continued

Site No.	Station No.	Local well No.	Period of record	Geo-logic source code	Data fre-quency	Field office	Funding agency	Local name
				SWEETWATER COUNTY				
1	413228109220801	18-106-16ada01	1981-	WSTC	C	R	USGS	Green River Oil Shale
2	413850109150601	19-105-10bbb01	1984-	--	C	R	SE	Rock Spgs Golf Course
				WASHAKIE COUNTY				
1	440621107273801	48-089-25ada01	1988-	FLTD	C	R	USGS	Mills
				WESTON COUNTY				
1	434544104233701	44-063-26cac01	1982-	MDSN	M	S	SE	Townsend Well
2	435822104243101	46-063-10cda01	1982-	MDSN	M	S	SE	Black Hills Power #3
3	435807104224901	46-063-15add01	1982-	MDSN	M	S	SE	Black Hills Power #4
4	435610104433001	46-066-25dbb01	1982-	MDSN	M	S	SE	Terra Resources Madison
5	440633104364201	47-065-01bab01	1983-	MDSN	M	S	SE	Town of Upton #6
6	440530104381001	48-065-35ccb01	1982-	MDSN	M	S	SE	Town of Upton #4

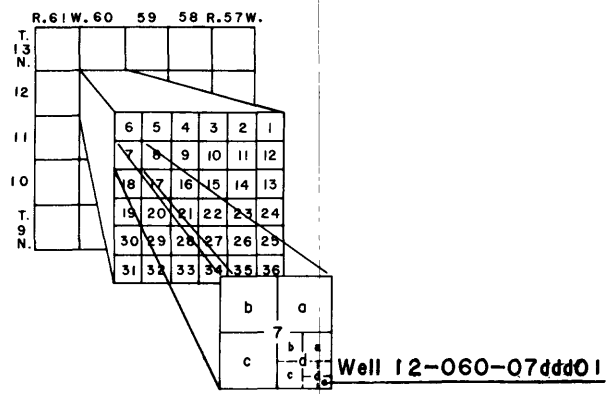
Table 5.--Ground-water-quality sites

Explanation of abbreviations and codes used in table 5

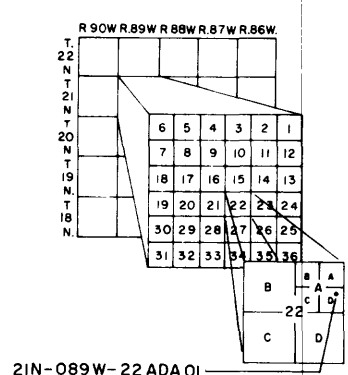
Site number: Sequential number (by county) used to show location of well in figure 6.

Station number: Station identification number which consists of latitude, longitude, and a two-digit sequence number.

Local well number: The locations of most wells in this report are based on the Federal system of land subdivision. The first number denotes the township north of the 40th Parallel Base Line, the second number denotes the range west of the Sixth Principal Meridian, and the third number denotes the section. A section is divided into quarters of 160 acres each; each quarter is designated a, b, c, or d in a counterclockwise direction, beginning in the northeast quarter. Each quarter is divided into quarters of 40 acres each and again into quarters (10-acre tracts). Alphabetical designations also are assigned to the subsequent subdivisions. A numeral appearing after the letters distinguishes that well from other numbered wells within the same 10-acre tract. The following illustration shows the location of well 12-060-07ddd01 in Laramie County:



Observation wells on the Wind River Indian Reservation and adjacent area in Fremont County are located similarly; however, they are in a land subdivision that is referenced as the Wind River Base Line and Meridian. The uppercase letter that begins the number designates the quadrant of the system. The quadrants are numbered A, B, C, and D in a counterclockwise direction beginning with A in the northeast quadrant. Otherwise, the well numbers are the same as given in the preceding paragraph.



Analysis schedule:

1 major dissolved ions (salinity)
2 herbicides

Note--The statewide ground-water-quality reconnaissance network is operated in cooperation with the Wyoming Department of Agriculture. The sampling design is based on division of the State into four quarters, with a different quarter of the State sampled each year. Within the selected quadrant, approximately 25 active wells in irrigated areas are selected for sampling. Personnel from the Cheyenne office have collected at least one sample per well, although some wells have been resampled as noted in the table.

Table 5.--Ground-water-quality sites

Site number	Station number	Local well number	Water year(s) sampled	Analysis schedule
		ALBANY COUNTY		
1	412857105380401	17-073-06bbb	1986	1
		BIG HORN COUNTY		
1	441449107464801	49-091-03cbb01	1987-88	1,2
2	441514107580801	49-092-06	1987	1,2
3	441726108004901	50-093-22dab01	1987-88	1,2
4	442346108135701	51-095-14a	1987	1,2
5	442620108270801	52-096-31bcb01	1987	1,2
6	443020108171001	52-095-04cdb01	1987-88	1,2
7	443223107503001	53-091-29cbc	1987	1,2
8	444832108302501	56-097-26ca	1987	1,2
		CAMPBELL COUNTY		
1	445510105590401	57-076-15ddb	1988	1,2
		CARBON COUNTY		
1	413133106462701	18-083-18dcc	1986	1
2	411221106424901	14-083-03cda	1986	1
		CONVERSE COUNTY		
1	424310105232601	32-071-29adb	1988	1,2
2	424621105371501	32-073-04cbb01	1988,89	1,2
3	424826105245601	33-071-30add	1988	1,2
4	424834105244301	33-071-29bbb	1988	1,2
5	424908105242601	33-071-20bdc01	1988	1,2
6	425209105535001	34-075-31dca01	1988	1,2
7	430127105414401	35-074-11aac01	1988	1,2
		FREMONT COUNTY		
1	430335108221301	1N-04E-14dcb01	1987	1,2
2	430414108223301	1N-04E-11ccd01	1987	1,2
3	431107108180502	2N-05E-04bbb01	1987	1,2
4	430600108403801	2N-02E-32ccc01	1989	1,2
5	431748109122501	4N-04W-26bcb01	1989	1,2
6	431839109124401	4N-04W-22adb01	1989	1,2
7	431855109120701	4N-04W-23bab01	1989	1,2
8	432005109142101	4N-04W-09cad01	1989	1,2

Table 5.--Ground-water-quality sites--Continued

Site number	Station number	Local well number	Water year(s) sampled	Analysis schedule
		GOSHEN COUNTY		
1	414028104071801	20-060-30bdd01	1986	1
2	422958104134801	27-061-07db01	1986	1
3	423527104112901	30-061-09acc01	1988	1,2
		JOHNSON COUNTY		
1	440932106421001	48-082-03bdc01	1988	1,2
		LARAMIE COUNTY		
1	410135104183500	12-062-03ccc	1986,90	1,2
2	411143104160801	14-062-12bcd02	1986,90	1,2
3	411222104291701	14-064-1dba01	1986,90	1,2
4	411851104362001	16-065-36acb01	1986,90	1,2
5	411905104231801	16-063-26ddd01	1986,90	1,2
6	411941104041401	16-060-27abc01	1986,90	1,2
7	412523104210701	17-062-19dbc	1986,90	1,2
8	413634104475901	19-066-17cdc	1986,90	1,2
		LINCOLN COUNTY		
1	415841110563701	23-119-16bbb01	1989	1,2
2	421258110100201	26-112-21ddb01	1989	1,2
3	424128110585301	31-119-10abc01	1989	1,2
4	425759111003901	34-119-02bbb01	1989	1,2
		HOT SPRINGS COUNTY		
1	434141108285401	8N-03E-02dca01	1989	1,2
2	434301108362701	9N-02E-35bdb01	1989	1,2
		NATRONA COUNTY		
1	422849107291401	29-089-16ddc01	1987	1,2
2	423536106392401	30-082-03ccc01	1987-88	1,2
3	423648106375701	31-081-35bdc01	1987-88	1,2
		NIOBRARA COUNTY		
1	424303104070701	32-060-30cbd01	1988	1,2
2	424539104222401	32-063-12cbd01	1988	1,2
3	424654104182501	32-062-04aca01	1988	1,2
4	424859104073001	33-061-24ddc01	1988	1,2

Table 5.--Ground-water-quality sites--Continued

Site number	Station number	Local well number	Water year(s) sampled	Analysis schedule
		PARK COUNTY		
1	440732108535601	48-100-18ddc	1987	1,2
2	443253109045101	53-102-25aad01	1987	1,2
3	444126108513401	54-100-2abb01	1987	1,2
4	444147108472801	55-099-33cdb01	1987-88	1,2
5	444217108390900	55-098-34bcb01	1987,88,89	1,2
6	444425108483701	55-099-17cdd01	1987	1,2
7	445744109051901	58-101-31dad01	1987	1,2
		PLATTE COUNTY		
1	420046104552401	24-067-32bbc01	1986,90	1,2
2	420224104531601	24-067-21adc01	1986,90	1,2
3	420523104563801	25-067-31ccd	1986,90	1,2
4	420523104563902	25-067-31ccc02	1986,90	1,2
5	420559104585301	25-068-35bcb	1986	1
6	421733105042201	27-069-24dcc	1986,90	1,2
7	422818105013501	29-068-21bcc01	1986,90	1,2
		SHERIDAN COUNTY		
1	443938106565601	54-084-14bbb01	1988	1,2
2	443938106565602	54-084-14bbb02	1988	1,2
3	443939107014901	54-084-18bbb01	1988	1,2
4	444155106561801	55-084-35acd01	1988	1,2
5	445131106033901	56-076-06cab01	1988	1,2
6	445436107163401	57-086-17ccc01	1988	1,2
		SUBLETTE COUNTY		
1	423104110102001	29-112-10abc01	1989	1,2
2	423911109570301	31-110-21abd01	1989	1,2
3	424454109424101	32-108-15bbd01	1989	1,2
4	424645109574301	32-110-04baa01	1989	1,2
5	425606109570901	34-110-11bdb01	1989	1,2
		SWEETWATER COUNTY		
1	420421109235701	24-106-10daa01	1989	1,2
2	420636109265301	25-106-27cba01	1989	1,2
		TETON COUNTY		
1	432913110474201	41-116-29cab01	1989	1,2
2	435628110261301	--	1989	1,2

Table 5.--Ground-water-quality sites--Continued

Site number	Station number	Local well number	Water year(s) sampled	Analysis schedule
		UINTA COUNTY		
1	410836110490501	14-119-34ddb01	1989	1,2
2	411623110221801	15-111-16dcd01	1989	1,2
3	411741110185501	15-114-07bcc01	1989	1,2
4	412555111013201	17-120-30abd01	1989	1,2
		WASHAKIE COUNTY		
1	435720108005701	46-093-15cab01	1988	1,2
2	435724108010901	46-093-15bdd01	1987,88,89	1,2
3	435724108011601	46-093-15bcc01	1987-88	1,2
4	440334107542301	47-092-09bcc01	1987-88	1,2
5	440547107525701	48-092-27ccd01	1987-88	1,2
6	440915107532501	48-092-04ddc01	1987-88	1,2
		WESTON COUNTY		
1	435722104210701	46-062-19bca01	1988	1,2
2	440610104471901	48-066-33abc01	1988	1,2
3	440632104455603	48-066-26ccb03	1988,89,90	1,2
4	440636104451804	48-066-26cbd04	1988,89,90	1,2
5	440640104450001	48-066-26cad01	1988,89,90	1,2
6	440642104443802	48-066-26dbc02	1988,89,90	1,2

Table 6.--Streamflow stations discontinued in water years 1989 and 1990

Station number	Station name	Period of record
	YELLOWSTONE RIVER BASIN	
06205950	Lodgepole Creek at mouth, near Painter	1989
06280000	North Fork Shoshone River near Wapiti	1921-26, 1979-89
06291200	Lodgegrass Creek at State line, near Wyola, Montana	1983-89
06309450	Beaver Creek below Bayer Creek, near Barnum	1974-89
06309460	Beaver Creek above White Panther Ditch, near Barnum	1974-89

Table 7.--Surface-water-quality stations discontinued in water years 1989 and 1990

Station number	Station name	Period of record	Other data still being collected
	YELLOWSTONE RIVER BASIN		
06189000	Blacktail Deer Creek near Mammoth, Yellowstone National Park	1989	Streamflow
06282900	Shoshone River above Dry Creek, near Cody	1974-89	
06284450	Bitter Creek below sewage lagoon, near Powell	1981-89	
06286200	Shoshone River at Kane	1976-89	
06305700	Goose Creek near Acme	1984-89	Streamflow
06310000	Red Fork near Barnum	1987-90	
06312000	North Fork Powder River near Kaycee	1987-90	
06313000	South Fork Powder River near Kaycee	1949-53, 1968-81, 1983-85, 1986-90	
	CHEYENNE RIVER BASIN		
06426400	Donkey Creek near Moorcroft	1977-89	
06427500	Belle Fourche River below Keyhole Reservoir	1984-89	Streamflow
	PLATTE RIVER BASIN		
06625000	Encampment River at mouth, near Encampment	1965-89	Streamflow
06634620	Little Medicine Bow River at Boles Spring, near Medicine Bow	1985-89	Streamflow
06636000	North Platte River above Pathfinder Reservoir	1969-82, 1987-89	
06645000	North Platte River below Casper	1950-52, 1957-59, 1967-89	
06652000	North Platte River at Orin	1966-89	Streamflow
06660070	Laramie River above Howell	1980-89	
413918-105021401	Chugwater Creek at Platte-Laramie County line, near Chugwater	1984-89	
06669500	Chugwater Creek at Chugwater	1984-89	

Table 7.--Surface-water-quality stations discontinued in water years 1989 and 1990--Continued

Station number	Station name	Period of record	Other data still being collected
	GREEN RIVER BASIN		
09221650	Smiths Fork near Lyman	1974-89	
09222000	Blacks Fork near Lyman	1962-89	
09224050	Hams Fork near Diamondville	1975-89	
09229500	Henrys Fork near Manila, Utah	1951-89	Streamflow
	BEAR RIVER BASIN		
10018900	Yellow Creek at mouth, near Evanston	1984-89	

Table 8.--Sediment stations discontinued in water years 1989 and 1990

Station number	Station name	Period of record
	PLATTE RIVER BASIN	
06635000	Medicine Bow River above Seminoe Reservoir, near Sinclair	1988-89
06636000	North Platte River above Pathfinder Reservoir	1988-89

Table 9.--Ground-water-level observation wells discontinued in water years 1989 and 1990

Station number	Local well number	Period of record	Local name
		CARBON COUNTY	
415430106493801	22-084-01bcb01	1983-89	St. Marys Ditch
415535106482301	23-083-31bbb01	1985-89	Medicine Bow #1
		GOSHEN COUNTY	
413852104115801	19-061-04abc01	1972-88	F. Sanders

DATA-COLLECTION PROGRAMS

PROJECT TITLE: Surface-water stations (WY 00-001)

FUNDING AGENCIES: Wyoming State Engineer, Wyoming Department of Environmental Quality, Wyoming Water Development Commission, Wyoming Water Research Center, Teton County, Uinta County, Sheridan Area Water Supply-Joint Powers Board, City of Gillette, Northern Arapaho Tribe, Shoshone Tribe, Midvale Irrigation District, U.S. Bureau of Reclamation, U.S. Corps of Engineers, U.S. Forest Service, and USGS

PROJECT LEADER: Stanley A. Druse

FIELD LOCATION: Statewide

PERIOD OF PROJECT: Ongoing

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

OBJECTIVE: (1) Collect sufficient surface-water data to satisfy needs for current-purpose uses such as (a) assessment of water resources, (b) operation of reservoirs and irrigation projects, (c) prediction of stage or discharge, (d) pollution controls and disposal of wastes, (e) discharge data to accompany water-quality measurements, (f) compact and legal requirements, and (g) research or special studies; and (2) collection of data necessary for analytical studies to define for any location the statistical properties of, and trends in, the occurrence of water in streams and lakes for use in planning and design.

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

PROGRESS AND SIGNIFICANT RESULTS: Computation and compilation of surface-water data for water year 1989 (fiscal year 1989) data reports were completed by mid-March 1990 and 1991, allowing the Wyoming District to meet the Division's goal of having the report to the printer by April 1. The level of activity continued to increase during 1990 with the addition of 12 new or reactivated continuous-record stations. Three stations were discontinued, effective at the start of water year 1990, and one is to be discontinued at the end of water year 1990. The Wyoming State Engineer's Office continues to operate 26 gages, mostly seasonal, for direct-services credit. Work was initiated as part of the District's safety program to install handrails on cableway platforms at a rate of about 10 per year.

PLANS FOR FISCAL YEAR 1991: The regulation of irrigation water continues to cause problems between Indian and non-Indian irrigators in the Wind River Indian Reservation. Part of the problem is insufficient streamflow stations to monitor the flow in major streams and selected tributaries adequately. This provides potential for increasing the monitoring network within and adjacent to the Reservation. The goals of installing four data-collection platforms and rehabilitating cableways will be continued. Publication of a gaging-station index is planned.

REPORTS PUBLISHED DURING FISCAL YEARS 1989 and 1990:

Druse, S.A., Glass, W.R., McCollam, P.B., and Peterson, D.A., 1989, Water-resources data, Wyoming--water year 1988: U.S Geological Survey Water-Data Report, WY-88-1, 518 p.

Druse, S.A., Glass, W.R., McCollam, P.B., and Peterson, D.A., 1990, Water-resources data, Wyoming--water year 1989: U.S. Geological Survey Water-Data Report, WY-89-1, 516 p.

PROJECT TITLE: Ground-water stations (WY 00-002)

FUNDING AGENCIES: Wyoming State Engineer and USGS

PROJECT LEADER: Hugh I. Kennedy

FIELD LOCATION: Statewide

PERIOD OF PROJECT: Ongoing

PROBLEM: (1) Long-term ground-water-level records are needed to evaluate the effects of climatic variations on the recharge to and discharge from the ground-water systems to provide a data base from which to (a) measure the effects of development, (b) assist in the prediction of future supplies, and (c) provide data for management of the resource. (2) Short-term water-level records also are needed for (a) ground-water resources assessment, (b) areal investigations, and (c) water-use investigations.

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

APPROACH: The most advantageous locations for long-term observations will be determined. This network will be refined as records become available and detailed areal studies of the ground-water system more closely define the aquifers, their properties, and the stresses to which they are subjected.

PROGRESS AND SIGNIFICANT RESULTS: The biennial ground-water-level report for the 10-year period 1980-89 was completed and published. The network of observation wells continued at about the same level--87 wells. Computation and compilation of the data have been maintained at a near-current status. The Wyoming State Engineer's Office continues to operate about two-thirds of the network wells for direct-services credit.

PLANS FOR FISCAL YEAR 1991: Continue to keep computation and compilation of data at "near current" status. The Wyoming State Engineer will continue to operate a majority of the wells for direct-services credit.

REPORTS PUBLISHED DURING FISCAL YEARS 1989 AND 1990:

Druse, S.A., Glass, W.R., McCollam, P.B., and Peterson, D.A., 1989, Water-resources data, Wyoming--water year 1988: U.S. Geological Survey Water-Data Report, WY-88-1, 518 p.

Druse, S.A., Glass, W.R., McCollam, P.B., and Peterson, D.A., 1990, Water-resources data, Wyoming--water year 1989: U.S. Geological Survey Water-Data Report, WY-89-1, 516 p.

Kennedy, H.I., and Green, S.L., 1990, Ground-water levels in Wyoming, 1980 through September 1989: U.S. Geological Survey Open-File Report 90-106, 136 p.

PROJECT TITLE: Water-quality stations (WY 00-003)

FUNDING AGENCIES: Wyoming Department of Agriculture, Wyoming State Engineer, Wyoming Department of Environmental Quality, Wyoming Water Development Commission, City of Gillette, Northern Arapaho Tribe, Shoshone Tribe, U.S. Bureau of Reclamation, U.S. Forest Service, and USGS

PROJECT LEADER: David A. Peterson

FIELD LOCATION: Statewide

PERIOD OF PROJECT: Ongoing

PROBLEM: Water-resource planning and water-quality assessment require a nationwide base level of standardized information. For intelligent planning and realistic assessment of the water resource, the chemical and physical quality of surface and ground water must be defined and monitored.

OBJECTIVE: Provide a national bank of water-quality data for broad Federal and State planning and action programs and to provide data for State and Federal management of interstate waters.

APPROACH: A network of water-quality stations will be operated at stream sites to provide data on average chemical concentrations, loads, and trends as required by planning and management agencies. Selected ground-water wells also will be sampled.

PROGRESS AND SIGNIFICANT RESULTS: Water-quality samples were collected at 119 surface-water stations, in cooperation with State, local, and Federal agencies. Adjustments to the surface-water monitoring network included increased sampling of nonpoint-source pollutants, particularly suspended sediment. The ground-water monitoring program focused on the southeastern quadrant of the State; 25 wells were sampled for herbicides, major dissolved constituents, and field measurements. Data were compiled, checked, and published in the annual data report for 1989. The report was sent to the printer by the Division goal date of April 1.

PLANS FOR FISCAL YEAR 1991: Minor adjustments in the surface-water-quality network are expected. The ground-water-quality monitoring program will focus on the northwestern quadrant of the State.

REPORTS PUBLISHED DURING FISCAL YEARS 1989 AND 1990:

Druse, S.A., Glass, W.R., McCollam, P.B., and Peterson, D.A., 1989, Water-resources data, Wyoming--Water year 1988: U.S. Geological Survey Water-Data Report, WY-88-1, 518 p.

Druse, S.A., Glass, W.R., McCollam, P.B., and Peterson, D.A., 1990, Water-resources data, Wyoming--Water year 1989: U.S. Geological Survey Water-Data Report, WY-89-1, 516 p.

PROJECT TITLE: Sediment stations (WY 00-004)

FUNDING AGENCIES: Wyoming Water Development Commission, Wyoming Department of Environmental Quality, City of Gillette, U.S. Bureau of Reclamation, U.S. Forest Service, and USGS

PROJECT LEADER: David A. Peterson

FIELD LOCATION: Statewide

PERIOD OF PROJECT: Ongoing

PROBLEM: Water-resource planning and water-quality assessment require a nationwide base level of relatively standardized information. Sediment concentrations and discharges in rivers and streams must be defined and monitored.

OBJECTIVE: (1) Provide a national bank of sediment data for use in broad Federal and State planning and action programs, (2) provide data for Federal and State management of interstate water, and (3) provide data for interpretation in areal studies.

APPROACH: A network of sediment stations will be established and operated to provide data on areal and temporal averages and trends of sediment concentration, sediment discharges, and particle-size distribution of sediment being transported by rivers and streams.

PROGRESS AND SIGNIFICANT RESULTS: Computation and compilation of sediment data were processed ahead of schedule, helping to allow timely publication of the 1989 data report. Four continuous-record stations were operated during the year; and sediment samples were collected on an intermittent basis at 25 stations. All concentrations and 0.062-millimeter splits were analyzed in the District Sediment Laboratory. Samples also were processed for the Colorado and Utah Districts. The report of results of an investigation of sediment yields in small ephemeral streams was completed and prepared for technical review.

PLANS FOR FISCAL YEAR 1991: Continuation of data collection at the previous year's stations. The analysis procedures used in the sediment laboratory will be upgraded through linking of the laboratory weighing balances to the computer and use of associated software.

REPORTS PUBLISHED DURING FISCAL YEARS 1989 AND 1990:

Druse, S.A., Glass, W.R., McCollam, P.B., and Peterson, D.A., 1989, Water-resources data, Wyoming--water year 1988: U.S. Geological Survey Water-Data Report, WY-88-1, 518 p.

Druse, S.A., Glass, W.R., McCollam, P.B., and Peterson, D.A., 1990, Water-resources data, Wyoming--water year 1989: U.S. Geological Survey Water-Data Report, WY-89-1, 516 p.

WATER-RESOURCES-APPRAISAL PROJECTS

PROJECT TITLE: Water-use data system for Wyoming (WY 84-007)

FUNDING AGENCIES: Wyoming State Engineer and USGS

PROJECT LEADER: Charles L. Qualls

FIELD LOCATION: Statewide

PERIOD OF PROJECT: January 1984 through September 1991

PROBLEM: The demand for water for a variety of competing uses in Wyoming is expected to continue to increase. Planners and managers at all levels of government need detailed, accurate water information in order to assure that maximum benefits are derived from the available water. Available water-use data for Wyoming may be inconsistent for current management needs. The USGS has designed and implemented a program to develop a uniform national data base of water-use information. A water-use data system is needed in Wyoming, not only to meet national needs, but to provide State agencies with the detailed information needed for water planning and administration.

OBJECTIVE: Establish a water-use data system that is responsive to the needs of water planners at the State and national levels. The system will provide for the collection, storage, retrieval, and dissemination of water-use data. The data base will include quantitative information about water rights, withdrawals, transfers, and returns.

APPROACH: The State Water-Use Data System (SWUDS), part of the National Water Information System (NWIS) of the USGS, has been loaded onto the Wyoming District computer. Population of the SWUDS is to be accomplished, region-by-region or basin-by-basin, as project work in the regions or basins allows, beginning with water-use data to be collected as part of the Wind River Indian Reservation water-use program.

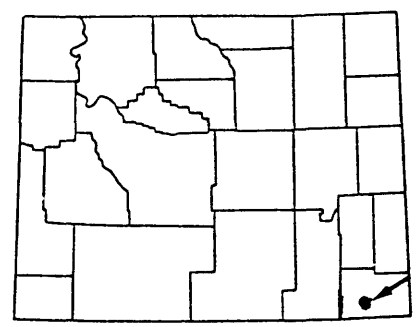
PROGRESS AND SIGNIFICANT RESULTS: The Wyoming State Engineer's Office and other agencies were contacted concerning creation of a water-use steering committee. Progress was made in designing a Geographic Information System (GIS) for compiling water-use data in lieu of entry into the State Water Use Data System. A project proposal was presented to the Wyoming State Engineer for creation of a GIS data base of irrigated lands in the North Platte River basin; this data base is to be used by USGS personnel to estimate irrigation water use in the basin. Another project proposal was prepared and discussed to create a GIS data base of water wells throughout the State of Wyoming. Planning has begun for the compilation of data for the publication Estimated Use of Water in the United States, 1990. Algorithms were written to calculate commercial, industrial, and mining water use for Wyoming, based on employment data and employee per-capita water use.

PLANS FOR FISCAL YEAR 1991: A water-use steering committee will be organized and convened. Project work will concentrate on compiling Wyoming data for the publication Estimated Use of Water in the United States, 1990. Data for this compilation will be entered into a GIS-based data system for later transfer into the USGS Aggregated Water-Use Data System. Personnel of the Wyoming State Engineer's Office are being encouraged to participate by defining needs of the State for water-use studies by personnel of the USGS and the State Engineer's Office.

REPORTS COMPLETED DURING FISCAL YEAR 1991:

Schuetz, J.R., in press, Wyoming [Water supply and demand], in National water summary 1987--Selected hydrologic events and water-supply and demand: U.S. Geological Survey Water-Supply Paper 2350.

PROJECT TITLE: Site characterization and preparation of a remedial-action plan for the Installation Restoration Program at F.E. Warren Air Force Base, Wyoming (WY 86-095)



FUNDING AGENCY: U.S. Air Force

PROJECT LEADER: L. Rodney Larson

FIELD LOCATION: Southeastern Wyoming

PERIOD OF PROJECT: December 1985 through December 1991

PROBLEM: As part of its operations at F.E. Warren Air Force Base, the U.S. Air Force has used, stored, and disposed of various hazardous materials. During 1985-90, geotechnical studies showed that soil, ground water, or surface water was contaminated at 24 sites. The hazardous materials primarily were trichloroethene, gasoline or oil, ethylene glycol, and battery acid.

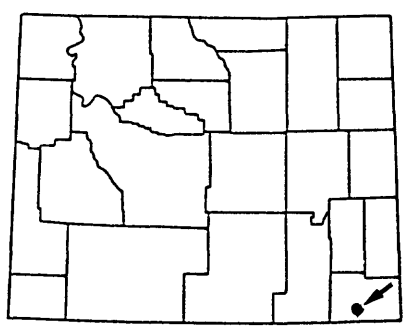
OBJECTIVE: The remedial investigation will determine the nature and extent of contamination at each site, assess the impact of the contaminants on the environment, and summarize the data and conclusions in a final report. This information will then be used by the Air Force to determine appropriate remedial action for each site.

APPROACH: The investigation is planned to determine the extent and movement of contaminants in the soil and water. Observation wells and boreholes will be drilled and logged, water-level measurements obtained, aquifer tests performed, and a potentiometric-surface map prepared. Streamflow measurements will be made and historical streamflow data analyzed. Soil and water samples will be obtained and soil-gas and surface geophysical surveys will be made to detect and delineate contaminant plumes.

PROGRESS AND SIGNIFICANT RESULTS: A preliminary draft report was completed and submitted to the Air Force in December 1989 for review. The base was added to the Environmental Protection Agency National Priorities List; the designation was final in February 1990. This will require additional work concerning remedial investigation and feasibility study, leading to remedial action such as cleanup. During water year 1990, geotechnical work was conducted at several individual spill sites, and these data will be included in the final report.

PLANS FOR FISCAL YEAR 1991: Review comments for the phase 1 remedial investigation report have been received from the Air Force. The report was completed and delivered by May 1, 1991. Designation of the base to the National Priorities List will require additional comprehensive onsite studies and individual reports concerning remedial investigation for specific spill sites and operable units.

PROJECT TITLE: Flood investigation for Cheyenne, Wyoming (WY 87-100)



FUNDING AGENCY: Wyoming Highway Department, Laramie County, City of Cheyenne, and USGS

PROJECT LEADER: James G. Rankl

FIELD LOCATION: Southeastern Wyoming

PERIOD OF PROJECT: October 1986 through September 1992

PROBLEM: The City of Cheyenne, Wyoming, is susceptible to extreme flooding because of its location in the foothills of the Laramie Mountains. Streams in this area pose a significant flood hazard from intense thunderstorms, especially during the months of July and August. Although more than 80 years of precipitation data are available, the relation between precipitation and runoff has not been defined for rural areas around Cheyenne or for urban areas within the city limits.

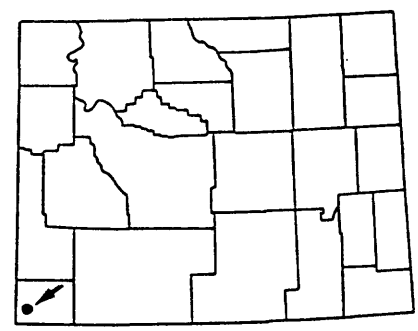
OBJECTIVE: (1) Determine the relation between rainfall and runoff for both rural and urban areas, and (2) use the results of the rainfall and runoff relations in conjunction with the 80 years of precipitation data to develop predictions of peak and volume frequencies. The peak and volume frequencies will be used by the City of Cheyenne to design the proper size openings for hydraulic structures.

APPROACH: Three streamflow-gaging stations equipped with stage sensors and recording precipitation gages will be installed on channels of three small drainage basins entering the Cheyenne area. An additional site will be installed on Henderson Drain to sample a completely urbanized area. A streamflow-gaging station will be located about 15 miles west of Cheyenne for collecting hydrologic data. All sites will be equipped with a flood-alert system operated by the National Weather Service. Hydrologic data will be collected for 4 to 5 years.

PROGRESS AND SIGNIFICANT RESULTS: Precipitation for the first 6 months of water year 1990 was 140 percent of normal. Snowfall for March exceeded a previous record resulting in record snowmelt runoff at Crow Creek below North Fork near Silver Crown. Although precipitation was above normal for May, June, and July, flooding was minor. Numerous discharges were measured and preliminary rating curves were developed for Crow Creek and for Henderson Drain. No additional work was done on the Childs Draw flood study because funding was not received until September 1990.

PLANS FOR FISCAL YEAR 1991: Backwater computations for Dry Creek and Dry Creek tributary will be completed, and rating curves and tables will be developed. Levels will be run at all streamflow-gaging stations in the urban network. Flood-profile computations will be completed for Childs Draw between Ridge Road and Yellowstone Highway. The Childs Draw flood study has been expanded to include the reach between Ridge Road and Braehill Road, between Yellowstone Highway and Interstate-25, and a major tributary extending from Four-Mile Road to Interstate-25. The added reaches will be surveyed in spring 1991.

PROJECT TITLE: Streamflow and channel characteristics of the Bear River at Evanston, Wyoming (WY 88-105)



FUNDING AGENCY: Wyoming Parks and Recreation Commission, Uinta County, City of Evanston, and USGS

PROJECT LEADER: Mark E. Smith

FIELD LOCATION: Southwestern Wyoming

PERIOD OF PROJECT: January 1987 through September 1991

PROBLEM: Channel alterations caused by high flows of 1983 and 1984, by landowners constricting and straightening the channel to increase property area, and by the City of Evanston adding riprap and dikes to control bank erosion and flooding have resulted in channel instability. The channel instability has caused degradation that has lowered the channel through the town as much as 3 feet. Bank erosion has caused water-quality problems, the loss of fish habitat, increased flooding in some areas, and the destruction of streamside property in other areas.

OBJECTIVE: Provide background hydrologic and hydraulic information to be used as an aid to a comprehensive plan for the correction of channel problems and the rebeautification of the Bear River at and near Evanston.

APPROACH: Aerial photos will be used to document changes in channel and sinuosity. An advisory committee of hydrologists, engineers, fishery biologists, and planners will review background data and make recommendations for corrective actions, and possible funding. The USGS will combine a geomorphic analysis of the river, in which maps and aerial photographs are used to identify a stable channel pattern, with a hydraulic analysis of flow using a river computer model.

PROGRESS AND SIGNIFICANT RESULTS: Data collection was completed in November 1989 when low-flow water-quality samples were collected. Computer-model calibration was completed for the present channel, and bankfull discharge was identified for a reconstructed channel slope with cross-sectional hydraulics. The model was used to evaluate the haybale stabilization structure. The historic channel pattern of the early 1900s was simulated with the model and compared with the present-day channel. Hydraulic calculations for flow over the proposed diversion structure were completed for the 100-year flood. Report preparation was begun near the end of the year.

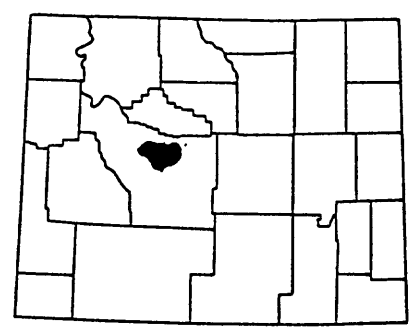
PLANS FOR FISCAL YEAR 1991: The project report will be completed and reviewed. Hydraulic and geomorphic analyses, along with all onsite data, will be compiled and included in the report.

PROJECT TITLE: Field screening study of water quality, bottom sediments, and biota of the Riverton Irrigation Project, Fremont County, Wyoming (WY 88-106)

FUNDING AGENCY: Office of the Secretary of the Interior

PROJECT LEADER: David A. Peterson

FIELD LOCATION: Central Wyoming



PERIOD OF PROJECT: October 1987 through September 1991

PROBLEM: The U.S. Department of the Interior Irrigation Drainage Program selected 19 areas in the Western United States where irrigation drainage may have negative effects on wildlife, such as the deformed birds observed at Kesterson National Wildlife Refuge in California. Nine areas were studied during 1986-87; the Riverton Project is one of 10 areas to be studied during 1989-90.

OBJECTIVE: Determine whether irrigation drainage has caused or has the potential to cause harmful effects on human health or on fish and wildlife, or to affect other beneficial uses of the water.

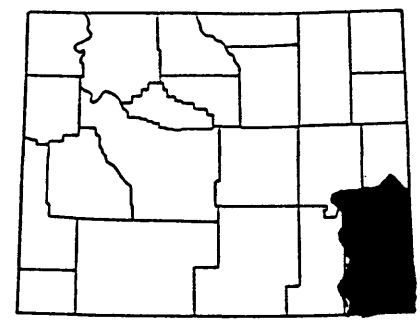
APPROACH: Sampling sites for surface water and bottom sediment will be selected at the upstream and downstream edges of the project area, as well as within. Streams and canals to be sampled include Muddy Creek, Fivemile Creek, and Wyoming Canal. Ocean Lake and other State wildfowl management areas also will be sampled. Water analyses will include trace elements and pesticides; bottom sediments will be analyzed for major and minor elements; and biota from several trophic levels will be analyzed for trace elements and organochlorine pesticides.

PROGRESS AND SIGNIFICANT RESULTS: The project report, co-authored by USGS (lead), U.S. Fish and Wildlife Service, and U.S. Bureau of Reclamation, titled "Reconnaissance investigation of water quality, bottom sediment, and biota associated with irrigation drainage in the Riverton Reclamation Project, Wyoming, 1988-89," was approved for publication as Water-Resources Investigations Report 90-4187. Project is completed.

REPORTS COMPLETED DURING FISCAL YEAR 1991:

Peterson, D.A., and others, 1991, Reconnaissance investigation of water quality, bottom sediment, and biota associated with irrigation drainage in the Riverton Reclamation Project, Wyoming, 1988-89: U.S. Geological Survey Water-Resources Investigations Report 90-4187, 84 p.

PROJECT TITLE: Description and analysis of water-level changes in the High Plains aquifer, Wyoming (WY 88-107)



FUNDING AGENCY: Wyoming State Engineer and USGS

PROJECT LEADER: Kirk A. Miller

FIELD LOCATION: Southeastern Wyoming

PERIOD OF PROJECT: April 1990 through September 1992

PROBLEM: In response to concerns over the status of conditions in the High Plains (Ogallala) aquifer, Congress has directed the USGS to monitor water levels in the aquifer and to report the results annually to them.

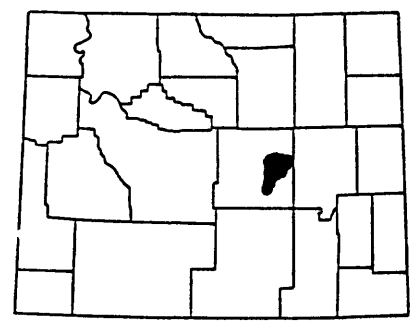
OBJECTIVE: The directive from Congress will be met by preparing an annual report with information concerning (1) changes in water levels or storage, (2) changes in water quality with time, (3) factors such as climatic and land-use conditions that affect the aquifer, and (4) results of an analysis of the relations between causative factors and changes in the aquifer.

APPROACH: Data on ground-water levels will be collected, and new observation wells will be installed where necessary. Data that have been collected by State agencies will be compiled and reviewed. All data will be analyzed and presented in annual reports.

PROGRESS AND SIGNIFICANT RESULTS: Initial results indicate supplemental water-level data are needed. Areas outside local observation-well networks have few data points. Data-deficient areas were delineated. Well data base searches were initiated. Eleven wells were located for measurement once each water year to supplement existing observation-well data. The supplemental wells were photographed, and water levels were measured. Water-level data for existing observation wells were obtained by the High Plains regional coordinator through the USGS Automated Data Processing System. Well header-file information was provided as requested.

PLANS FOR FISCAL YEAR 1991: Slug tests will be performed on the supplemental wells to determine if adequate communication between each well and the aquifer exists. Well files will be entered and updated in the existing Ground Water Site Inventory data base for the supplemental wells in the study. Annual water levels will be measured and transmitted to the regional coordinator.

PROJECT TITLE: Detailed study and assessment of irrigation drainage in the Kendrick Reclamation Project area, Wyoming (WY 88-111)



FUNDING AGENCY: Office of the Secretary of the Interior

PROJECT LEADER: Randolph B. See

FIELD LOCATION: Central Wyoming

PERIOD OF PROJECT: October 1987 through September 1991

PROBLEM: Samples taken on or near the Kendrick Project have shown elevated concentrations of selenium in water, bottom sediments, and biota. The studies to date have been at a reconnaissance level, and, with the data currently available, an evaluation of whether the elevated concentrations are localized or widespread requires additional information. In addition, the geochemical and biological processes controlling the mobility and availability of selenium and associated trace elements are not understood at the Kendrick Project. An understanding of these processes is needed to evaluate the magnitude of potential toxicity problems and to provide data for any mitigative measures that may be needed.

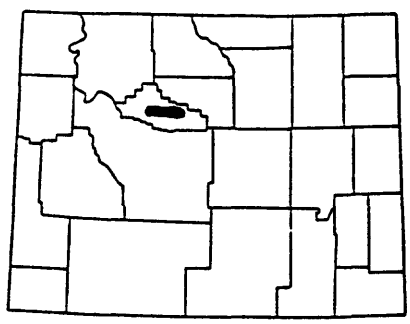
OBJECTIVE: To determine the extent, magnitude, and effects of contaminants associated with irrigation drainage, and, where effects are documented, the sources and exposure pathways that cause contamination.

APPROACH: An interagency study team has been formed. Work elements include: (1) sampling tributaries; (2) locating and sampling domestic and livestock wells; (3) determining bird nesting success, species composition, and frequency of use; (4) determining contaminant levels in rainbow trout and waterfowl; (5) determining relations between trace-element concentrations in Kendrick waterfowl and fish to those in water, sediment, and diet organisms; (6) determining which irrigated areas are contributing the largest concentrations of selenium; (7) determining the physical and geochemical process controlling selenium mobility; and (8) determining the geologic sources of selenium and associated trace elements.

PROGRESS AND SIGNIFICANT RESULTS: Sampling for selenium in surface and ground water and in birds and fish was completed. Laboratory analysis of all samples was completed, and the results analyzed. A Water-Resources Investigation Report and two journal articles were completed and submitted for colleague review.

PLANS FOR FISCAL YEAR 1991: Each of the three reports in review will be revised after review and submitted for Director's approval. An open-file report will be prepared that lists data for the water and biota samples.

PROJECT TITLE: Quality of surface water and ground water in the Owl Creek basin, Wind River Indian Reservation, Wyoming (WY 88-114)



FUNDING AGENCY: Northern Arapaho Tribe and USGS

PROJECT LEADER: Kathy Muller Ogle

FIELD LOCATION: Central Wyoming

PERIOD OF PROJECT: July 1989 through September 1991

PROBLEM: Large concentrations of dissolved solids limit the use of water in much of the Owl Creek basin. Surface water is used for irrigation, but has a large to very large salinity hazard to crops. Water from the alluvial aquifer generally is unsuitable for most purposes other than stock watering. Water for domestic supply must be hauled to ranches in the area at a substantial cost to the Arapaho Tribe.

OBJECTIVE: To assess the suitability of surface- and ground-water resources in the Owl Creek basin as potential drinking-water sources.

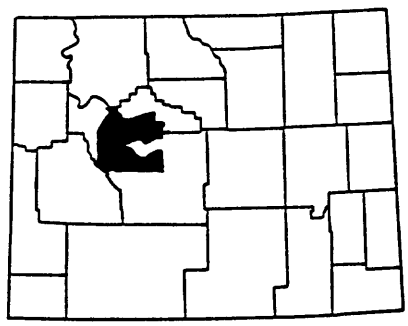
APPROACH: (1) Previously collected data for the Owl Creek basin will be compiled and evaluated; this will include USGS data and data from other sources; (2) where needed, additional surface-water and ground-water data

will be collected; (3) the data will be compared to the U.S. Environmental Protection Agency drinking-water regulations for major ions and dissolved-solids concentration.

PROGRESS AND SIGNIFICANT RESULTS: All data gathering and analysis were completed. A draft report was written. The report received editorial, colleague, and reports specialist reviews. A presentation was made at the Wyoming Section, American Water Resources Association annual conference on part of the findings. Project is complete except for the report.

PLANS FOR FISCAL YEAR 1991: The report will be submitted for Director's approval to publish.

PROJECT TITLE: Hydrologic appraisal of the Wind River Indian Reservation, Wyoming (WY 88-115)



FUNDING AGENCY: Northern Arapaho Tribe, Shoshone Tribe, and USGS

PROJECT LEADER: Richard L. Daddow

FIELD LOCATION: Central Wyoming

PERIOD OF PROJECT: July 1990 through September 1992

PROBLEM: A comprehensive appraisal of the ground-water resources of the area was undertaken 20 years ago. No comprehensive appraisal of the surface-water resources has been published, although substantial amounts of data have been gathered. An understanding of the quantity and quality of the water resources of the reservation is necessary before the water resources can be used fully.

OBJECTIVE: (1) Appraise the water resources of the Wind River Indian Reservation; and (2) write a comprehensive report to be used by water-resources managers.

APPROACH: (1) Compile data; (2) do preliminary data analysis to identify areas where more data are needed; (3) develop and implement data-collection plan; and (4) do final data analysis and prepare report.

PROGRESS AND SIGNIFICANT RESULTS: A detailed literature review of the water resources of the project area was completed. All the non-USGS data records for 510 well and 240 spring sites were entered into the alternative, project-base ground-water site inventory (GWSI) data base and verified for data accuracy. All the non-USGS water-quality data (250 records) were entered into the alternative water-quality (QWDATA) data base. All the project-area well and spring data records in the Wyoming GWSI data base were checked for accuracy based on original well-schedule records, and 1,500 site records were updated or corrected. Historic USGS water-quality analyses for 100 well sites were entered into the Wyoming QWDATA data base. Detailed summary tables of all the USGS flow and water-quality data for gaging stations (117 sites) and miscellaneous surface-water sites (42 sites) were compiled and prepared for the project area using a drainage-basin approach.

A complete quality-assurance review of all water-quality chemical data records was conducted using a computer program developed by the project chief. Onsite parameters were measured and water-quality samples were collected from 75 selected surface-water, spring, and well sites. A project-review meeting was held with tribal and U.S. Bureau of Indian Affairs representatives. The annotated outline of the planned report was modified and updated. It was decided also to prepare an open-file report of hydrologic data for all wells and springs in the project area. Detailed analysis of all the compiled ground-water and surface-water data was started.

PLANS FOR FISCAL YEAR 1991: Data inventory and statistical analysis will be completed and summarized for the hydrogeologic and water-quality characteristics of selected aquifer systems and flow and water-quality characteristics of selected stream sites. A water table map representative of the shallow ground water in the Wind River Formation and the Quaternary deposits in the Wind River basin will be produced. The planned interpretive and hydrologic-data reports will be prepared, written, and completed by March 31, 1992.

PROJECT TITLE: Water quality of the Powder River, Wyoming and Montana (WY 88-116 and MT 88-121)

FUNDING AGENCY: Wyoming State Engineer, Wyoming Water Development Commission, Montana Department of Natural Resources and Conservation, and USGS

PROJECT LEADER: J.B. Lindner-Lunsford (Wyoming)
Charles Parrett (Montana)

FIELD LOCATION: Northeastern Wyoming and Southeastern Montana

PERIOD OF PROJECT: July 1990 through September 1991

PROBLEM: Water from the Powder River and its tributaries is used for irrigation, industry, and domestic and livestock supply. Water in the downstream reach of the river always has been of marginal quality for irrigation. Dissolved-solids concentrations tend to increase during low flow, particularly during the summer irrigation season, and decrease during high flow, such as spring runoff. Additional knowledge and understanding of the water-quality characteristics of the river system is needed before managers can evaluate potential changes in quality resulting from hydrologic changes.

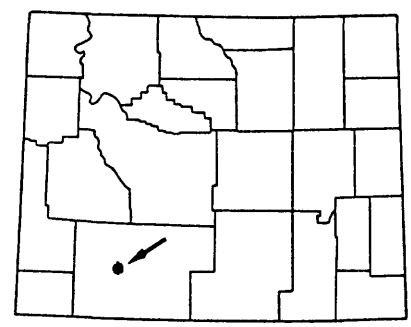
OBJECTIVE: (1) Compile and expand available water-quality data for the basin; (2) determine water-quality characteristics of the Powder River and its major tributaries; (3) develop a conceptual model of the river system; and (4) develop a computer-based mass-balance accounting model for the river system.

APPROACH: (1) Compile streamflow and water-quality data, measure mean-daily specific conductance in the Powder River at Sussex, Wyoming, sample 13 sites on a near-monthly basis for 18 months, analyze samples for common ions and field parameters; (2) conduct synoptic flow and water-quality measurements on mainstem and significant tributaries, determine land use and water use, evaluate data for trends; (3) develop a conceptual model; and (4) develop mass-balance model to check conceptual model and to provide managers a tool for future resource evaluation. This work will be done concurrently in Wyoming and Montana by the Wyoming and Montana Districts, USGS, and will be coordinated closely. Reports of the results of the investigations will cover the entire drainage basin of the Powder River.

PROGRESS AND SIGNIFICANT RESULTS: Water-quality sampling at supplemental sites was completed in December 1989. Mass-balance and other statistical analyses of stream discharge and major dissolved constituents in the Powder River were completed. The monthly mass-accounting model was calibrated and verified for both discharge and dissolved-solids concentrations. Potential applications of the model were demonstrated by using the model to predict impacts of several water-management strategies. The project report, co-authored by Wyoming and Montana District personnel, was completed and submitted for editorial review at year's end. Also, a separate report on statistical analyses of trends in water-quality characteristics at selected long-term stations in Wyoming and Montana was completed by the Montana District and was approved by the Director, USGS, for publication as USGS Water-Resources Investigations Report 91-4029.

PLANS FOR FISCAL YEAR 1991: The project report will be given colleague review, revised, and submitted for Director's approval to publish.

PROJECT TITLE: Effects of in-situ oil-shale retorting on water quality near Rock Springs, Wyoming (WY 88-118)



FUNDING AGENCY: U.S. Department of Energy

PROJECT LEADER: J.B. Lindner-Lunsford and Kathy Muller Ogle

FIELD LOCATION: Southwestern Wyoming

PERIOD OF PROJECT: July 1990 through September 1991

PROBLEM: A variety of experimental in-situ oil-shale retorting techniques was used from 1969-79 at the U.S. Department of Energy sites near Rock Springs, in southwestern Wyoming. Water of poor quality was produced during the experiments. There is concern that the plume of contaminated water might have migrated from the experiment site to a nearby creek, which ultimately discharges into the Green River and Flaming Gorge Reservoir. The geologic structure is such that there is potential for migration of contaminants from the oil-shale aquifer into the underlying aquifer (which can be used for domestic supply); it is unclear whether the two formations are hydraulically connected.

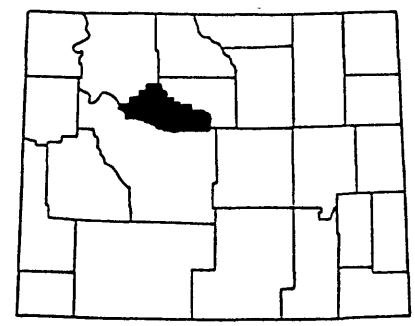
OBJECTIVE: To determine the current nature and extent of the contamination at all sites in the study area, and to investigate the movement and fate of the contaminants in the hydrologic system.

APPROACH: Twelve to fifteen monitoring wells will be drilled and logged. Wells will be constructed and sampled according to National Water Quality Assessment field procedures for ground water. The wells will have screens 10 to 15 feet in length and will be screened at different depths in the formation to enable definition of the plume in three dimensions and estimation of vertical leakage between layers. Head space will be analyzed onsite using a portable gas chromatograph, and wells will be sampled for a wide range of organic and inorganic constituents.

PROGRESS AND SIGNIFICANT RESULTS: The project report was completed and submitted for publication by the U.S. Department of Energy. The project has been extended into fiscal year 1991 for additional work requested by the U.S. Department of Energy.

PLANS FOR FISCAL YEAR 1991: The project report has received Director's approval and has been submitted for publishing by the U.S. Department of Energy.

PROJECT TITLE: Water resources of Hot Springs County, Wyoming (WY 89-119)



FUNDING AGENCY: Wyoming State Engineer and USGS

PROJECT LEADER: Maria Plafcan

FIELD LOCATION: North-central Wyoming

PERIOD OF PROJECT: October 1988 through September 1991

PROBLEM: Ground water of poor chemical quality has long been a problem for residents in the county. Demand for water suitable for domestic and municipal supply has increased as previous supplies have become unsatisfactory because of yield or water quality. Water quality and the potential yield of aquifers currently not used need to be investigated to aid county planners.

OBJECTIVE: To describe the geohydrologic conditions in the county; to determine the general occurrence and chemical quality of ground water, and to describe areas of potential contamination and the availability of ground water.

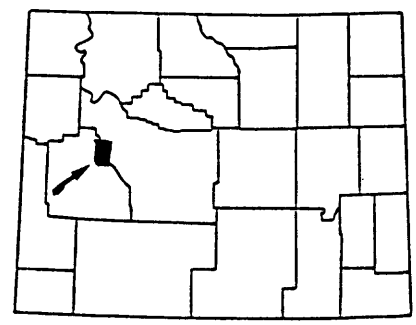
APPROACH: Representative wells and springs will be inventoried and specific conductance of ground water and base flow will be measured. Samples of ground water will be collected for dissolved constituents. Some ground-water samples will be analyzed to determine if specific contaminants are in the water. Low-flow gains and losses along selected reaches of the Wind

River, Bighorn River, and tributaries will be measured at specific geologic formations to estimate recharge and discharge. Observation wells will be established and monitored for water-level changes.

PROGRESS AND SIGNIFICANT RESULTS: The inventory of representative wells and springs was completed. Forty-eight sites were inventoried (10 springs and 38 wells). Water-quality samples were collected at 32 sites and were analyzed for selenium, boron, and inorganics or trace elements (depending on geologic unit), in addition to major ions. The largest dissolved-solids concentration (nearly 8,000 milligrams per liter) was from the Cody Shale. A base-flow study was conducted on Grass Creek. Discharge and water-quality samples were collected at 13 sites. The lowest specific-conductance values were at the headwaters (200-300 microsiemens per centimeter).

PLANS FOR FISCAL YEAR 1991: Water-quality analyses will be interpreted by geologic units. Water-quality samples collected in fiscal years 1989 and 1990 and wells and springs inventoried in fiscal years 1989 and 1990 will be included in the project report. Precipitation in relation to water-level changes in shallow wells will be considered to estimate annual recharge. Base-flow results will be evaluated to determine the ground water and surface water relations along Grass Creek and water-quality changes. The project report will be completed and submitted for approval.

PROJECT TITLE: Determination of long-term atmospheric deposition quality and climatic changes in the Western United States using continuous ice cores, Wind River Range, Wyoming (WY 90-120)



FUNDING AGENCY: Wyoming Water Development Commission, Northern Arapaho Tribe, Shoshone Tribe, and USGS

PROJECT LEADER: David L. Naftz

FIELD LOCATION: Northwestern Wyoming

PERIOD OF PROJECT: February 1990 through September 1992

PROBLEM: There are many indications that climate is changing as a result of increasing concentrations of carbon dioxide and other trace gases in the atmosphere. The magnitude and rate of change are subject to question because of a lack of data. Long-term records of the chemical quality of atmospheric deposition and climate data are needed to make decisions regarding the effects of anthropogenic inputs to the atmosphere and climate-change issues. A long-term record of atmospheric deposition appears likely to be preserved as glacial ice layers in the Wind River Range of Wyoming.

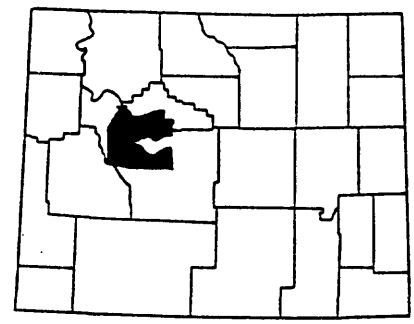
OBJECTIVE: To use variations in concentrations of chemical and isotopic constituents from ice and tree-ring samples to reconstruct long-term records of the chemical quality of atmospheric deposition, as well as long-term climatic and discharge records.

APPROACH: Continuous ice cores will be obtained from the surface to bedrock from selected glaciers in the Wind River Range. The samples will be dated using a combination of chemical and stratigraphic techniques. Major, minor, and trace chemical constituents will be determined in detailed subsamples of the core. Correlations between selected chemical constituents in the ice will be used to extend the period of record at the National Atmospheric Deposition Program site near Pinedale. Stable isotopes will be used to investigate long-term climate records in the ice. If possible, attempts will be made to use ice-core properties to extend the discharge records at established gaging stations back in time using time-series analysis.

PROGRESS AND SIGNIFICANT RESULTS: Upper Fremont Glacier in the Wind River Range of Wyoming was selected as the project study site based on reconnaissance-phase results from Knife Point Glacier (1988) and initial findings from Gannett Glacier (1989). Data collection on Upper Fremont Glacier was initiated in April 1990 with the excavation of three snow pits. Samples collected at these sites are being analyzed to determine major-ion concentrations, oxygen-18/oxygen-16 ratios, tritium levels, and particle counts, as well as pH and specific conductance. Snow stratigraphy and density and temperature profiles were noted in each pit. Also, probings along lateral and longitudinal traverses of the glacier were made to determine snow-pack depth. The above sampling protocol was repeated in July 1990 so that chemical and physical changes in the snowpack could be documented. Tree cores were taken near timberline in the North Fork Bull Lake Creek drainage. Radioecho soundings of the glacier were completed and these data are in the process of being reduced and compiled. Ablation and velocity stakes were installed so the dynamics of the glacier might be better understood. Surveys of these points, as well as the sounding locations, were conducted from benchmarks established in July 1990. Benchmark "ICE-1" was located by a survey technique using satellites. An additional survey of the ablation and velocity stakes was made in September 1990. Ice-temperature thermistors were installed at depth at two sites. An automated meteorological station was installed in July 1990 and serviced in August 1990. Site-specific temperature, relative humidity, solar radiation, and wind direction and speed are being recorded hourly. Discharge measurements were made on North Fork Bull Lake Creek above Little Milky Lake in July 1990 and again in August 1990. Digital topographic coverage of the glacier and the vicinity has been generated.

PLANS FOR FISCAL YEAR 1991: Reduction and compilation of the chemical data will begin. Digital coverages of the surveys and other data will be completed and integrated to begin interpreting the dynamics of the glacier. Attempts to retrieve ice cores from depths greater that 15 meters below the glacier surface will be made. Chemical analyses of the ice will be initiated using the protocol already outlined. Monitoring of the chemical and physical properties of the snowpack will continue. Additional surveys of the ablation and velocity stakes will be completed. Operation of the meteorological station will continue, and data from the station will be reduced and compiled for analysis of the local weather environment. Additional discharge will be measured on North Fork Bull Lake Creek.

PROJECT TITLE: Quantification of seepage and sedimentation in selected irrigation canals on the Wind River Indian Reservation, Wyoming (WY 90-121)



FUNDING AGENCY: Northern Arapaho and Shoshone Tribes and USGS

PROJECT LEADER: Kirk A. Miller

FIELD LOCATION: Fremont County, Wyoming

PERIOD OF PROJECT: March 1990 through September 1992

PROBLEM: Irrigation on the Wind River Indian Reservation occurs mostly on lands within the Wind River Indian Federal Irrigation Project (WRFIP) area. A major water management concern to the Shoshone and Arapaho Tribes, U.S. Bureau of Indian Affairs (BIA) and other water users in the Wind River basin is the seepage losses from the main canals. Reducing seepage losses would provide additional water for the irrigated lands, future expansion of irrigated lands, and for the downstream users. Sedimentation of the canals is another major water management problem. The accumulation of sediment reduces the conveyance capacity and efficiency of the canal and requires costly dredging operations.

OBJECTIVE: (1) To determine the magnitude and time distribution of seepage in selected canal reaches that have been identified as problem areas or are in representative surficial deposits within the WRFIP area; and (2) to determine the transverse distribution of the fluvial-sediment load in the reach upstream from selected diversion structures and the percentage of the sediment load entering canals.

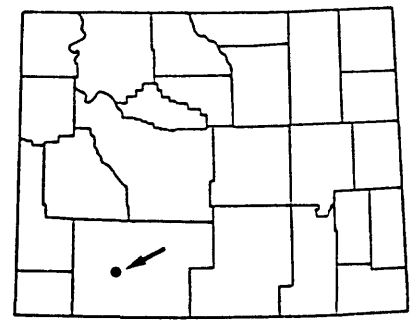
APPROACH: Four canal reaches identified as either known seepage problem areas or on representative surficial deposits or both will be selected. Various stream diversion structures will be investigated, and three sediment study sites will be selected. Pre-irrigation site conditions including canal dimensions and surficial-material properties will be established for each canal reach. Three inflow-outflow seepage runs will be conducted on each canal reach during the irrigation season. Adjacent ground-water levels will be monitored. Three suspended-sediment and bedload samples will be taken from streams just above selected diversion structures and in canals near the same diversion point.

PROGRESS AND SIGNIFICANT RESULTS: Study reaches were selected for the seepage element of the investigation. Continuous-stage recorders were installed at both ends of the reaches to document steady-flow conditions. Discharge measurements were made at both ends and at intermediate points where necessary. Three sets of discharge measurements were made for two study reaches on Ray Canal. Two sets of discharge measurements were made for the study reaches on Dinwoody and Dry Creek Canals. Study sites were selected for the sediment element of the investigation. Suspended-sediment and bedload samples were collected in the river or creek directly upstream of the diversion. Transverse distribution of the sediment load will be determined in the river or creek. Suspended-sediment and bedload samples

were collected in the canal. Three sets of sediment samples were collected at the Wind River and Johnstown Canal study site. Two sets of sediment samples were collected at the Dry Creek and Dry Creek Canal study site. One set of sediment samples was collected at the Little Wind River and Subagency Canal study site.

PLANS FOR FISCAL YEAR 1991: One additional set of discharge measurements will be made on the Dinwoody Canal (recorder failure, early August) and the Dry Creek Canal (unsteady flows, late May) study reaches. Physical properties of soil samples from the study reaches will be investigated. One set of sediment samples from the Dry Creek and Dry Creek Canal site will be collected. Two sets of sediment samples will be collected at the Little Wind River and Subagency Canal site (sediment deposition in Subagency Canal might occur in "pulses" associated with gate changes at the headworks early in the season). Sediment samples will be processed. A report summarizing the study and data compilation will be ready for colleague review by July 1991. The published report will be completed by March 1992.

PROJECT TITLE: Hydrologic characteristics in fractured-rock aquifer, Rock Springs, Wyoming (WY 90-122)



FUNDING AGENCY: USGS

PROJECT LEADER: Kathy Muller Ogle

FIELD LOCATION: Rock Springs, Wyoming

PERIOD OF PROJECT: March 1990 through September 1991

PROBLEM: A 1976 in-situ oil-shale retorting experiment produced 150 distinct organic and inorganic contaminants at a site near Rock Springs in southwestern Wyoming, according to previous studies by the U.S. Department of Energy and USGS. The site provides an opportunity to study ground-water movement in a fractured shale aquifer and the transport and fate of contaminants. Funding to study these processes has been applied for through the toxic waste ground-water contamination program. The first phase of the study (this project) will be to define the ground-water flow system.

OBJECTIVE: (1) Determine whether the flow system is static or dynamic; (2) determine major mechanism affecting flow and transport at the site; and (3) plan future studies concerning contaminant transport.

APPROACH: Continue monitoring water levels in all wells (fluctuations in water table would be a good indicator of a dynamic flow system). Continue quantitative analysis of existing data to assess the role of the sandstone layer in contaminant transport, and analyze data on distribution of contaminants during 1989 to determine contaminant transport in the aquifer.

PROGRESS AND SIGNIFICANT RESULTS: The White Mountain in-situ oil-shale site near Rock Springs was evaluated to determine suitability as a site for additional research on toxic contaminants in a fractured-flow aquifer. Data from previous studies at the site were compiled, and 117 new water-level measurements were made. Analysis of the data indicated that (1) there is evidence of fractures at the site, (2) there is evidence of fracture flow, (3) the system is dynamic, and (4) the data are too limited to define the hydrologic function of the 8-foot sandstone layer. A summary of the findings was prepared and sent to the coordinator of the USGS Toxics Research Program.

PLANS FOR FISCAL YEAR 1991: A short report on the findings will be prepared, as well as a brief paper for a meeting in 1991 on USGS toxics research. All research has stopped because of loss of funding.

PROJECT TITLE: Assessment of the current collection of basic records sediment data base (WY 90-123)

FUNDING AGENCY: USGS

PROJECT LEADER: James G. Rankl

FIELD LOCATION: Topical research

PERIOD OF PROJECT: February 1990 through September 1992

PROBLEM: The USGS is reviewing sediment data collection and processing to determine program strengths and weaknesses. Emphasis is being placed on evaluation of the existing sediment data base and how sampling procedures can be modified to provide better sediment information for determining frequency distributions of loads and concentrations by size.

OBJECTIVE: To conduct a thorough assessment of Collection of Basic Records (CBR) daily sediment data sets focusing on: (1) the suitability of the data, by particle-size ranges, to be described by transport curves or other models; (2) the range of flow conditions sampled; frequency distribution of mean-daily concentrations and daily, monthly, and annual loads; and frequency distribution of daily concentrations for each month; (3) the representativeness of climate and runoff conditions during the period of record, and the detection of trends in transport rates during the period of record; and (4) the quality of the record, including the adequacy of sampled concentrations.

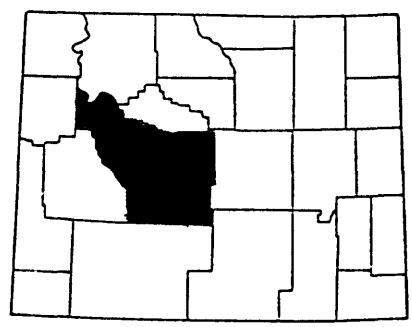
APPROACH: (1) Review literature concerning sediment-related studies on data collected at the CBR sediment stations and sediment stations in Canada; (2) working with the USGS Branch of Systems Analysis, develop methods for evaluating sediment records for daily sediment stations; (3) test these methods on 2 of the 12 daily CBR sediment stations; (4) based on results of

the tests at these two stations, develop a detailed work plan for evaluating all the daily CBR sediment stations; and (5) present the work plan and results to the Sediment Action Committee, Office of Surface Water, and Office of the Assistant Chief Hydrologist for Operations.

PROGRESS AND SIGNIFICANT RESULTS: The approach used in the study was to determine how much reduction in uncertainty can be obtained from a given number of suspended-sediment measurements. The uncertainty in the estimates of the transport is the mean square error of the difference between the estimated suspended-sediment load and the true suspended-sediment load. The estimated load was computed from a model of the discharge rating curve developed from the engineer samples, and the true load was taken as the load determined from daily samples collected by the observers, type curves, and the hydrographer's judgment in drawing the daily-concentration curve. Several models, based on the logarithmic transforms of sediment and water discharge, were tested to determine which model had the minimum error in estimating the observer samples. Ten years of sediment and discharge data for the Yadkin River at Yadkin College, North Carolina and the Pecos River near Artesia, New Mexico were used in the analysis. The residuals for each station were analyzed as a time series to estimate lag-one-day autocorrelation coefficient, the process variance, and the measurement variance. These three parameters were used in a lognormal regression model to obtain the standard error of estimate of the total transport as a function of the number of measurements made at the site per year. Uncertainty curves were generated for both stations. Based on the uncertainty curves, there are now some measures of how much uncertainty there would be at the two stations for different sampling frequencies. Basically, daily sampling achieved a 10-percent reduction in the root mean square error, compared with monthly sampling for the two stations.

PLANS FOR FISCAL YEAR 1991: Work discontinued because of loss of funding.

PROJECT TITLE: Water resources of Fremont County, Wyoming (WY 90-124)



FUNDING AGENCY: Wyoming State Engineer and USGS

PROJECT LEADER: Maria Plafcan

FIELD LOCATION: Central Wyoming

PERIOD OF PROJECT: March 1990 through September 1993

PROBLEM: Ground water of poor chemical quality has long been a problem for residents in Fremont County. Demand for water suitable for domestic and municipal supply has increased as previous supplies have become unsatisfactory because of yield or water quality. Water quality and the potential yield of aquifers currently not used need to be investigated to aid county planners.

OBJECTIVE: (1) To describe the geohydrologic conditions in the county; (2) to determine the general occurrence and chemical quality of ground water; and (3) to describe the availability of ground water and areas of potential contamination.

APPROACH: Representative wells and springs will be inventoried and specific conductance of ground water and base flow will be measured. Samples of ground water will be collected and analyzed for dissolved constituents. Some ground-water samples will be analyzed to determine if specific contaminants are in the water. Low-flow gains and losses along selected reaches of the Wind River and tributaries will be measured at specific geologic formations to estimate recharge and discharge. Based on the study, observation wells will be suggested for potential long-term monitoring.

PROGRESS AND SIGNIFICANT RESULTS: All ground-water and water-quality information in the data base was checked against the well schedules and plotted on 7.5-minute maps. This information was used for selecting sites to sample during the summer of 1990. Seventy-seven ground-water sites were visited, and data were collected for 44 new sites and 7 existing sites. Forty water samples were collected for analysis of common cations and anions. Discharges were measured at a number of springs. All data were entered into the data base. Preliminary data from U.S. Bureau of Land Management have been gathered to enhance site choices for summer 1991 onsite work. Current work includes digitizing a base map of the county for the project report to develop plots to aid in the analysis of water-quality and geologic variables. Previously collected data also are being used to facilitate writing the geology, climate, hydrologic-characteristics, and land-use sections of the report. Data are being compiled and entered into a data base from a 1959 publication on ground-water resources of the Riverton Irrigation Project Area and will be analyzed statistically to provide a perspective in selecting 1991 summer sampling sites on Irrigation Project land, as well as to develop quality-assurance procedures for existing data.

PLANS FOR FISCAL YEAR 1991: Work to be completed includes ground-water and water-quality data collection and analyses for standard cations and anions, selected pesticides, and metals. Low-flow data also may be collected. For site selection, other Federal and State agencies will be contacted concerning their samplings and findings. Selected sections of the project report, as well as initial water-quality tables, also will be completed in the fiscal year.

PROJECT TITLE: Preparation of U.S. Department of the Interior environmental impact statement on operation of Glen Canyon Dam, Arizona (WY 91-125)

FUNDING AGENCY: USGS

PROJECT LEADER: James F. Wilson, Jr.

FIELD LOCATION: Administrative

PERIOD OF PROJECT: February 1991 through June 1993

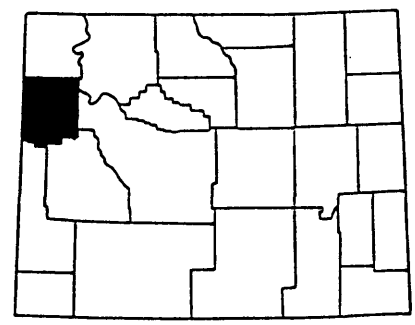
PROBLEM: The Secretary of the Interior has directed that an Environmental Impact Statement (EIS) be prepared on the effects of operation of Glen Canyon Dam on the aquatic and riparian resources of the Colorado River downstream in Glen Canyon and Grand Canyon National Park. Sediment transported and deposited in the river is the foundation for biological and recreational resources, such as fish habitat, whitewater rapids, and camping beaches. The dam traps about 80 percent of the annual sediment load that formerly entered the canyon; there is concern about the long-term net loss of sediment. Patterns of water releases from the dam for power generation exacerbate the problem. Concurrently with preparation of the EIS, extensive research is being done; the USGS is involved in hydrologic and hydraulic studies that will provide useful information for the EIS.

OBJECTIVE: To serve as the USGS representative on the interagency EIS Team, led by the U.S. Bureau of Reclamation, including preparation of sections of the EIS having to do with sediment-related topics.

APPROACH: Principal activities will include: (1) familiarization with past and ongoing USGS sediment-related research in the Colorado River in the Grand Canyon and adjacent areas; (2) liaison between the EIS team and the scientists of the Water Resources Division (WRD) National Research Program and Arizona District; (3) participation in all EIS team functions, including public hearings; (4) preparation of the fluvial-sediment sections of the draft and final EIS.

PLANS FOR FISCAL YEAR 1991: First-year activities will include: (1) contacts with USGS hydrologists to become familiar with current related research; (2) gathering and studying scientific literature; (3) attending EIS Team meetings; (4) attending public hearings on the proposed operational alternatives to be assessed; and (5) preparation of preliminary rough drafts of the sediment sections of the EIS.

PROJECT TITLE: Characterization of water resources in Teton County, Wyoming (WY 91-126)



FUNDING AGENCY: Northern Arapaho Tribe, Shoshone Tribe, and USGS

PROJECT LEADER: Bernard T. Nolan

FIELD LOCATION: Northwestern Wyoming

PERIOD OF PROJECT: March 1991 through December 1994

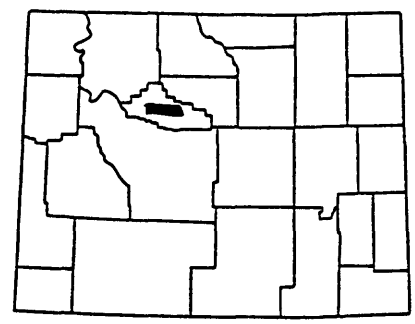
PROBLEM: Collection and interpretation of ground- and surface-water data are necessary to characterize thoroughly the water resources of Teton County. Land-use planners lack detailed information about the water resources of the county. Increased development in the Snake River basin has increased the potential for changes in water quantity and quality. Lack of understanding of land-use effects on water resources could result in unnecessary depletion or degradation of water both in developed and in pristine areas.

OBJECTIVE: (1) To determine the current condition of water resources in the county; (2) to identify land uses capable of affecting water quantity and quality in developed areas; (3) to evaluate the availability of ground and surface water and the spatial distribution of water-quality constituents; and (4) to determine future ground- and surface-water monitoring requirements.

APPROACH: The technical approach is: (1) to determine prior conditions by reviewing information in USGS data bases (year 1 of study); (2) to identify major land uses and potential effects on water quantity and quality (year 1); (3) to characterize current conditions by conducting a representative, county-wide survey (years 1-3); and (4) to determine the statistical distribution of the data with histograms and fractile analysis (years 2-3).

PLANS FOR FISCAL YEAR 1991: (1) Wells, springs, and streams will be selected for water-level and flow measurements and water-quality sampling; (2) permission will be obtained from their owners to sample wells; and (3) onsite samples will be collected.

PROJECT TITLE: Evaluation of potential causes of water-quality changes in major streams in Owl Creek basin, Wyoming (WY 91-127)



FUNDING AGENCY: Northern Arapaho Tribe and USGS

PROJECT LEADER: Kathy Muller Ogle

FIELD LOCATION: North-central Wyoming

PERIOD OF PROJECT: April 1991 through December 1993

PROBLEM: A recent investigation in the Owl Creek basin concluded that the quality of the major streams in the basin degraded significantly in the downstream direction. The watershed reflected three distinct segments, each having significantly different dissolved-solids concentration, water type, and dissolved solids to specific conductance ratio. However, the causes of these changes are unknown. Possible causes have been identified as irrigation return flows, surface geology, and ground-water inflow from various aquifers.

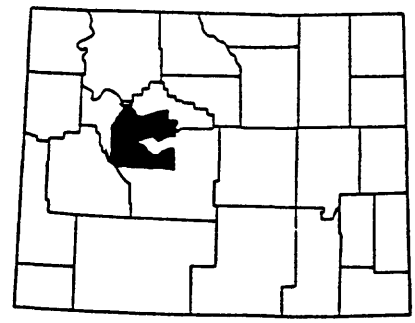
OBJECTIVE: To determine the changes in water quality and the human-induced and naturally occurring causes of changes in water quality of the major streams in the Owl Creek basin.

APPROACH: Changes in water quality and possible causes of these changes in Owl Creek basin will be examined in the two areas where water-quality changes were observed in the previous study. Onsite parameters, major ions, selected metals, and isotopes will be sampled at selected sites in those two areas. Streamflow measurements will be made concurrently. The water-

quality and streamflow data will be compared to changes in land use, surface geology, geologic structures, and data from aquifers in the area to determine the causes of the changes in water quality.

PLANS FOR FISCAL YEAR 1991: Project planning will be completed and data gathering activities will be initiated.

PROJECT TITLE: Estimates of monthly streamflow characteristics for ungaged sites, Wind River Indian Reservation, Wyoming (WY 91-128)



FUNDING AGENCY: Northern Arapaho Tribe, Shoshone Tribe, and USGS

PROJECT LEADER: James G. Rankl

FIELD LOCATION: Central Wyoming

PERIOD OF PROJECT: October 1990 through September 1993

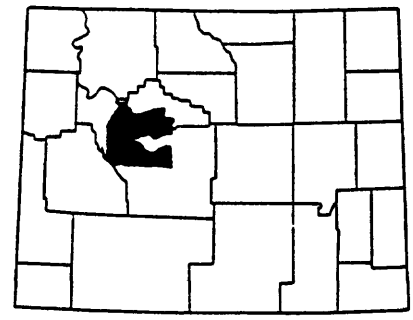
PROBLEM: Following a 12-year legal action, the U.S. Supreme Court in 1989 awarded 500,000 acre-feet per year of surface water on the Wind River and its tributaries to the Arapaho and Shoshone Indian Tribes. Planning and management of these waters make accurate data important. However, only a few of the stream sites where data are needed have streamflow-gaging stations. Questions that arise during management of surface-water allocations involve (1) the quantity of runoff that originates on the Reservation, and (2) the magnitudes of monthly and mean-annual flows in streams entering and leaving the Reservation.

OBJECTIVE: A refined technique for estimating mean monthly and annual streamflows will be developed, and streamflows at selected sites will be estimated to assist the Wind River Environmental Quality Council in the development of a streamflow management model.

APPROACH: About 20 ungaged sites will be selected for estimation of mean monthly and annual discharge along with about 10 gaged sites for control. Monthly measurements will be made for 1 year. Three methods will be investigated: (1) instantaneous discharge will be correlated to monthly mean discharge at nearby gaged sites using regression equations; (2) a set of mean monthly discharge estimates will be made from regression equations relating mean monthly discharge to physical and climatic variables; and (3) a set of mean monthly discharge estimates will be made from regression equations using channel width. The final estimate will be a weighted average of methods that are statistically significant.

PLANS FOR FISCAL YEAR 1991: The streams that will be used in the study will be selected, staff gages installed, levels run, and monthly measurements made at all sites. An annotated outline will be prepared.

PROJECT TITLE: Summary and evaluation of well and geologic data for pre-Tertiary aquifers on the Wind River Indian Reservation, Wyoming (WY 91-129)



FUNDING AGENCY: Northern Arapaho Tribe, Shoshone Tribe, and USGS

PROJECT LEADER: J.B. Lindner-Lunsford

FIELD LOCATION: Central Wyoming

PERIOD OF PROJECT: April 1991 through September 1992

PROBLEM: Information is needed to define and to evaluate new sources of ground-water supplies on the Wind River Indian Reservation for future population growth and economic development.

OBJECTIVE: (1) Provide ground-water information on total dissolved-solids concentrations, expressed as sodium chloride (NaCl) for aquifers having a potential to yield more than 500 gallons per minute to wells; and (2) provide information on well locations and depths for aquifers identified in objective (1) as having total dissolved solids (as NaCl) less than 1,000 milligrams per liter.

APPROACH: Calibrated geophysical logs for oil-and-gas wells will be the primary source of data. A straight-line correlation between resistivity and total dissolved solids (as NaCl) will be applied.

PLANS FOR FISCAL YEAR 1991: Resistivity logs for about 400 wells will be acquired, and preliminary data analysis started.

PROJECTS COMPLETED DURING FISCAL YEARS 1990 AND 1991

Project number	Project title	Project leader
WY 81-060	Ground-water hydrology of the southern Powder River Uranium District, Wyoming	Marlin E. Lowry
WY 82-072	Stream-aquifer interaction in the upper Bear River valley of Wyoming and Utah	Kent C. Glover
WY 86-098	Assessment of selenium concentrations in soils, sediments, and water; Sandstone Reservoir Project, Carbon County, Wyoming	David L. Naftz

WY 86-099	Summary and assessment of investigations for evaluating the effects of coal development on ground-water resources in the Powder River basin, northeastern Wyoming	James F. Wilson, Jr.
WY 87-102	Water resources of Washakie County, Wyoming	David D. Susong
WY 88-106	Field screening study of water quality, bottom sediments, and biota of the Riverton Irrigation Project, Fremont County, Wyoming	David A. Peterson
WY 88-110	A geographic information system for evaluating potential disturbance of bald eagles by recreational use of the Snake River in Grand Teton National Park, Wyoming	James F. Wilson, Jr.
WY 88-112	Sediment transport of streams in the Sierra Madre, Wyoming	James G. Rankl

PROJECTS COMPLETED EXCEPT FOR REPORT(S)

The following projects, with project number, title, and leader, have been completed except for approval of the final report(s). Funding for these projects ended prior to fiscal year 1990.

Project number	Project title	Project leader
WY 82-070	Upper Colorado River basin Regional Aquifer-System Analysis, Wyoming	Lawrence J. Martin and W.B. Borchert
WY 83-076	Fluvial system in energy-mineral areas of Wyoming	Hugh W. Lowham
WY 84-081	Water resources of Park County, Wyoming	Marlin E. Lowry and W.B. Borchert
WY 85-091	Geohydrology of the High Plains Aquifer, Cheyenne, Wyoming	Marvin A. Crist
WY 87-103	Water resources of Big Horn County, Wyoming	Maria Plafcan and Earl W. Cassidy
WY 88-114	Quality of surface water and ground water in the Owl Creek basin, Wind River Indian Reservation, Wyoming	Kathy Muller Ogle

WATER-RESOURCES INFORMATION

A monthly summary of the national water situation is presented in the newsletter National Water Conditions, available free upon request to the Hydrologic Information Unit, USGS, 419 National Center, Reston, VA 22092. Requests for miscellaneous water information and information about programs in other states may be referred to Water Resources Division, USGS, 440 National Center, Reston, VA 22092. Streamflow, ground-water, and water-quality data are available in several series of publications.

Hydrologic Data Prior to 1971

Records of streamflow, ground-water levels, and quality of water were published for many years as U.S. Geological Survey (USGS) Water-Supply Papers, as explained below. The Water-Supply Papers are not listed in this report; information about them can be obtained from the USGS office in Cheyenne.

Records of daily flows of streams prior to 1971 were published in the Water-Supply Paper series, "Surface-Water Supply of the United States," which was released in numbered parts as determined by natural drainage basins. Data for Wyoming are published in Parts 6, 9, 10, and 13. 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 September 1950," and "Compilation of Records of Surface Waters of the United States, October 1950 to September 1960." A 5-year compilation was published for 1965-70.

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

Surface-water-quality data prior to 1971 were published annually in the Water-Supply Paper series "Quality of Surface Waters of the United States," which also was released in numbered parts as determined by natural drainage basins. Data for Wyoming are in Parts 6, 9, 10, and 13.

Hydrologic Data After 1970

Beginning with water year 1971, the aforementioned Water-Supply Paper series was replaced by a new publication series, U.S. Geological Survey Water-Data Reports. For water years 1971-74, surface-water records and water-quality records were published in separate volumes. Beginning with 1975, this series combines under one cover: streamflow data, water-quality data for surface and ground water, and ground-water-level data for each state. For Wyoming, the title is "Water Resources Data, Wyoming--Water Year (date)." Since 1975 the reports are numbered: "U.S. Geological Survey Water-Data Report WY-(year)-1 or 2"; reports for 1971-74 are unnumbered. These reports are listed in a subsequent section of this report.

Flood Information

Methods for estimating the magnitude and frequency of floods for streams in Wyoming are given in Water-Resources Investigations Report 88-4045; methods for estimating flood volumes and hydrographs on small plains streams are described in Water-Supply Paper 2056 (see listings that follow). The USGS also has outlined flood-prone areas on topographic maps as part of a nationwide Federal program for managing flood losses. In Wyoming 225 flood-prone area maps have been completed. These maps, available at no charge from the District Office in Cheyenne, show areas estimated to be inundated by a 100-year flood. Official flood-insurance maps are available from the Federal Emergency Management Agency (toll-free phone number 1-800-638-6620).

SELECTED PUBLICATIONS ON WATER RESOURCES

General Information

The USGS announces all its publications in a monthly report, "New Publications of the USGS." Subscription to this monthly listing is available free upon request to the Mailing List Unit, USGS, 582 National Center, Reston, VA 22092. All publications are for sale unless specifically stated otherwise; prepayment is required. Checks or money orders should be payable to: "U.S. Department of the Interior--USGS." Prices, which are subject to change, are not included here. Information on price and availability should be obtained from listed sales offices before placing an order.

Additional information about USGS products and sources where they may be obtained is given in "A Guide to Obtaining USGS Information," U.S. Geological Survey Circular 900, available without cost from the Books and Open-File Reports Section, USGS, Federal Center, Box 25425, Denver, CO 80225.

The USGS maintains a library with an extensive earth-sciences collection. Local libraries may obtain books, periodicals, and maps through interlibrary loan by writing to USGS Library, 950 National Center, Reston, VA 22092, telephone (703) 860-6671.

Publications pertaining to water resources in Wyoming are listed as follows. The list includes all reports published during the last 15 years and selected older reports. Most of these reports are available for inspection at the USGS offices in Cheyenne, Casper, and Riverton and also at large public and university libraries. The sources for obtaining copies of the reports are given for each report series. Because many of the older reports are out of print, loan copies are available from the District Office in Cheyenne.

Professional Papers (P)

Professional papers are sold by USGS, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225.

P 501-D. Variation of permeability in the Tensleep Sandstone in the Bighorn basin, Wyoming, as interpreted from core analyses and geophysical logs, by J.D. Bredehoeft, in Geological Survey Research 1964, Chap. D, by U.S. Geological Survey, p. D166-D170. 1964.

P 550-D. The White River Formation as an aquifer in southeastern Wyoming and adjacent parts of Nebraska and Colorado, by M.E. Lowry, in Geological Survey Research 1966, Chap. D, by U.S. Geological Survey, p. D217-D222. 1966.

P 622-A. The hydraulics of overland flow on hillslopes, by W.W. Emmett. 1970.

P 700-D. Synthesizing hydrographs for small semiarid drainage basins, by G.S. Craig, Jr., in Geological Survey Research 1970, Chap. D, by U.S. Geological Survey, p. D238-D243. 1970.

P 1117. Scour and fill in a stream channel, East Fork River, western Wyoming, by E.D. Andrews. 1979.

P 1130. Hydrologic and human aspects of the 1976-77 drought, by H.F. Matthai. 1979.

P 1164. Effects of coal mine subsidence in the Sheridan, Wyoming area, by C.R. Dunrud and F.W. Osterwald. 1980.

P 1242. Perennial-streamflow characteristics related to channel geometry and sediment in the Missouri River basin, by W.R. Osterkamp and E.R. Hedman. 1982.

P 1244. Floods of May 1978 in southeastern Montana and northeastern Wyoming, by Charles Parrett, D.D. Carlson, G.S. Craig, Jr., and E.H. Chin.

P 1273-A. Stratigraphy and sedimentary facies of the Madison Limestone and associated rocks in parts of Montana, Nebraska, North Dakota, South Dakota, and Wyoming, by J.A. Peterson. 1984.

P 1273-B. Correlation of paleostructure and sediment deposition in the Madison Limestone and associated rocks in parts of Montana, North Dakota, South Dakota, Wyoming, and Nebraska, by D.L. Brown, R.K. Blankennagel, L.M. MacCary, and J.A. Peterson. 1984.

P 1273-C. Relationship of porosity and permeability to petrology of the Madison Limestone in rock cores from three test wells in Montana and Wyoming, by P.A. Thayer. 1983.

P 1273-D. Apparent water resistivity, porosity, and water temperature of the Madison Limestone and underlying rocks in parts of Montana, Nebraska, North Dakota, South Dakota, and Wyoming, by L.M. MacCary. 1984.

P 1273-E. Potentially favorable areas for large-yield wells in the Red River Formation and Madison Limestone in parts of Montana, North Dakota, South Dakota, and Wyoming, by L.M. MacCary, E.M. Cushing, and D.L. Brown. 1983.

P 1273-G. Geohydrology of the Madison and associated aquifers in parts of Montana, North Dakota, South Dakota, and Wyoming, by J.S. Downey. 1984.

P 1277-A. Hydrologic and morphologic changes in channels of the Platte River basin in Colorado, Wyoming, and Nebraska; a historical perspective, by H.R. Eschner, R.F. Hadley, and K.D. Crowley. 1983.

P 1277-B. Effects of water development on surface-water hydrology, Platte River basin in Colorado, Wyoming, and Nebraska upstream from Duncan, Nebraska, by J.E. Kircher, and M.R. Karlinger. 1983.

P 1273-F. Geochemical evolution of water in the Madison aquifer in parts of Montana, South Dakota, and Wyoming, by J.F. Busby, L.N. Plummer, R.W. Lee, and B.B. Hanshaw. 1991.

P 1330. A seismic-stratigraphic investigation of the Madison and associated aquifers; application to ground-water exploration, Powder River basin, Montana-Wyoming, edited by A.H. Balch. 1988.

P 1338. Effects of organic wastes on water quality from the processing of oil shale from the Green River Formation, Colorado, Utah, and Wyoming, by J.A. Leenheer and T.I. Noyes. 1986.

P 1400-A. Summary of the High Plains Regional Aquifer-System Analysis in parts of Colorado, Kansas, Nebraska, New Mexico, South Dakota, Texas, Oklahoma, and Wyoming, by J.B. Weeks, E.D. Gutentag, F.J. Heimes, and R.R. Luckey. 1988.

P 1400-B. Geohydrology of the High Plains aquifer in parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming, by E.D. Gutentag, F.J. Heimes, N.C. Krothe, R.R. Luckey, and J.B. Weeks. 1984.

P 1400-C. Mapping irrigated cropland from Landsat for determination of water-use from the High Plains aquifer in parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming, by G.P. Thelin and F.J. Heimes. 1987.

P 1400-D. Digital simulation of ground-water flow in the High Plains aquifer in parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming, by R.R. Luckey, E.D. Gutentag, F.J. Heimes, and J.B. Weeks. 1986.

P 1400-E. Effects of future ground-water pumpage on the High Plains aquifer in parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming, by R.R. Luckey, E.D. Gutentag, F.J. Heimes, and J.B. Weeks. 1988.

P 1402-A. The regional aquifer system underlying the Northern Great Plains in parts of Montana, North Dakota, South Dakota, and Wyoming--Summary, by J.S. Downey and G.A. Dinwiddie. 1988.

P 1402-B. Geologic framework of the ground-water system in Jurassic and Cretaceous rocks in the Northern Great Plains in parts of Montana, North Dakota, South Dakota, and Wyoming, by L.O. Anna. 1986.

P 1402-C. Geochemistry of ground water in two sandstone aquifer systems in the Northern Great Plains in parts of Montana and Wyoming, by Thomas Henderson. 1985.

P 1402-D. Freshwater heads and ground-water temperatures in aquifers of the Northern Great Plains in parts of Montana, North Dakota, South Dakota, and Wyoming, by D.H. Lobmeyer. 1985.

P 1402-E. Geohydrology of bedrock aquifers in the Northern Great Plains in parts of Montana, North Dakota, South Dakota, and Wyoming, by J.S. Downey. 1986.

P 1411-C. Geohydrology of Mesozoic rocks in the upper Colorado River basin--excluding the San Juan basin--in Arizona, Colorado, Utah, and Wyoming, by G.W. Freethey and G.E. Cordy. In press.

P 1464. Summary of the USGS and U.S. Bureau of Land Management national coal-hydrology program, 1974-84, edited by L.J. Britton, C.L. Anderson, D.A. Goolsby, and B.P. Van Haveren. 1989.

Journal of Research of the Geological Survey

The Journal of Research Series has been discontinued. Separate prints of the articles listed below are available from the District Chief, Cheyenne, Wyoming.

Iron in water near wastewater lagoons in Yellowstone National Park, Wyoming, by E.R. Cox, v. 6, no. 3, p. 319-324. 1978.

Hydrologic characteristics of the Madison Limestone, the Minnelusa Formation, and equivalent rocks as determined by well-logging formation evaluation, Wyoming, Montana, South Dakota, and North Dakota, by W.J. Head and R.H. Merkel, v. 5, no. 4, p. 473-485. 1977.

Water-Supply Papers (W)

Water-Supply Papers are sold by USGS, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225.

W 1261. A postglacial chronology for some alluvial valleys in Wyoming, by L.B. Leopold and J.P. Miller. 1954.

W 1373. Sedimentation and chemical quality of surface waters in the Wind River basin, Wyoming, by B.R. Colby, C.H. Hembree, and F.H. Rainwater. 1956.

W 1375. Ground-water resources of the Riverton irrigation project area, Wyoming, by D.A. Morris, O.M. Hackett, K.E. Vanlier, and E.A. Moulder, with a section on Chemical quality of ground water, by W.H. Durum. 1959.

W 1377. Geology and ground-water resources of Goshen County, Wyoming, by J.R. Rapp, F.N. Visher, and R.T. Littleton, with a section on Chemical quality of ground water, by W.H. Durum. 1957.

W 1458. Geology and ground-water resources of the Rawlins area, Carbon County, Wyoming, by D.W. Berry. 1960.

W 1490. Geology and ground-water resources of Platte County, Wyoming, by D.A. Morris and H.M. Babcock, with a section on Chemical quality of ground water, by R.H. Langford. 1960.

W 1531. Hydrology of the upper Cheyenne River basin: Part A. Hydrology of stock-water reservoirs in upper Cheyenne River basin, by R.C. Culler; Part B. Sediment sources and drainage-basin characteristics in upper Cheyenne River basin, by R.F. Hadley and S.A. Schumm. 1961.

W 1532-A. Hydrologic effects of water spreading in Box Creek basin, Wyoming, by R.F. Hadley, I.S. McQueen, and others. 1961.

W 1535-E. Chemical degradation on opposite flanks of the Wind River Range, Wyoming, by C.H. Hembree and F.H. Rainwater. 1961.

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Miscellaneous Investigations Maps (I)

Miscellaneous Investigations Maps are sold by U.S. Geological Survey, Map Distribution, Federal Center, Building 810, Box 25286, Denver, CO 80225.

I-847-A. Energy resources map of the Powder River basin, Wyoming and Montana, by W.R. Keefer and T.W. Schmidt. 1973.

I-847-B. Map showing streamflow volumes in northeastern Wyoming and southeastern Montana, by D.G. Frickel and L.M. Shown. 1974.

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Open-file reports, which may be in manuscript form, generally are not reproduced and distributed in quantity. These reports are available for inspection in the Cheyenne, WY, and Reston, VA, offices of the USGS. Most numbered open-file reports may be purchased from U.S. Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225. Information on

the availability of numbered and unnumbered reports may be obtained from the District Chief, Cheyenne, Wyoming; free copies of some reports, such as periodic compilations of ground-water levels, are available from the Cheyenne office.

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