

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

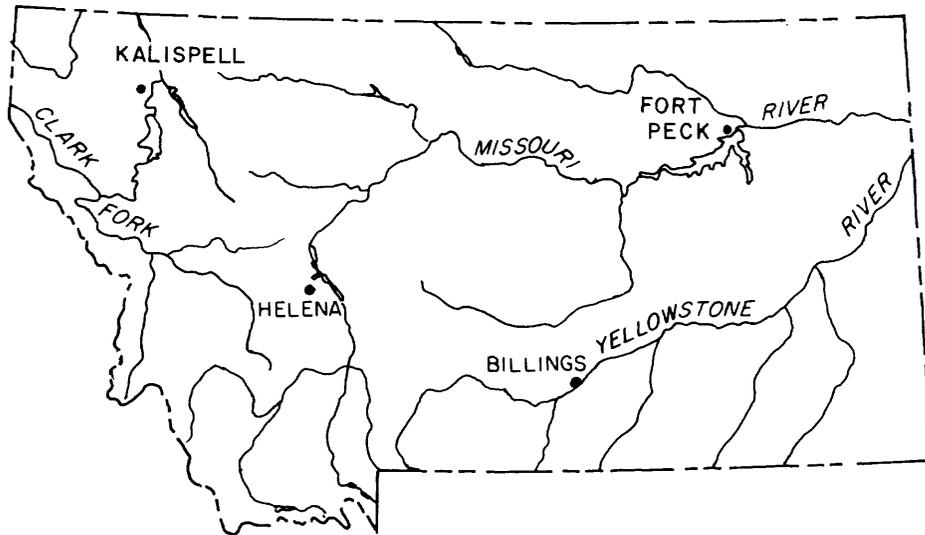
WATER-RESOURCES INVESTIGATIONS OF THE
U.S. GEOLOGICAL SURVEY IN MONTANA,
OCTOBER 1980 THROUGH SEPTEMBER 1981

Open-File Report 81-817

Prepared in cooperation with the
State of Montana and other agencies

Helena, Montana

July 1981



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WATER-RESOURCES INVESTIGATIONS OF THE
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INTRODUCTION

The U.S. Geological Survey was established as an agency in the Department of the Interior on March 3, 1879, 30 years to the day after establishment of the Department itself. The initial purpose of the Survey was to prepare a plan that would secure the best possible results at the least possible cost for surveying and mapping the Territories of the United States. One mission of the Geological Survey is to provide the hydrologic information and understanding needed for the optimum utilization and management of the Nation's water resources for the overall benefit of the people of the United States. This mission is accomplished, in large part, through cooperation with other Federal and non-Federal agencies by:

1. Collecting data needed for the continuing determination and evaluation of the Nation's water resources;
2. Conducting water-resources investigations to describe the occurrence, availability, and characteristics of surface and ground waters;
3. Conducting supportive research in hydraulics, hydrology, and related fields of science to improve the scientific basis for investigations and measurements and to understand hydrologic systems sufficiently well to be able to predict their response to stress;
4. Disseminating the water data and the results of these investigations and research through reports, maps, and other forms of public release;
5. Coordinating the activities of Federal agencies in the acquisition of water data for streams, lakes, reservoirs, and ground waters; and
6. Providing scientific and technical assistance in hydrologic fields to other Federal, State, and local agencies; to licensees of the Federal Energy Regulatory Commission; and to international agencies on behalf of the Department of State.

The Montana district of the Geological Survey conducts its hydrologic work through a headquarters office in Helena (Federal Office Building, 301 S. Park), a subdistrict office in Billings, and field offices in Helena, Kalispell, and Fort Peck. The district employs 78 people (50 full-time and 28 less than full-time) to work on 26 funded projects. Funding for program operation comes from joint-funding agreements with State and local agencies, direct Federal allotments to the U.S. Geological Survey, and transfer of funds from other Federal agencies.

Funding agencies include:

State and local agencies

Montana Department of Natural Resources and Conservation
Montana Bureau of Mines and Geology
Montana Department of Fish, Wildlife, and Parks
Montana Department of Health and Environmental Sciences
Montana Department of Highways
Wyoming State Engineer
Montana State University

Federal agencies

U.S. Geological Survey
U.S. Bureau of Land Management
U.S. Army Corps of Engineers
U.S. Department of State-International Joint Commission, Waterways Treaty
U.S. Water and Power Resources Service
Federal Energy Regulatory Commission
Bonneville Power Administration
U.S. Bureau of Indian Affairs
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Forest Service

Distribution of funding for program operation is illustrated in figure 1.

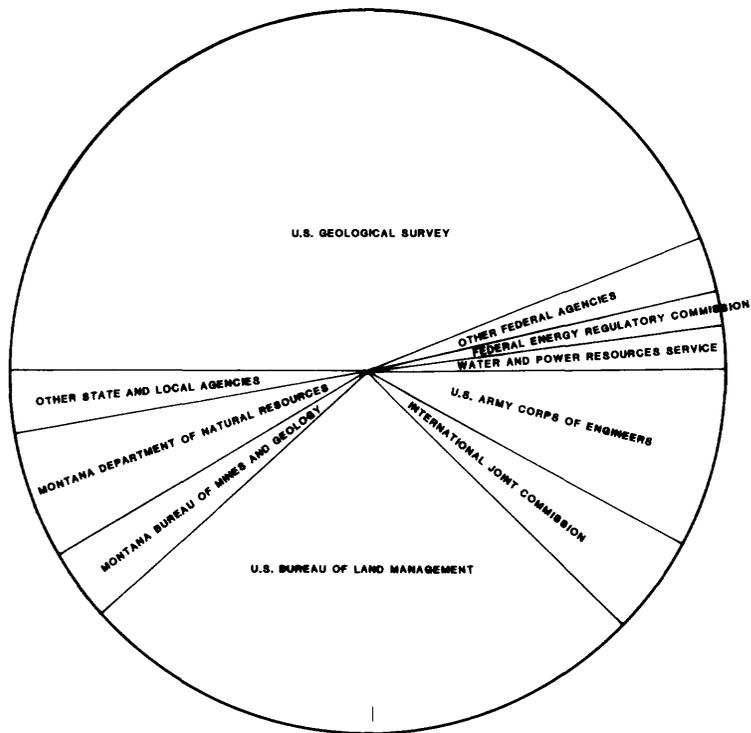


Figure 1.--Sources of funding for the water-resources program in Montana.

The following projects are funded for fiscal year 1981 in Montana:

001	Surface-Water Stations	065	Stream-Response Modeling
002	Ground-Water Stations	066	EMRIA Sites
003	Water-Quality Stations	067	Northern Great Plains
004	Sediment Stations	070	Channel Geometry
005	Precipitation Stations	071	Salinity Modeling
007	Water Use	072	Water-Quality Monitoring
010	Peak-Flow Analysis	073	Runoff Characteristics
022	National Parks	074	Lake Creek
023	Bridge-Site Investigations	075	Geochemistry of Mine Spoils
030	Special Investigations	076	East Big Dry Resource Area
056	Madison Aquifer in Northern Montana	077	Willow Creek Modeling
059	Coal-Lease Monitoring	078	Benthic Study
064	Reservoir Study	079	Stillwater Complex

These projects are described in following sections of this report under the general headings of: (1) Data-collection programs, (2) Problem-oriented studies, (3) Areal appraisals, (4) Coal-related studies, (5) Regional studies, and (6) Research projects. An additional section describes grants and contracts administered by the Montana district to research organizations.

DATA-COLLECTION PROGRAMS

Hydrologic-data stations are maintained at selected sites throughout Montana to collect basic information concerning streamflow, ground-water levels, quality of water, sediment concentrations in streams, and depth and water content of snowpack. The network of stations is revised periodically to ensure collection of meaningful and worthwhile data. Information collected from the network is kept on file for use by managers, investigators, and users of water resources. Much of the information is published annually in water-data reports, most is stored in computer files for efficient processing and retrieval, and all is available to requesters.

The locations of data-collection stations are shown on figure 2 for surface water and figure 3 for surface-water quality. Surface-water stations in operation as of October 1980 are listed in table 1. Surface-water-quality stations are listed in table 2.

Surface-Water Stations

(MT-001)

Location: Statewide

Period of project: Continuing

Project chief: George M. Pike, Helena



Objectives: (1) To collect surface-water data sufficient to satisfy needs for current-purpose uses, such as (a) assessment of water resources, (b) operation of reservoirs or industries, (c) forecasting, (d) disposal of wastes and pollution control, (e) discharge data to accompany water-quality measurements, (f) compact and legal requirements, and (g) research and special studies. (2) To collect data necessary for analytical studies to define for any location the statistical properties of, and trends in, the occurrence of water in streams, lakes, and so forth, for use in planning and design.

Information products: Missouri River Basin Ground Water Resources Work Group, 1980, Inventory of ground-water resources, technical paper of Upper Missouri River Basin Level B Study: Missouri River Basin Commission, 54 p.

Moore, L. G., and Shields, R. R., 1980, Streamflow characteristics of the Yellowstone River basin, Montana, through 1976: U.S. Geological Survey Water-Resources Investigations 80-41, 67 p.

Shields, R. R., and White, M. K., Streamflow characteristics of the Hudson Bay and upper Missouri River basins, Montana, through 1979: U.S. Geological Survey Water-Resources Investigations report (in review).

U.S. Geological Survey, Water resources data for Montana--Water year 1980, v. 1, Hudson Bay basin and Missouri River basin: U.S. Geological Survey Water-Data Report MT-80-1 (in preparation).

_____ Water resources data for Montana--Water year 1980, v. 2, Upper Columbia River basin: U.S. Geological Survey Water-Data Report MT-80-2 (in preparation).

Waltemeyer, S. D., and Shields, R. R., Streamflow characteristics of the upper Columbia River basin, through 1979: U.S. Geological Survey Water-Resources Investigations report (in preparation).

Yellowstone River Compact Commission, Twenty-ninth annual report (in preparation).

Ground-Water Stations

(MT-002)

Location: Statewide

Period of project: Continuing

Project chief: Thomas E. Reed, Helena



Objectives: (1) To collect water-level data sufficient to provide a minimum long-term data base so that the general response of the hydrologic system to natural climatic variations and induced stresses is known and potential problems can be defined early enough to allow proper planning and management. (2) To provide a data base against which the 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 management of the resource.

Information products: Coffin, D. L., Reed, T. E., and Ayers, S. D., 1977, Water-level changes in wells along the west side of the Cedar Creek anticline, southeastern Montana: U.S. Geological Survey Water-Resources Investigations 77-93, 11 p.

Roberts, R. S., 1980, Hydrogeologic data for selected coal areas, east-central Montana: U.S. Geological Survey Water-Resources Investigations Open-File Report 80-329, 63 p.

Water-Quality Stations

(MT-003)

Location: Statewide

Period of project: Continuing

Project chief: J. Roger Knapton, Helena

Objectives: (1) To provide a national bank of water-quality data for broad Federal planning and action programs. (2) To provide data for Federal management of interstate and international waters.

Information products: Knapton, J. R., 1978, Evaluation and correlation of water-quality data for the North Fork Flathead River, northwestern Montana: U.S. Geological Survey Water-Resources Investigations 78-111, 95 p.

Knapton, J. R., and Jacobson, M. A., 1980, Simulation of water-quality data at selected stream sites in the Missouri River basin, Montana: U.S. Geological Survey Water-Resources Investigations 80-76, 30 p.

U.S. Geological Survey, Water resources data for Montana--Water year 1980, v. 1, Hudson Bay basin and Missouri River basin: U.S. Geological Survey Water-Data Report MT-80-1 (in preparation).

____ Water resources data for Montana--Water year 1980, v. 2, Upper Columbia River basin: U.S. Geological Survey Water-Data Report MT-80-2 (in preparation).



Sediment Stations

(MT-004)

Location: Statewide

Period of project: Continuing

Project chief: J. Roger Knapton, Helena

Objectives: (1) To provide a national bank of sediment data for use in broad Federal and State planning and action programs. (2) To provide data for Federal management of interstate and international waters.

Information products: U.S. Geological Survey, Water resources data for Montana--Water year 1980, v. 1, Hudson Bay basin and Missouri River basin: U.S. Geological Survey Water-Data Report MT-80-1 (in preparation).

Water resources data for Montana--Water year 1980, v. 2, Upper Columbia River basin: U.S. Geological Survey Water-Data Report MT-80-2 (in preparation).



Precipitation Stations

(MT-005)

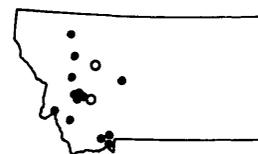
Location: West-central Montana

Period of project: Continuing

Project chief: Ronald R. Shields, Helena

Objective: To obtain the depth and water content of the snowpack at 13 designated snow courses (solid circles) for use in runoff forecasting and to monitor precipitation chemistry, including acid conditions, at two continuous collecting stations (open circles).

Information product: Results of measurements are included in U.S. Soil Conservation Service report, "Water supply outlook for Montana."



Water Use

(MT-007)

Location: Statewide

Period of project: Continuing

Project chief: Charles Parrett, Helena

Objective: To develop and maintain a water-use data system for Montana that is responsive to the needs of users at both State and national levels.

Information product: Water-use information will be supplied to requesters.



PROBLEM-ORIENTED STUDIES

The Geological Survey is often asked by Federal, State, or local agencies to investigate hydrologic problems of limited areal extent. These problem-oriented studies range in scope from cursory examination of baseline conditions to detailed investigations of cause and effect. For problems of a recurring nature, such as bridge-site investigations for the Montana Department of Highways, continuing projects are established to provide an ongoing service to the funding agency. Some problems are of sufficient scope to warrant formal projects.

In addition to the recurring-problem projects and the large-scope projects, an umbrella project entitled "Special Investigations" has been established. This project provides a mechanism for handling special problems on short notice. Examples of work included under this project are investigations of water-level declines in small basins, documentation of ground-water-quality problems, and investigation of water-supply problems for other Federal agencies.

National Parks

(MT-022)



Location: National Parks in Montana

Period of project: Continuing

Project chief: Joe A. Moreland, Helena

Objective: To assist National Park Service in developing water supplies, monitoring waste disposal, and evaluating hydrologic problems.

Information product: Moreland, J. A., and Wood, W. A., Evaluation of ground-water quality near waste-water treatment facilities, Glacier National Park, Montana: U.S. Geological Survey Open-File Report (in preparation).

Bridge-Site Investigations

(MT-023)



Location: Statewide

Period of project: Continuing

Project chief: Robert J. Omang, Helena

Objective: To supply the Montana Department of Highways with sufficient hydrologic and hydraulic information at selected sites to allow the most economic and hydraulically safe bridge or culvert design possible.

Information product: Johnson, M. V., 1978, Floods of June 4 and 12, 1976, at Culbertson, Montana: U.S. Geological Survey Open-File Report 78-429, 6 p.

Special Investigations

(MT-030)

Location: Statewide

Period of project: Continuing

Project chief: Joe A. Moreland, Helena



Objectives: (1) To assist State and other Federal agencies in solving water-resources problems on short notice. (2) To furnish the basic data to the cooperator soon after the fieldwork is completed. (3) To improve the quality of all district reports and their usefulness to the cooperator. Included in this project are all reports from completed studies which are not yet approved for release or published. The project provides a funding mechanism to complete manuscript revisions and final drafting of illustrations.

Information products: Moreland, J. A., Leonard, R. B., Reed, T. E., Clausen, R. O., and Wood, W. A., 1979, Hydrologic data from selected wells in the Helena Valley, Lewis and Clark County, Montana: U.S. Geological Survey Open-File Report 79-1676, 54 p.

Boettcher, A. J., Ground-water resources in the central part of the Flathead Indian Reservation, northwestern Montana: Montana Bureau of Mines and Geology Memoir (in press).

Leonard, R. B., Supplemental data from the Ennis and other thermal-spring areas, southwestern Montana, 1978-80: U.S. Geological Survey Open-File Report (in press).

Leonard, R. B., and Wood, W. A., Geothermal gradients in the Missoula and Bitterroot Valleys, west-central Montana: U.S. Geological Survey Water-Resources Investigations (in press).

Leonard, R. B., Wood, W. A., and Boettcher, A. J., Changes in quality of ground water in the Lincoln area, Montana, 1974-79: U.S. Geological Survey Open-File Report 80-1108 (in press).

Lewis, B. D., and Hotchkiss, W. R., Thickness, percent sand, and configuration of shallow hydrogeologic units in the Powder River Basin, Montana and Wyoming: U.S. Geological Survey Miscellaneous Investigations Map I-1317 (in press).

Miller, W. R., Water resources of the southern Powder River area of southeastern Montana: Montana Bureau of Mines and Geology Memoir (in press).

Moreland, J. A., and Leonard, R. B., Evaluation of shallow aquifers in the Helena valley, Lewis and Clark County, Montana: U.S. Geological Survey Water-Resources Investigations Open-File Report 80-1102, 24 p. (in press).

Woods, P. F., Physical limnological factors suppressing primary productivity in Lake Koocanusa, Montana: Minneapolis, Proceedings of the Symposium on Surface-Water Impoundments, June 2-5, 1980 (in press).

- Feltis, R. D., Potential sources of ground water for irrigation, domestic, and municipal supply, Fort Belknap Indian Reservation, north-central Montana: Montana Bureau of Mines and Geology Memoir (in review).
- Feltis, R. D., and Shields, R. R., Streamflow losses to Madison Group rocks in the Little Belt and Big Snowy Mountains, Montana: U.S. Geological Survey Water-Resources Investigations report (in review).
- Ferreira, R. F., Mean annual streamflow of small drainage basins in the coal area of southeastern Montana: U.S. Geological Survey Water-Resources Investigations report (in review).
- Lee, R. W., Slagle, S. E., and Stimson, J. R., Magnitude and chemical quality of base flow of Otter Creek, Tongue River, and Rosebud Creek, southeastern Montana, October 26-November 5, 1977: U.S. Geological Survey Water-Resources Investigations Open-File Report (in review).
- Boettcher, A. J., Thermal-infrared imagery and heat modeling of the Madison River and Lake Ennis, southwestern Montana: U.S. Geological Survey Open-File Report (in preparation).
- Hutchinson, R. D., Shallow ground-water resources in the Yellowstone River valley, Park City to Billings, Montana: Montana Bureau of Mines and Geology Hydrogeologic Map (in preparation).
- Parrett, Charles, Potential effects of urbanization on peak flows in Rattlesnake Creek, Missoula County, Montana: U.S. Geological Survey Water-Resources Investigations (in preparation).
- Slagle, S. E., Lewis, B. D., and Lee, R. W., Water resources and potential effects of coal strip mining in the northern Powder River Basin, southeastern Montana: U.S. Geological Survey Water-Supply Paper (in preparation).
- Wilke, K. R., Ground-water resources of northern Cascade County, central Montana: Montana Bureau of Mines and Geology Memoir (in preparation).

AREAL APPRAISALS

The Geological Survey has a continuing program of areal studies designed to provide hydrologic information needed in managing the State's water resources. These studies evaluate the occurrence and movement of ground water, thickness and extent of aquifers, distribution of streamflow in time and space, and quality of surface and ground waters. The studies generally include a ground-water basin, hydrologic unit, county, or other convenient subunit of the State.

Each areal investigation is uniquely designed to address hydrologic conditions, development potential, and specific hydrologic problems associated with the area in question. Some studies are aimed primarily at evaluating the potential for development of ground-water supplies, some deal primarily with water-quality problems, and some are broad investigations of the hydrologic system. All are intended to provide a clearer understanding of the State's water resources.

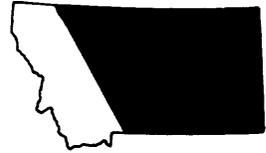
Madison Aquifer in Northern Montana

(MT-056)

Location: Central and eastern Montana

Period of project: October 1975 to September 1982

Project chief: Richard D. Feltis, Billings



Objective: To compile information from test holes and wells and prepare maps describing the (a) structural configuration of the top of the aquifer, (b) potentiometric surface, and (c) quality of water. These maps will form the basis for a future evaluation of the aquifer and will supplement an intensive study of the Madison aquifer in eastern and southeastern Montana.

Information products: Feltis, R. D., 1980, Map showing configuration of the top of the Madison Group, Havre 1-degree by 2-degree quadrangle, north-central Montana: Montana Bureau of Mines and Geology Geologic Map 9.

_____ 1980, Map showing configuration of the top of the Madison Group, Great Falls 1-degree by 2-degree quadrangle, north-central Montana: Montana Bureau of Mines and Geology Geologic Map 10.

_____ 1980, Map showing configuration of the top of the Madison Group, Shelby 1-degree by 2-degree quadrangle, north-central Montana: Montana Bureau of Mines and Geology Geologic Map 11.

_____ 1980, Map showing configuration of the top of the Madison Group, Lewistown 1-degree by 2-degree quadrangle, north-central Montana: Montana Bureau of Mines and Geology Geologic Map 12.

_____ 1980, Map showing potentiometric surface of water in the Madison Group, Montana: Montana Bureau of Mines and Geology Hydrogeologic Map 2.

_____ 1980, Map showing dissolved-solids concentration of water in the Madison Group, Montana: Montana Bureau of Mines and Geology Hydrogeologic Map 3.

_____ 1980, Map showing ratio of sodium, potassium, and chloride to dissolved-solids concentration in water of the Madison Group, Montana: Montana Bureau of Mines and Geology Hydrogeologic Map 3.

_____ 1980, Map showing ratio of sulfate to total anions in water of the Madison Group, Montana: Montana Bureau of Mines and Geology Hydrogeologic Map 3.

_____ Map showing configuration of the top of the Madison Group, Glendive 1-degree by 2-degree quadrangle, Montana: Montana Bureau of Mines and Geology Geologic Map 15 (in press).

_____ Map showing configuration of the top of the Madison Group, Jordan 1-degree by 2-degree quadrangle, Montana: Montana Bureau of Mines and Geology Geologic Map 16 (in press).

Map showing configuration of the top of the Madison Group, Wolf Point 1-degree by 2-degree quadrangle, Montana: Montana Bureau of Mines and Geology Geologic Map 17 (in press).

Map showing configuration of the top of the Madison Group, Glasgow 1-degree by 2-degree quadrangle, Montana: Montana Bureau of Mines and Geology Geologic Map 18 (in press).

Map showing configuration of the top of the Madison Group, Forsyth 1-degree by 2-degree quadrangle, Montana: Montana Bureau of Mines and Geology Geologic Map (in review).

Map showing configuration of the top of the Madison Group, Miles City 1-degree by 2-degree quadrangle, Montana: Montana Bureau of Mines and Geology Geologic Map (in review).

Map showing configuration of the top of the Madison Group, Ekalaka 1-degree by 2-degree quadrangle, Montana: Montana Bureau of Mines and Geology Geologic Map (in review).

Map showing configuration of the top of the Madison Group, Roundup 1-degree by 2-degree quadrangle, Montana: Montana Bureau of Mines and Geology Geologic Map (in preparation).

Map showing configuration of the top of the Madison Group, White Sulphur Springs 1-degree by 2-degree quadrangle, Montana: Montana Bureau of Mines and Geology Geologic Map (in preparation).

Map showing configuration of the top of the Madison Group, Hardin 1-degree by 2-degree quadrangle, Montana: Montana Bureau of Mines and Geology Geologic Map (in preparation).

Map showing configuration of the top of the Madison Group, Billings 1-degree by 2-degree quadrangle, Montana: Montana Bureau of Mines and Geology Geologic Map (in preparation).

Map showing configuration of the top of the Madison Group, Bozeman 1-degree by 2-degree quadrangle, Montana: Montana Bureau of Mines and Geology Geologic Map (in preparation).

Map showing configuration of the top of the Madison Group, Choteau 1-degree by 2-degree quadrangle, Montana: Montana Bureau of Mines and Geology Geologic Map (in preparation).

Map showing configuration of the top of the Madison Group, Cut Bank 1-degree by 2-degree quadrangle, Montana: Montana Bureau of Mines and Geology Geologic Map (in preparation).

Reservoir Study

(MT-064)

Location: Eastern Montana

Period of project: October 1977 to September 1981

Project chief: Rodger F. Ferreira, Helena

Objectives: (1) To characterize the present physical, chemical, and biological conditions in selected reservoirs in eastern Montana. (2) To evaluate the suitability of the reservoirs for various uses.

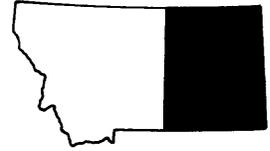
Information products: Ferreira, R. F., 1980, Limnological data for 12 reservoirs in Valley County, Montana: U.S. Geological Survey Open-File Report 80-339, 68 p.

_____ Limnological data for selected reservoirs in southeastern Montana: U.S. Geological Survey Open-File Report (in preparation).

_____ Limnological data for 12 reservoirs in Phillips County, northeastern Montana: U.S. Geological Survey Open-File Report (in preparation).

_____ Significance of water quality to fish, water fowl, livestock, and recreation uses for 24 reservoirs in Phillips and Valley Counties, Montana: U.S. Geological Survey Water Resources-Investigations report (in preparation).

_____ Suitability for multiple use of selected reservoirs in southeastern Montana: U.S. Geological Survey Water-Resources Investigations report (in preparation).



Lake Creek

(MT-074)

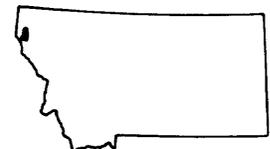
Location: Lake Creek drainage in Lincoln County

Period of project: January 1980 to September 1981

Project chief: Gary W. Levings, Helena

Objectives: (1) To determine the quantity and quality of ground and surface waters in the Lake Creek drainage. (2) To document baseline hydrologic conditions. (3) To evaluate the potential impacts of mining on the ground- and surface-water resources.

Information product: Levings, G. W., and Lambing, J. H., Water resources in the Lake Creek area, northwestern Montana: Montana Bureau of Mines and Geology Memoir (in preparation).



Willow Creek Modeling

(MT-077)

Location: Willow Creek watershed in Valley County.

Period of project: October 1980 to September 1982

Project chief: Charles Parrett, Helena

Objectives: (1) To develop a runoff model of Willow Creek basin. (2) To evaluate the effects of reservoirs and water-conservation structures on runoff.

Information product: Parrett, Charles, and Waltemeyer, S. D., Effects of water conservation on runoff in the Willow Creek basin, Montana: U.S. Geological Survey Water-Resources Investigations report (planned).



Stillwater Complex

(MT-079)

Location: Stillwater and Sweet Grass Counties

Period of project: October 1980 to September 1983

Project chief: Richard D. Feltis, Billings

Objectives: (1) To collect hydrologic information needed to assess the effects of mining in the Stillwater Complex. (2) To inventory wells and springs in areas subject to population increases. (3) To develop baseline water-quality information needed to approve exploration and mining permits.

Information product: Feltis, R. D., Hydrologic data from wells, springs, and streams in the Stillwater Complex, Montana: U.S. Geological Survey Open-File Report (planned).



COAL-RELATED STUDIES

The nation's pressing need for an expanded domestic energy base has resulted in increased interest in Montana's vast coal resources. Environmental impacts associated with exploration, mining, conversion, and transportation of coal must be considered in planning and managing the coal-mining activities. Many of the activities associated with coal utilization may significantly affect the water resources in Montana. To address these problems, the Geological Survey is involved in several hydrologic projects relating to coal development.

Projects include investigations in the coal areas of Montana designed to provide baseline hydrologic information at proposed coal-lease sites, to monitor water quality of streamflow, to estimate runoff characteristics of ungaged watersheds, to map the areal distribution of aquifer units and evaluate the impact of mining on shallow ground-water systems, and to evaluate the benthic algae populations of streams.

Coal-Lease Monitoring

(MT-059)

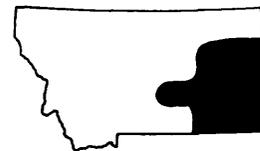
Location: Southeastern Montana

Period of project: Continuing

Project chief: Joe A. Moreland, Helena

Objectives: (1) To determine the characteristics of the regional water-resources system. (2) To detect and document changes in the system or in its components that may be associated with coal mining should changes occur.

Information products: Results of measurements are included in reports of other projects.



EMRIA Sites

(MT-066)

Location: Eastern Montana

Period of project: October 1977 to September 1981

Project chief: Neal E. McClymonds, Helena

Objectives: (1) To collect hydrologic data at selected coal-lease application sites. (2) To evaluate potential hydrologic impacts of coal development at the sites. (3) To design monitoring networks to define baseline conditions and document changes in the hydrologic system associated with mining and reclamation.

Information products: McClymonds, N. E., Hydrology of the Prairie Dog Creek drainage basin, Rosebud and Big Horn Counties, Montana: U.S. Geological Survey Water-Resources Investigations report (in review).

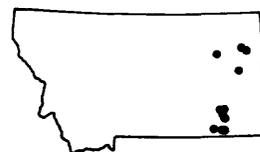
Cannon, M. R., Hydrology of the Cook Creek area, Ashland coal field, southeastern Montana: U.S. Geological Survey Water-Resources Investigations report (in preparation).

_____ Hydrology of the Snider Creek drainage basin, southeastern Montana: U.S. Geological Survey Water-Resources Investigations report (in preparation).

_____ Hydrology of the Timber Creek drainage basin, east-central Montana: U.S. Geological Survey Water-Resources Investigations report (in preparation).

_____ Hydrology of the Bloomfield mining unit, east-central Montana: U.S. Geological Survey Water-Resources Investigations report (in preparation).

_____ Hydrology of the Burns Creek mining unit, east-central Montana: U.S. Geological Survey Water-Resources Investigations report (in preparation).



McClymonds, N. E., Hydrology of the Corral Creek drainage basin, southeastern Montana: U.S. Geological Survey Water-Resources Investigations report (in preparation).

_____ Hydrology of the West Otter Creek drainage basin, southeastern Montana: U.S. Geological Survey Water-Resources Investigations report (in preparation).

_____ Hydrology of the Horse Creek and Little Bear Creek drainage basins, southeastern Montana: U.S. Geological Survey Water-Resources Investigations report (in preparation).

_____ Hydrology of the southwest Glendive mining unit, east-central Montana: U.S. Geological Survey Water-Resources Investigations report (in preparation).

Water-Quality Monitoring

(MT-072)

Location: Eastern Montana

Period of project: Continuing since October 1979

Project chief: J. Roger Knapton, Helena



Objectives: (1) To develop methods of analysis and presentation of surface-water-quality data to aid non-technical users in understanding data. (2) To use various analysis techniques to reduce water-quality data and interpret the information. (3) To review and modify surface-water-quality monitoring networks. (4) To assist projects in collecting and interpreting surface-water-quality data.

Information products: Knapton, J. R., and Ferreira, R. F., 1980, Statistical analyses of surface-water-quality variables in the coal area of southeastern Montana: U.S. Geological Survey Water-Resources Investigations 80-40, 128 p.

Lambing, J. H., Analyses of surface-water-quality variables in the coal area of east-central Montana: U.S. Geological Survey Water-Resources Investigations report (in preparation).

Litke, D. W., Evaluation of suspended sediment in selected streams in southeastern Montana: U.S. Geological Survey Water-Resources Investigations report (in preparation).

Knapton, J. R., Surface-water quality evaluation of the Bull Mountains region, south-central Montana: U.S. Geological Survey Water-Resources Investigations report (in preparation).

Runoff Characteristics

(MT-073)

Location: Eastern Montana

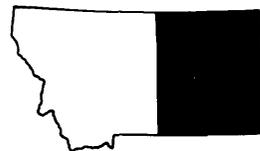
Period of project: October 1979 to September 1982

Project chief: Robert J. Omang, Helena

Objectives: (1) To develop methods to estimate runoff characteristics from ungaged watersheds in eastern Montana. (2) To estimate mean annual flow, peak discharges, and flood boundaries at selected ungaged sites in the Fort Union coal region using the best available techniques.

Information products: Omang, R. J., and others, Streamflow characteristics at EMRIA sites in southeastern Montana: U.S. Geological Survey Water-Resources Investigations report (in preparation).

Omang, R. J., A method of estimating runoff characteristics from ungaged watersheds, eastern Montana: U.S. Geological Survey Water-Resources Investigations report (planned).



East Big Dry Resource Area

(MT-076)

Location: Eastern Montana

Period of project: October 1979 to September 1981

Project chief: Steven E. Slagle, Helena

Objectives: (1) To define the shallow aquifers in the East Big Dry Resource Area. (2) To determine the occurrence, availability, and quality of water in aquifers overlying the Pierre Shale. (3) To develop a network of monitoring wells for documenting the impact of mining and reclamation on shallow aquifers.

Information products: Slagle, S. E., Hydrogeologic data for Dawson, McCone, Prairie, and Richland Counties, east-central Montana: U.S. Geological Survey Open-File Report (in preparation).

Slagle, S. E., Ground-water resources of the East Big Dry Resource Area, east-central Montana: U.S. Geological Survey Water-Resources Investigations report (in preparation).



Benthic Study

(MT-078)

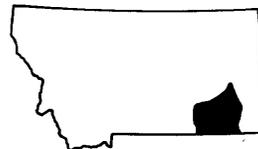
Location: Southeastern Montana

Period of project: October 1980 to September 1981

Project chief: Paul F. Woods, Helena

Objectives: (1) To assist Montana Department of Health and Environmental Sciences in statistical evaluation of benthic algae populations in streams. (2) To develop relationships between benthic communities and various basin and hydrologic characteristics.

Information product: Bahls, L. L., and Woods, P. F., Benthic algae communities in streams in southeastern Montana: U.S. Geological Survey Water-Resources Investigations report (planned).



REGIONAL STUDIES

In addition to areal appraisals within the State, the Montana district of the Geological Survey participates in larger-scale studies of regional hydrologic systems. Because these studies transect State boundaries, coordination through the Regional Office is necessary to minimize duplication and assure compatibility of interpretations. The Montana district is currently participating in an analysis of the northern Great Plains regional aquifer systems.

A statewide regional study to collect and evaluate peak-flow data for small drainage areas has been underway since 1955. Information is evaluated to develop regional relationships for various climatic and geomorphic areas of the State.

Peak-Flow Analysis

(MT-010)

Location: Statewide

Period of project: Continuing

Project chief: Robert J. Omang, Helena

Objective: To collect adequate base data to enable definition, within a specified degree of accuracy, of the magnitude and frequency of floods to be expected from any given small drainage in Montana.

Information products: Johnson, M. V., and Omang, R. J., 1976, A method for estimating magnitude and frequency of floods in Montana: U.S. Geological Survey Open-File Report 75-650, 35 p.



Omang, R. J., Hull, J. A., and Parrett, Charles, 1979, Annual peak discharges from small drainage areas in Montana for stations discontinued before 1978: U.S. Geological Survey Open-File Report 79-510, 117 p.

_____ 1980, Annual peak discharges from small drainage areas in Montana through September 1979: U.S. Geological Survey Open-File Report 80-340, 114 p.

Parrett, Charles, Carlson, D. D., Craig, G. S., Jr., and Chin, E. H., Floods of May 1978 in southeastern Montana and northeastern Wyoming: U.S. Geological Survey Professional Paper (in review).

Parrett, Charles, and Omang, R. J., Techniques for estimating magnitude and frequency of floods in Montana: U.S. Geological Survey Open-File Report (in review).

Omang, R. J., Parrett, Charles, and Hull, J. A., Annual peak discharges from small drainage areas in Montana through September 1980: U.S. Geological Survey Open-File Report (in preparation).

Northern Great Plains

(MT-067)

Location: Central and eastern Montana

Period of project: October 1977 to September 1981

Project chief: William R. Hotchkiss, Helena



Objectives: (1) To compile and examine existing basic data and develop a program to selectively collect additional data. (2) To identify and map geohydrologic units and construct structure, tectonic, percent sand, transmissivity, and storage coefficient maps for each unit. (3) To prepare potentiometric, water-level change, and inter-aquifer head-difference maps for each unit. (4) To develop water budgets. (5) To describe water quality within the regional framework and define geochemical trends and anomalies. (6) To construct and calibrate regional and subregional models and interface with adjacent States.

Information products: Dodge, K. A., and Levings, G. W., Measurements of discharge, gain or loss in flow, and chemical quality of the Poplar and Redwater Rivers, northeastern Montana, October 24-25, 1979: U.S. Geological Survey Open-File Report (in review).

Druse, S. A., and Dodge, K. A., Measurements of discharge, gain or loss in flow, and chemical quality of streams in the northern Great Plains area of Montana and Wyoming, 1977-78: U.S. Geological Survey Water-Resources Investigations Open-File Report (in review).

Levings, J. F., Levings, G. W., Feltis, R. D., Hotchkiss, W. R., and Lee, R. W., Selective annotated bibliography of geology and ground-water resources for the Montana part of the Northern Great Plains Regional Aquifer-System Analysis: U.S. Geological Survey Water-Resources Investigations report (in review).

Boettcher, A. J., and others, Thermal infrared imagery along the Powder and Tongue Rivers, Montana: U.S. Geological Survey Open-File Report (in preparation).

- Feltis, R. D., Structure, thickness, and sand-percent maps of the 6 stratigraphic intervals in the northern Great Plains area of Montana: U.S. Geological Survey Open-File Report (in preparation).
- Feltis, R. D., Lewis, B. D., Rioux, R. P., Jauhola, C. A., and Hotchkiss, W. R., Selected geologic data from the northern Great Plains area of Montana: U.S. Geological Survey Water-Resources Investigations Open-File Report (in preparation).
- Hotchkiss, W. R., and Levings, G. W., Chemical quality data from the northern Great Plains area of Montana: U.S. Geological Survey Open-File Report (in preparation).
- Hotchkiss, W. R., and Levings, J. F., Development and use of a digital model of water in shallow hydrogeologic units of eastern Montana and northeastern Wyoming: U.S. Geological Survey Professional Paper (in preparation).
- Hotchkiss, W. R., and Van Voast, W. A., Hydrogeologic data from test drilling along the Yellowstone River between Miles City and Terry, Montana: U.S. Geological Survey Open-File Report (in preparation).
- Levings, G. W., Potentiometric-surface map of water in the Eagle Sandstone and equivalent units in the northern Great Plains area of Montana: U.S. Geological Survey Open-File Report (in preparation).
- ____ Potentiometric-surface map of water in the Fox Hills-lower Hell Creek aquifer in the northern Great Plains area of Montana: U.S. Geological Survey Open-File Report (in preparation).
- ____ Potentiometric-surface map of water in the Judith River Formation in the northern Great Plains area of Montana: U.S. Geological Survey Open-File Report (in preparation).
- ____ Selected drill-stem-test data from the northern Great Plains area of Montana: U.S. Geological Survey Water-Resources Investigations Open-File Report (in preparation).
- ____ Selected hydrologic data from the northern Great Plains area of Montana: U.S. Geological Survey Water-Resources Investigations Open-File Report (in preparation).
- Levings, J. F., Hydrogeologic and chemical data from the Judith basin, central Montana: U.S. Geological Survey Open-File Report (in preparation).
- Levings, J. F., and Hotchkiss, W. R., Development and use of a digital model of water in shallow hydrogeologic units of the Judith basin, central Montana: U.S. Geological Survey Professional Paper (in preparation).

RESEARCH PROJECTS

The Montana district program includes basic and applied research on various hydrologic principles. All projects directly or indirectly benefit from the results of research activities and contribute data needed in research programs. However, certain projects are primarily research-oriented and are designed to develop or apply new or unconventional hydrologic methods. Four such projects are currently underway.

Stream-Response Modeling

(MT-065)

Location: Prairie Dog Creek, southeastern Montana

Period of project: October 1977 to September 1982

Project chief: Lawrence E. Cary, Billings



Objective: To develop a stream-response model capable of simulating effects of land-use changes on runoff. The model will include problems associated with (a) runoff and infiltration for frozen-ground conditions, (b) runoff from melting snow, (c) redistribution of snowpack, and (d) changes in base flow due to changes in ground-water flow pattern (if applicable).

Information products: Cary, L. E., and Johnson, J. D., Selected hydrologic and climatologic data from the Prairie Dog Creek basin, southeastern Montana, water year 1979: U.S. Geological Survey Open-File Report (in review).

Cary, L. E., Small-watershed modeling in southeastern Montana: U.S. Geological Survey Water-Resources Investigations report (in preparation).

Cary, L. E., and others, Precipitation-runoff models for small watersheds: U.S. Geological Survey Professional Paper (in preparation).

Channel Geometry

(MT-070)

Location: Statewide

Period of project: October 1978 to September 1981

Project chief: Robert J. Omang, Helena



Objectives: (1) To collect information on channel characteristics of selected streams in Montana. (2) To develop equations relating channel geometry to streamflow characteristics. (3) To statistically analyze the results from channel-geometry calculations to determine the accuracy of estimates.

Information products: Omang, R. J., Parrett, Charles, and Hull, J. A., Streamflow characteristics related to channel geometry of ephemeral streams, southeastern Montana: U.S. Geological Survey Water-Resources Investigations report (in preparation).

____ Streamflow characteristics related to channel geometry of ephemeral streams in Montana: U.S. Geological Survey Water-Resources Investigations report (in preparation).

Salinity Modeling

(MT-071)

Location: Tongue River, southeastern Montana

Period of project: October 1979 to September 1981

Project chief: Paul F. Woods, Helena

Objective: To construct and calibrate a salinity model of the Tongue River. The model will be used to evaluate the impacts of mining, reclamation, agriculture, and other land-management practices on the salinity of the Tongue River.

Information products: Woods, P. F., Documentation of a dissolved-solids model of the Tongue River, southeastern Montana: U.S. Geological Survey Open-File Report (in preparation).



Modeled impacts of surface coal mining on dissolved solids in the Tongue River, southeastern Montana: U.S. Geological Survey Water-Resources Investigations report (in preparation).

Geochemistry of Mine Spoils

(MT-075)

Location: Decker and Big Sky Mines, Montana

Period of project: October 1979 to September 1982

Project chief: Robert E. Davis, Helena

Objectives: (1) To document ground-water quality in mine spoils and adjacent, undisturbed aquifers. (2) To develop techniques to predict water quality in mine spoils. (3) To evaluate and predict the effects of mine spoils on local hydrologic systems.

Information product: A series of interim data and interpretive reports is planned throughout the study.



GRANT AND CONTRACT PROGRAM

In addition to the projects conducted by its own personnel, the Montana district administers grants and contracts to other agencies and universities to participate in hydrologic studies and perform research on particular problems. This program not only provides research essential to program operation, but it also greatly increases the district capabilities by utilizing expertise of personnel in other agencies. In the past, this program has funded test-drilling projects, research in stream biology, and development of computer programs for data storage and retrieval.

Geohydrologic Data in Fort Union Coal Region

Contractor: Montana Bureau of Mines and Geology

Project chief: Wayne A. Van Voast, Billings

Objectives: (1) To provide a ground-water data base from which an assessment can be made of the resource, future response to stress predicted, and pollution and supply problems predicted. (2) To provide a test-drilling program that can be directed by the U.S. Geological Survey to areas of critical need for hydrologic information or to areas of impending leasing.

Investigation of Soluble Salts and Quality of Water in Mine Spoils

Contractor: Montana Bureau of Mines and Geology

Project chief: Wayne A. Van Voast, Billings

Objectives: To investigate methods to predict water quality in mine spoils, install test wells at selected locations, and monitor ground-water conditions in and around coal strip mines.

Benthic Study of Streams

Grantee: Montana Department of Health and Environmental Sciences

Project chief: Duane A. Klarich, Billings

Objectives: (1) To obtain biological data on periphytic and macroinvertebrate components of stream benthos at selected sites in the southern part of the Fort Union coal region. (2) To assess the effects of salinity on stream biota. The study will attempt to provide information on potential effects of increased salinity resulting from mining activities on stream biota.

Intermediate-Depth Drilling in Northern Great Plains

Contractor: Montana Bureau of Mines and Geology

Project chief: Wayne A. Van Voast, Billings

Objective: To drill hydrologic test holes at selected locations in the northern Great Plains region of Montana, install casing, perform hydrologic tests, and collect ground-water samples.

Ground-Water Monitoring in Poplar River Area of Northeastern Montana

Contractor: Montana Bureau of Mines and Geology

Project chief: Marvin R. Miller, Butte

Objective: To monitor water levels and water quality in selected observation wells in the Poplar River area.

SOURCES OF GEOLOGICAL SURVEY PUBLICATIONS

Current reports are listed in a pamphlet, "New Publications of the Geological Survey." Subscription to the pamphlet, which is issued monthly, is free upon request to the U.S. Geological Survey, 329 National Center, Reston, VA 22092.

Professional papers, bulletins, water-supply papers, techniques of water-resources investigations, circulars, and publications of general interest (such as leaflets, pamphlets, booklets) are available by mail from the Branch of Distribution, U.S. Geological Survey, 604 South Pickett Street, Alexandria, VA 22304.

Miscellaneous investigations maps, hydrologic investigations atlases, hydrologic unit maps, and other maps pertaining to Montana are available for sale from the Branch of Distribution, U.S. Geological Survey, Box 25286 Federal Center, Denver, CO 80225.

Records of streamflow, ground-water levels, and quality of water have been published for many years as Geological Survey water-supply papers. Beginning with the 1971 water year, however, this series was replaced by a new publications series, U.S. Geological Survey Water-Data Reports. This new series combines for each State: streamflow data, water-quality data for surface and ground water, and ground-water-level data from the basic network of observation wells. For Montana, the title is, "Water-Resources Data for Montana--Water Year 1979: U.S. Geological Survey Water-Data Report MT-79-1." Further information on these publications can be obtained from the District Chief, U.S. Geological Survey, 301 South Park, Drawer 10076, Helena, MT 59626.

Open-file reports and water-resources investigations reports are available for inspection at the District office of the Geological Survey in Helena, Mont. Most reports in these series can be purchased in microfiche and paper-copy forms from sources in Denver, Colo., or Springfield, Va. Availability of the reports can be obtained from the District office.

REPORTS PUBLISHED OR RELEASED DURING PRECEDING 5 YEARS
(October 1975 through September 1980)

- Boettcher, A. J., 1980, Ground-water resources in the central part of the Flathead Indian Reservation, northwestern Montana: U.S. Geological Survey Open-File Report 80-731, 41 p.
- Boettcher, A. J., and Gosling, A. W., 1977, Water resources of the Clark Fork basin upstream from St. Regis, Montana: Montana Bureau of Mines and Geology Bulletin 104, 28 p.
- Boettcher, A. J., and Haralick, R. M., 1977, Use of thermal-infrared imagery in ground-water investigations in Montana, in Eleventh International Symposium on Remote Sensing of Environment Proceedings: Ann Arbor, Mich., Environmental Research Institute of Michigan, p. 1161-1170.
- Boettcher, A. J., Haralick, R. M., Paul, C. A., and Smothers, Norman, 1976, Use of thermal-infrared imagery in ground-water investigations, northwestern Montana: U.S. Geological Survey Journal of Research, v. 4, no. 9, p. 727-732.
- Boettcher, A. J., and Wilke, K. R., 1977, Ground-water resources in the Libby area, northwestern Montana: U.S. Geological Survey Open-File Report 77-397, 65 p.
- _____ 1978, Ground-water resources in the Libby area, northwestern Montana: Montana Bureau of Mines and Geology Bulletin 106, 36 p.
- Chadwick, R. A., and Leonard, R. B., 1979, Structural controls of hot spring systems of southwestern Montana: U.S. Geological Survey Open-File Report 79-1333, 25 p.
- Coffin, D. L., Reed, T. E., and Ayers, S. D., 1977, Water-level changes in wells along the west side of the Cedar Creek anticline, southeastern Montana: U.S. Geological Survey Water-Resources Investigations 77-93, 11 p.
- Dockins, W. S., Olson, G. J., McFeters, G. A., Turback, S. C., and Lee, R. W., 1980, Sulfate reduction in ground water of southeastern Montana: U.S. Geological Survey Water-Resources Investigations 80-9, 13 p.
- Feltis, R. D., 1977, Geology and water resources of the northern part of the Judith Basin, Montana: Montana Bureau of Mines and Geology Bulletin 101, 65 p.
- _____ 1979, Water resources of shallow aquifers in the upper Poplar River basin, northeastern Montana: U.S. Geological Survey Water-Resources Investigations 79-51, 27 p.
- _____ 1980, Map showing configuration of the top of the Madison Group, Havre 1 degree by 2 degree quadrangle, north-central Montana: Montana Bureau of Mines and Geology Geologic Map 9.
- _____ 1980, Map showing configuration of the top of the Madison Group, Great Falls 1 degree by 2 degree quadrangle, north-central Montana: Montana Bureau of Mines and Geology Geologic Map 10.

- ____ 1980, Map showing configuration of the top of the Madison Group, Shelby 1 degree by 2 degree quadrangle, north-central Montana: Montana Bureau of Mines and Geology Geologic Map 11.
- ____ 1980, Map showing configuration of the top of the Madison Group, Lewistown 1 degree by 2 degree quadrangle, north-central Montana: Montana Bureau of Mines and Geology Geologic Map 12.
- ____ 1980, Water resources of the Judith Basin, central Montana: Montana Bureau of Mines and Geology Hydrogeologic Map 1.
- ____ 1980, Map showing potentiometric surface of water in the Madison Group, Montana: Montana Bureau of Mines and Geology Hydrogeologic Map 2.
- ____ 1980, Map showing dissolved-solids concentration of water in the Madison Group, Montana, sheet 1 of Montana Bureau of Mines and Geology Hydrogeologic Map 3.
- ____ 1980, Map showing ratio of sodium, potassium, and chloride to dissolved-solids concentration in water of the Madison Group, Montana, sheet 2 of Montana Bureau of Mines and Geology Hydrogeologic Map 3.
- ____ 1980, Map showing ratio of sulfate to total anions in water of the Madison Group, Montana, sheet 3 of Montana Bureau of Mines and Geology Hydrogeologic Map 3.
- Ferreira, R. F., 1980, Limnological data for 12 reservoirs in Valley County, Montana: U.S. Geological Survey Open-File Report 80-339, 68 p.
- Hopkins, W. B., 1976, Water-resources data for deep aquifers of eastern Montana: U.S. Geological Survey Water-Resources Investigations 76-40, 37 p.
- International Souris-Red Rivers Engineering Board, 1976, Poplar River Basin in Saskatchewan and Montana: Poplar River Task Force Report, Joint Studies for Flow Apportionment, 43 p.
- Johnson, M. V., 1978, Floods of June 4 and 12, 1976, at Culbertson, Montana: U.S. Geological Survey Open-File Report 78-429, 6 p.
- Johnson, M. V., and Omang, R. J., 1976, A method for estimating magnitude and frequency of floods in Montana: U.S. Geological Survey Open-File Report 75-650, 35 p.
- ____ 1976, Floods of May-July 1975 along the Continental Divide in Montana: U.S. Geological Survey Open-File Report 76-424, 18 p.
- Johnson, M. V., Omang, R. J., and Hull, J. A., 1976, Annual peak discharges from small drainage areas in Montana through September 1975: U.S. Geological Survey Open-File Report, 204 p.
- ____ 1977, Annual peak discharges from small drainage areas in Montana through September 1976: U.S. Geological Survey Open-File Report 77-172, 204 p.
- Knapton, J. R., 1978, Evaluation and correlation of water-quality data for the North Fork Flathead River, northwestern Montana: U.S. Geological Survey Water-Resources Investigations 78-111, 95 p.

- Knapton, J. R., and Bochy, B. M., 1976, Results of phytoplankton sampling at National Stream Quality Accounting Network stations in Montana--1975 water year: U.S. Geological Survey Open-File Report 76-219, 27 p.
- Knapton, J. R., and Ferreira, R. F., 1980, Statistical analyses of surface-water-quality variables in the coal area of southeastern Montana: U.S. Geological Survey Water-Resources Investigations 80-40, 128 p.
- Knapton, J. R., and Jacobson, M. A., 1980, Simulation of water-quality data at selected stream sites in the Missouri River basin, Montana: U.S. Geological Survey Water-Resources Investigations 80-76, 30 p.
- Knapton, J. R., and McKinley, P. W., 1977, Water quality of selected streams in the coal area of southeastern Montana: U.S. Geological Survey Water-Resources Investigations 77-80, 145 p.
- Lee, R. W., 1977, Geochemistry of shallow ground water in the northern Powder River Basin, southeastern Montana [abs.]: Rocky Mountain Section, Geological Society America, 30th Annual Meeting, Boulder, Colo., May 12-13, Abstracts with Programs, v. 9, no. 6, p. 743-744.
- _____ 1979, Ground-water-quality data from the northern Powder River Basin, southeastern Montana: U.S. Geological Survey Water-Resources Investigations Open-File Report 79-1331, 55 p.
- _____ 1980, Geochemistry of water in the Fort Union Formation of the northern Powder River Basin, southeastern Montana: U.S. Geological Survey Water-Resources Investigations Open-File Report 80-336, 17 p.
- Leonard, R. B., Brosten, T. M., and Midtlyng, N. A., 1978, Selected data from thermal-spring areas, southwestern Montana: U.S. Geological Survey Open-File Report 78-438, 71 p.
- Leonard, R. B., and Janzer, V. J., 1978, Natural radioactivity in geothermal waters, Alhambra Hot Springs and nearby areas, Jefferson County, Montana: U.S. Geological Survey Journal of Research, v. 6., no. 4, p. 529-540.
- Leonard, R. B., Shields, R. R., and Midtlyng, N. A., 1978, Water-quality investigations near the Chico and Hunters geothermal lease-application areas, Park and Sweet Grass Counties, Montana: U.S. Geological Survey Open-File Report 78-199, 23 p.
- Lewis, B. D., 1977, Geology of the northern Powder River Basin, southeastern Montana [abs.]: Rocky Mountain Section, Geological Society America, 30th Annual Meeting, Boulder, Colo., May 12-13, Abstracts with Programs, v. 9, no. 6, p. 744-745.
- Lewis, B. D., Custer, S. G., and Miller, M. R., 1979, Saline-seep-development in the Hailstone basin, northern Stillwater County, Montana: U.S. Geological Survey Water-Resources Investigations 79-107, 28 p.
- Lewis, B. D., and Roberts, R. S., 1978, Geology and water-yielding characteristics of rocks of the northern Powder River Basin, southeastern Montana: U.S. Geological Survey Miscellaneous Investigations Map I-847-D, 2 sheets.

- McKinley, P. W., 1979, Water quality of selected streams in the coal area of east-central Montana: U.S. Geological Survey Water-Resources Investigations 78-142, 56 p.
- Miller, W. R., 1976, Water in carbonate rocks of the Madison Group in southeastern Montana--A preliminary evaluation: U.S. Geological Survey Water-Supply Paper 2043, 51 p.
- _____ 1979, Water resources of the central Powder River area of southeastern Montana: Montana Bureau of Mines and Geology Bulletin 108, 69 p.
- _____ 1979, Water resources of the southern Powder River area of southeastern Montana: U.S. Geological Survey Open-File Report 79-343, 103 p.
- Miller, W. R., and Strausz, S. A., 1980, Preliminary map showing freshwater heads for the Mission Canyon and Lodgepole Limestones and equivalent rocks of Mississippian age in the northern Great Plains of Montana, North and South Dakota, and Wyoming: Water-Resources Investigations Open-File Map 80-729, 1 sheet.
- _____ 1980, Preliminary map showing freshwater heads for the Red River Formation, Bighorn Dolomite, and equivalent rocks of Ordovician age in the northern Great Plains of Montana, North and South Dakota, and Wyoming: Water-Resources Investigations Open-File Map 80-730, 1 sheet.
- Montana Bureau of Mines and Geology and U.S. Geological Survey, 1978, Ground water of the Fort Union Coal Region, eastern Montana: Montana Bureau of Mines and Geology Special Publication 80, 47 p.
- Moore, L. G., and Shields, R. R., 1980, Streamflow characteristics of the Yellowstone River basin, through 1976: U.S. Geological Survey Water-Resources Investigations 80-41, 67 p.
- Moreland, J. A., Leonard, R. B., Reed, T. E., Clausen, R. O., and Wood, W. A., 1979, Hydrologic data from selected wells in the Helena valley, Lewis and Clark County, Montana: U.S. Geological Survey Open-File Report 79-1676, 54 p.
- Omang, R. J., and Hull, J. A., 1978, Annual peak discharges from small drainage areas in Montana through September 1977: U.S. Geological Survey Open-File Report 78-219, 204 p.
- Omang, R. J., Hull, J. A., and Parrett, Charles, 1979, Annual peak discharges from small drainage areas in Montana for stations discontinued before 1978: U.S. Geological Survey Open-File Report 79-510, 124 p.
- Omang, R. J., Parrett, Charles, and Hull, J. A., 1979, Annual peak discharges from small drainage areas in Montana through September 1978: U.S. Geological Survey Open-File Report 79-522, 114 p.
- _____ 1980, Annual peak discharges from small drainage areas in Montana through September 1979: U.S. Geological Survey Open-File Report 80-340, 114 p.
- Parrett, Charles, Carlson, D. D., Craig, G. S., Jr., and Hull, J. A., 1978, Data for floods of May 1978 in northeastern Wyoming and southeastern Montana: U.S. Geological Survey Open-File Report 78-985, 16 p.

- Rioux, R. P., and Dodge, K. A., 1980, Hydrologic data from the Bull Mountains area, south-central Montana: U.S. Bureau of Land Management report, 148 p.
- Roberts, R. S., 1980, Hydrogeologic data for selected coal areas, east-central Montana: U.S. Geological Survey Water-Resources Investigations Open-File Report 80-329, 63 p.
- Slagle, S. E., and Stimson, J. R., 1979, Hydrogeologic data from the northern Powder River Basin, southeastern Montana: U.S. Geological Survey Water-Resources Investigations Open-File Report 79-1332, 111 p.
- Stoner, J. D., and Lewis, B. D., 1980, Hydrogeology of the Fort Union coal region, eastern Montana: U.S. Geological Survey Miscellaneous Investigations Map I-1236, 2 sheets.
- Swenson, F. A., Miller, W. R., Hodson, W. G., and Visher, F. N., 1976, Maps showing configuration and thickness, and potentiometric surface and water quality in the Madison Group, Powder River Basin, Wyoming and Montana: U.S. Geological Survey Miscellaneous Investigations Map I-847-C, 2 sheets.
- U.S. Geological Survey, 1975, Plan of study of the hydrology of the Madison Limestone and associated rocks in parts of Montana, Nebraska, North Dakota, South Dakota, and Wyoming: U.S. Geological Survey Open-File Report 75-631, 37 p.
- _____ 1976, Water resources data for Montana--Water year 1975: U.S. Geological Survey Water-Data Report MT-75-1, 607 p. [1977].
- _____ 1976, Water-resources investigations of the U.S. Geological Survey in the Northern Great Plains coal region of eastern Montana, 1975-76: U.S. Geological Survey Open-File Report, 29 p.
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Table 1.--Surface-water gaging stations in operation as of October 1980

Station number

Stations are listed in downstream order by standard drainage basin number: Part 5 (Hudson Bay basin), Part 6 (Missouri River basin), and Part 12 (Upper Columbia River basin). Each station number contains a 2-digit part number plus a 6-digit downstream order number. Locations of streamflow and major-reservoir stations are shown on figure 2; locations of stations for small reservoirs are not identified on the map.

Cooperation

BIA	U.S. Bureau of Indian Affairs
BLM	U.S. Bureau of Land Management
BPA	Bonneville Power Administration
FERC	Federal Energy Regulatory Commission
MDFWP	Montana Department of Fish, Wildlife, and Parks
MDHES	Montana Department of Health and Environmental Sciences
MDNRC	Montana Department of Natural Resources and Conservation
MSU	Montana State University
USAE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WPRS	U.S. Water and Power Resources Service
USGS	U.S. Geological Survey
WSE	Wyoming State Engineer
WWT	U.S. Department of State-International Joint Commission, Waterways Treaty

Operating office

- B - Records computed by Billings office
- F - Records computed by Fort Peck office
- H - Records computed by Helena office
- I - Records computed by International Waters Section, Helena office
- K - Records computed by Kalispell office
- W - Records computed by Wyoming district

Gage equipment

- A - Thermograph recorder
- C - CDCP
- D - Digital recorder
- G - Graphic recorder
- M - Manometer (bubbler) gage
- O - Observer record only
- P - Electrical power
- S - Selsyn unit
- T - Telemark, BDT satellite
- W - Well gage

Table 1.--Surface-water gaging stations in operation as of
October 1980--Continued

Station number	Station name	Coop- era- tion	Oper- ating office	Gage equip- ment
<u>Part 5</u>				
05014500	Swiftcurrent Creek at Many Glacier	USGS	I	DWP
05015500	Lake Sherburne at Sherburne	WWT	I	GMP
05016000	Swiftcurrent Creek at Sherburne	WWT	I	DGWP
05017500	St. Mary River near Babb	WWT	I	DGW
05018500	St. Mary Canal at St. Mary Crossing, near Babb	WWT	I	GW
05020500	St. Mary River at international boundary	WWT	I	GWTP
<u>Part 6</u>				
06012000	Lima Reservoir near Monida	MDNRC	H	O
06012500	Red Rock River below Lima Reservoir, near Monida	WPRS	H	DW
06014500	Red Rock River at Red Rock	WPRS	H	DGM
06015300	Clark Canyon Reservoir near Grant	USGS	H	G
06015400	Beaverhead River near Grant	WPRS	H	DGWC
06016000	Beaverhead River at Barretts	WPRS	H	DGWC
06018000	Beaverhead River near Dillon	WPRS	H	DGWC
06018500	Beaverhead River near Twin Bridges	USGS	H	DGWC
06019500	Ruby River above reservoir, near Alder	MDNRC	H	DWG
06020500	Ruby River Reservoir near Alder	MDNRC	H	O
06020600	Ruby River below reservoir, near Alder	MDNRC	H	DW
06023000	Ruby River near Twin Bridges	MDFWP	H	DGMA
06024580	Big Hole River near Wise River	MDFWP	H	DGMA
06024590	Wise River near Wise River	MDNRC	H	DGM
06025500	Big Hole River near Melrose	MDNRC	H	DWTPGAC
06026400	Big Hole River near Twin Bridges	MDFWP	H	DGMA
06035000	Willow Creek near Harrison	MDNRC	H	DWG
06036000	Willow Creek Reservoir near Harrison	MDNRC	H	O
06036650	Jefferson River near Three Forks	MDFWP	H	DGMPA
06038000	Hebgen Lake near West Yellowstone	FERC	H	O
06038500	Madison River below Hebgen Lake, near Grayling	FERC	H	DWGP
06038800	Madison River at Kirby Ranch, near Camerson	MDFWP	H	O
06040300	Jack Creek near Ennis	MDNRC	H	DGWP
06040500	Ennis Lake near McAllister	FERC	H	O
06041000	Madison River below Ennis Lake, near McAllister	FERC	H	DWGSPA
06043500	Gallatin River near Gallatin Gateway	USAE	H	DGWT
06049500	Middle Creek Reservoir near Bozeman	MDNRC	H	O
06050000	Hyalite Creek at Hyalite ranger station, near Bozeman	MDNRC	H	DGW

Table 1.--Surface-water gaging stations in operation as of
October 1980--Continued

Station number	Station name	Coop- era- tion	Oper- ating office	Gage equip- ment
<u>Part 6--Continued</u>				
06052500	Gallatin River at Logan	USAE	H	DWTPGA
06054500	Missouri River at Toston	USGS	H	DGWTP
06058500	Canyon Ferry Reservoir near Helena	USGS	H	GWSP
06062500	Tenmile Creek near Rimini	MSU	H	DGWP
06064500	Lake Helena near Helena	FERC	H	0
06065000	Hauser Lake near Helena	FERC	H	0
06066000	Holter Lake near Wolf Creek	FERC	H	0
06066500	Missouri River below Holter Dam, near Wolf Creek	FERC	H	DGWSP
06075000	Smith River Reservoir near White Sulphur Springs	MDNRC	H	0
06076690	Smith River near Fort Logan	MDFWP	H	DGM
06078200	Missouri River near Ulm	USAE	H	DW
06079500	Gibson Reservoir near Augusta	MDNRC	H	0
06080500	Pishkun Reservoir near Augusta	MDNRC	H	0
06082000	Willow Creek Reservoir near Augusta	MDNRC	H	0
06083000	Nilan Reservoir near Augusta	MDNRC	H	0
06088300	Muddy Creek near Vaughn	WPRS	H	DGW
06088500	Muddy Creek at Vaughn	WPRS	H	DGM
06089000	Sun River near Vaughn	FERC	H	DGWP
06090300	Missouri River near Great Falls	FERC	H	DGMSP
06090500	Belt Creek near Monarch	USGS	H	DWP
06090610	Belt Creek near Portage	WPRS	H	DGMA
06090720	Highwood Creek near Portage	WPRS	H	DGMA
06090800	Missouri River at Fort Benton	USGS	H	DGWTP
06090900	Lower Two Medicine Lake near East Glacier	MDNRC	H	0
06091700	Two Medicine River below South Fork, near Browning	BIA	H	DGM
06093000	Four Horns Lake near Heart Butte	MDNRC	H	0
06093200	Badger Creek below Four Horns Canal, near Browning	USGS	H	DGWP
06094000	Swift Reservoir near Dupuyer	MDNRC	H	0
06095500	Lake Frances near Valier	MDNRC	H	0
06098100	Birch Creek near Valier	USGS	H	DGM
06099500	Marias River near Shelby	USGS	H	DGMPC
06101200	Willow Creek near Galata	MDNRC	H	GM
06101300	Lake Elwell near Chester	USGS	H	0
06101500	Marias River near Chester	WPRS	H	DW
06101560	Pondera Coulee near Chester	MDNRC	H	DGM
06108000	Teton River near Dutton	USGS	H	DGMP
06109500	Missouri River at Virgelle	USAE	H	DGWPA
06110500	Ackley Lake near Hobson	MDNRC	H	0
06112500	Deadmans Basin Reservoir near Shawmut	MDNRC	H	0

Table 1.--Surface-water gaging stations in operation as of
October 1980--Continued

Station number	Station name	Coop- era- tion	Oper- ating office	Gage equip- ment
<u>Part 6--Continued</u>				
06115200	Missouri River near Landusky	USGS	B	DGMPW
06116500	Bair Reservoir near Delpine	MDNRC	H	O
06119000	Martinsdale Reservoir near Martinsdale	MDNRC	H	O
06120500	Musselshell River at Harlowton	MDNRC	B	DGWT
06126470	Half Breed Creek near Klein	BLM	B	DGM
06126500	Musselshell River near Roundup	MDNRC	B	DGWP
06130500	Musselshell River at Mosby	MDNRC	F	O
06131000	Big Dry Creek near Van Norman	USAE, USGS	F	GM
06131200	Nelson Creek near Van Norman	USGS	F	DGM
06131500	Fort Peck Lake at Fort Peck	USAE	H	GW
06132000	Missouri River below Fort Peck Dam	USGS	F	DGM
06132200	South Fork Milk River near Babb	WWT	I	DWGP
06133000	Milk River at western crossing of international boundary	WWT	I	DGWT
06133500	North Fork Milk River above St. Mary Canal, near Browning	WWT	I	DGWPT
06134000	North Milk River near international boundary	WWT	I	DGWT
06134500	Milk River at Milk River, Alberta	WWT	I	GWTP
06134850	Milk River near Writing-on-Stone Park, Alberta	WWT	I	GW
06134950	Milk River near Pendant d'Oreille, Alberta	WWT	I	GW
06135000	Milk River at eastern crossing of international boundary	WWT	I	DGWTP
06135500	Sage Creek at Q Ranch, near Wild Horse, Alberta	WWT	I	GW
06136000	Sage Creek at international boundary	WWT	I	GW
06136500	Fresno Reservoir near Havre	MDNRC	H	O
06137570	Boxelder Creek near Rocky Boy	USGS	H	DGWP
06137580	Sage Creek near Whitlash	MDNRC	H	DGW
06140500	Milk River at Havre	USAE	H	DGM
06144260	Altawan Reservoir near Govenlock, Saskatchewan	WWT	I	GWM
06144270	Spangler Ditch near Govenlock, Saskatchewan	WWT	I	GW
06144350	Middle Creek near Alberta boundary	WWT	I	GW
06144360	Middle Creek Reservoir near Battle Creek, Saskatchewan	WWT	I	GM
06144395	Middle Creek below Middle Creek Reservoir, near Govenlock, Saskatchewan	WWT	I	GW
06145500	Lodge Creek below McRae Creek, at international boundary	WWT	I	GWTP
06147950	Gaff Ditch near Merryflat, Saskatchewan	WWT	I	GW

Table 1.--Surface-water gaging stations in operation as of
October 1980--Continued

Station number	Station name	Coop- era- tion	Oper- ating office	Gage equip- ment
<u>Part 6--Continued</u>				
06148500	Cypress Lake west inflow canal near West Plains, Saskatchewan	WWT	I	GW
06148700	Cypress Lake west inflow canal drain near Oxarat, Saskatchewan	WWT	I	GW
06149000	Cypress Lake west outflow canal near West Plains, Saskatchewan	WWT	I	GWP
06149100	Vidora Ditch near Consul, Saskatchewan	WWT	I	GW
06149200	Richardson Ditch near Consul, Saskatchewan	WWT	I	GW
06149300	McKinnon Ditch near Consul, Saskatchewan	WWT	I	GW
06149400	Nashlyn Canal near Consul, Saskatchewan	WWT	I	GW
06149500	Battle Creek at international boundary	WWT	I	DGWT
06151000	Lyons Creek at international boundary	WWT	I	GW
06154400	Peoples Creek near Hays	BIA	F	DGW
06154410	Little Peoples Creek near Hays	USGS	F	GM
06155000	Nelson Reservoir near Saco	MDNRC	H	O
06156500	Belanger Creek diversion canal near Vidora, Saskatchewan	WWT	I	GWP
06157000	Cypress Lake near Vidora, Saskatchewan	WWT	I	GW
06157500	Cypress Lake east outflow canal near Vidora, Saskatchewan	WWT	I	GWP
06158500	Eastend Canal at Eastend, Saskatchewan	WWT	I	GW
06159000	Eastend Reservoir at Eastend, Saskatchewan	WWT	I	GM
06159500	Frenchman River below Eastend Reservoir, near Eastend, Saskatchewan	WWT	I	GWP
06161300	Huff pumping canal near Val Marie, Saskatchewan	WWT	I	GW
06161500	Huff gravity canal near Val Marie, Saskatchewan	WWT	I	GW
06162000	Huff Reservoir near Val Marie, Saskatchewan	WWT	I	GM
06162500	Newton Canal near Val Marie, Saskatchewan	WWT	I	GW
06163000	Newton Reservoir near Val Marie, Saskatchewan	WWT	I	GM
06163050	Frenchman River below Newton Reservoir, near Val Marie, Saskatchewan	WWT	I	GW
06164000	Frenchman River at international boundary	WWT	I	GWTP
06164510	Milk River at Juneberg Bridge, near Saco	WPRS	F	DGMP
06164800	Beaver Creek above Dix Creek, near Malta	MDNRC	F	DGM
06166000	Beaver Creek below Guston Coulee, near Saco	USFWS	F	GM
06169500	Rock Creek below Horse Creek, near international boundary	USGS	I	DGWP
06174000	Willow Creek near Glasgow	USGS	F	GM
06174500	Milk River at Nashua	USAE	F	DGWP

Table 1.--Surface-water gaging stations in operation as of
October 1980--Continued

Station number	Station name	Cooperation	Operating office	Gage equipment
<u>Part 6--Continued</u>				
06175540	Prairie Elk Creek near Oswego	USGS	F	DGM
06177000	Missouri River near Wolf Point	USAE	F	DGWP
06177500	Redwater River at Circle	USGS	F	DGWP
06177825	Redwater River near Vida	USGS	F	DGM
06178000	Poplar River at international boundary	WWT	F	DGWTMP
06178500	East Poplar River at international boundary	WWT	F	DGWPT
06181995	Beaver Creek at international boundary	WWT	F	GWP
06183450	Big Muddy Creek near Antelope	USGS	F	GMPD
06185500	Missouri River near Culbertson	USAE	F	DGM
06186000	Yellowstone Lake at Bridge Bay, Yellowstone National Park	USGS	B	O
06186500	Yellowstone River at Yellowstone Lake Outlet, Yellowstone National Park	USGS	B	GW
06191500	Yellowstone River at Corwin Springs	USAE	B	GWTPAC
06192500	Yellowstone River near Livingston	USAE	B	DGWPA
06195600	Shields River near Livingston	MDFWP	B	DGM
06200000	Boulder River at Big Timber	MDNRC	B	DGWP
06202510	Stillwater River above Nye Creek, near Nye	MDFWP	B	O
06204000	Mystic Lake near Roscoe	FERC	H	O
06204050	West Rosebud Creek near Roscoe	FERC	B	GDWP
06205000	Stillwater River near Absarokee	USAE	B	DWTGM
06207500	Clarks Fork Yellowstone River near Belfry	MDNRC	B	GMP
06207510	Big Sand Coulee at Wyoming-Montana State line	BLM	B	GM
06208800	Clarks Fork Yellowstone River near Silesia	MDNRC, WSE	B	DGWPA
06209500	Rock Creek near Red Lodge	MDNRC	B	DGWPTC
06211000	Red Lodge Creek above Cooney Reservoir, near Boyd	MDNRC	B	DW
06211500	Willow Creek near Boyd	MDNRC	B	DW
06212000	Cooney Reservoir near Boyd	MDNRC	H	O
06212500	Red Lodge Creek below Cooney Reservoir, near Boyd	MDNRC	B	DWP
06214500	Yellowstone River at Billings	USAE	B	DGWTP
06216000	Pryor Creek at Pryor	USGS	B	DWP
06216900	Pryor Creek near Huntley	USGS	B	DGM
06217750	Fly Creek at Pompeys Pillar	USGS	B	O
06217950	Buffalo Creek near Custer	USGS	B	O
06286400	Bighorn Lake near St. Xavier	USGS	H	GW
06287000	Bighorn River near St. Xavier	WPRS	B	DGWP
06289000	Little Bighorn River at State line, near Wyola	USGS	B	DGW
06290500	Little Bighorn River below Pass Creek, near Wyola	USGS	B	DGW

Table 1.--Surface-water gaging stations in operation as of
October 1980--Continued

Station number	Station name	Cooperation	Operating office	Gage equipment
<u>Part 6--Continued</u>				
06291000	Owl Creek near Lodge Grass	USGS	B	GMD
06294000	Little Bighorn River near Hardin	MDNRC, WSE	B	DW
06294690	Tullock Creek near Bighorn	MDNRC	B	GM
06294700	Bighorn River at Bighorn	MDNRC, WSE	B	DGWA
06294940	Sarpy Creek near Hysham	MDNRC	B	DGW
06294950	Starve to Death Creek near Sanders	USGS	B	O
06294995	Armells Creek near Forsyth	MDNRC	B	GW
06295000	Yellowstone River at Forsyth	MDNRC	B	DGM
06295113	Rosebud Creek at reservation boundary near Kirby	USGS	B	MG
06295250	Rosebud Creek near Colstrip	USGS	B	DGM
06296003	Rosebud Creek at mouth, near Rosebud	USGS	B	DGM
06306100	Squirrel Creek near Decker	USGS	B	DGM
06306300	Tongue River at State line, near Decker	MDNRC	B	DWGP
06307000	Tongue River Reservoir near Decker	MDNRC	H	O
06307500	Tongue River at Tongue River Dam, near Decker	MDNRC	B	DWG
06307525	Prairie Dog Creek above Jack Creek, near Birney	BLM	B	DGM
06307528	Prairie Dog Creek near Birney	BLM	B	DGM
06307560	East Trail Creek near Otter	BLM	B	GM
06307600	Hanging Woman Creek near Birney	MDNRC	B	DGW
06307616	Tongue River at Birney Day School Bridge, near Birney	USGS	B	GWP
06307740	Otter Creek at Ashland	MDNRC	B	DWGP
06307830	Tongue River below Brandenburg Bridge, near Ashland	MDNRC	B	DGW
06308400	Pumpkin Creek near Miles City	MDNRC	B	DW
06308500	Tongue River at Miles City	MDNRC, WSE	B	DGW
06309000	Yellowstone River at Miles City	USAE	B	DGTMP
06309075	Sunday Creek near Miles City	MDNRC	B	GDM
06324500	Powder River at Moorhead	MDNRC	W	DGW
06324710	Powder River at Broadus	MFS	B	DGM
06326300	Mizpah Creek near Mizpah	USGS	B	DGM
06326500	Powder River near Locate	MDNRC, WSE	B	DGWP
06326555	Cherry Creek near Terry	BLM	F	DGM
06326600	O'Fallon Creek near Ismay	USGS	B	DGM
06329200	Burns Creek near Savage	BLM	F	DGMP
06329500	Yellowstone River near Sidney	USAE	F	DGMPT
06336500	Beaver Creek at Wibaux	BLM	F	GMPD

Table 1.--Surface-water gaging stations in operation as of
October 1980--Continued

Station number	Station name	Coop- era- tion	Oper- ating office	Gage equip- ment
<u>Part 12</u>				
12301300	Tobacco River near Eureka	USAE	K	DGWA
12301550	Pinkham Creek near Rexford	USAE	K	DGM
12301810	Big Creek near Rexford	USAE	K	DGM
12301920	Lake Koocanusa near Libby	USAE	K	GW
12301933	Kootenai River below Libby Dam, near Libby	USAE	K	DGMP
12302055	Fisher River near Libby	USAE	K	DGWAP
12303000	Kootenai River at Libby	USAE	K	DGWPT
12303100	Flower Creek near Libby	MSU	K	DGW
12304500	Yaak River near Troy	USAE	K	DGWAP
12324200	Clark Fork at Deer Lodge	MDFWP	H	DGMA
12324590	Little Blackfoot River near Garrison	MDNRC	H	DGW
12324680	Clark Fork at Goldcreek	MDFWP	H	DGM
12325000	Georgetown Lake near Southern Cross	FERC	H	O
12325500	Flint Creek near Southern Cross	FERC	H	O
12329500	Flint Creek at Maxville	MDNRC	H	DGW
12330000	Boulder Creek at Maxville	MDNRC	H	DGW
12331600	Clark Fork at Drummond	MDNRC	H	O
12331900	Clark Fork near Clinton	MDFWP	H	OA
12332000	Middle Fork Rock Creek near Philipsburg	MDNRC	H	DGW
12332500	East Fork Rock Creek Reservoir near Philipsburg	MDNRC	H	DGW PAC
12334510	Rock Creek near Clinton	MDNRC	H	DGW PAC
12335500	Nevada Creek above reservoir, near Finn	MDNRC	H	DGM
12336500	Nevada Lake near Finn	MDNRC	H	O
12338690	Monture Creek near Ovando	MDNRC	H	DGW
12339450	Clearwater River near Clearwater	MDNRC	H	DGW
12340000	Blackfoot River near Bonner	MFS	H	DGWTP
12340500	Clark Fork above Missoula	USAE	H	DGWAP
12342000	Painted Rocks Lake near Conner	MDNRC	H	O
12342500	West Fork Bitterroot River near Conner	MDNRC	H	DGWP
12344000	Bitterroot River near Darby	MDNRC	H	DGW T CP
12344500	Lake Como near Darby	MDNRC	H	O
12353000	Clark Fork below Missoula	MDHES	K	DGW T AP
12353280	Ninemile Creek near Huson	MDNRC	K	DGW
12354500	Clark Fork at St. Regis	USGS	K	DGWTP
12355000	Flathead River at Flathead, British Columbia	WWT	K	GMA
12355500	North Fork Flathead River near Columbia Falls	USGS	K	GMDA
12358500	Middle Fork Flathead River near West Glacier	BPA	K	DGWTP
12359800	South Fork Flathead River above Twin Creek, near Hungry Horse	MDFWP	K	DGWA
12362000	Hungry Horse Reservoir near Hungry Horse	WPRS	K	GW

Table 1.--Surface-water gaging stations in operation as of
October 1980--Continued

Station number	Station name	Coop- era- tion	Oper- ating office	Gage equip- ment
<u>Part 12--Continued</u>				
12362500	South Fork Flathead River near Columbia Falls	WPRS	K	DGWSAP
12363000	Flathead River at Columbia Falls	FERC	K	DGWTAP
12363920	Stillwater River at Olney	MDNRC	K	DGW
12365000	Stillwater River near Whitefish	MDNRC	K	DGWA
12365800	Swift Creek near Whitefish	MDNRC	K	DGWMA
12366000	Whitefish River near Kalispell	MDNRC	K	DGW
12369200	Swan River near Condon	MDNRC	K	DGWA
12370000	Swan River near Bigfork	BPA	K	DGWP
12371500	Flathead Lake at Somers	FERC	K	GW
12372000	Flathead River near Polson	FERC	K	GWSAP
	Camas Reservoirs - Group of 4	BIA	H	O
	Mission Valley Reservoirs - Group of 8	BIA	H	O
12380500	Lower Jocko Lake near Arlee	BIA	H	O
12389000	Clark Fork near Plains	FERC	K	DGWTP
12389500	Thompson River near Thompson Falls	FERC	K	DGWP
12390000	Thompson Falls Reservoir at Thompson Falls	FERC	H	O
12390700	Prospect Creek at Thompson Falls	FERC	K	DGWP
12391300	Noxon Rapids Reservoir near Noxon	FERC	H	GW
12391400	Clark Fork below Noxon Rapids Dam, near Noxon	FERC	H	O
12391550	Bull River near Noxon	MDNRC	K	DGM

Table 2.--Surface-water-quality stations in operation as of October 1980

Station number

Stations are listed in downstream order by standard drainage basin number: Part 5 (Hudson Bay basin), Part 6 (Missouri River basin) and Part 12 (Upper Columbia River basin). Each station number contains a 2-digit part number plus a 6-digit downstream order number. Locations of the stations are shown on figure 3.

Cooperation

BIA	U.S. Bureau of Indian Affairs
BLM	U.S. Bureau of Land Management
EPA	U.S. Environmental Protection Agency
MDFWP	Montana Department of Fish, Wildlife, and Parks
USAE	U.S. Army Corps of Engineers
WPRS	U.S. Water and Power Resources Service
USGS	U.S. Geological Survey
WWT	U.S. Department of State-International Joint Commission, Waterways Treaty
USFWS	U.S Fish and Wildlife Service

Operating office

- B - Data collected by Billings office
- F - Data collected by Fort Peck office
- H - Data collected by Helena office
- I - Data collected by International Waters
Section, Helena office
- K - Data collected by Kalispell office
- W - Data collected by Wyoming district

Sampling frequency

- 0 Once-daily, continuous
- 1 Once-daily, seasonal
- 2 Semimonthly
- 3 Monthly, seasonal
- 4 Monthly
- 5 Miscellaneous
- 6 Continuous record

Table 2.--Surface-water-quality stations in operation as of October 1980--Continued

Station number	Station name	Cooperation	Operating office	Sampling frequency				Specific conductance
				Chemical	Sediment	Temperature	Biological	
<u>Part 5</u>								
05019000	St. Mary Canal at Hudson Bay Divide, near Browning	WWT	I	5	-	5	-	-
05020500	St. Mary River at international boundary	USGS	H	4	4	0	4	0
<u>Part 6</u>								
06018500	Beaverhead River near Twin Bridges	USGS	H	4	-	0	-	0
06023000	Ruby River near Twin Bridges	MDFWP	H	-	-	6	-	-
06024580	Big Hole River near Wise River	MDFWP	H	-	-	6	-	-
06025500	Big Hole River near Melrose	MDFWP	H	-	-	6	-	-
06026400	Big Hole River near Twin Bridges	MDFWP	H	-	-	6	-	-
06036650	Jefferson River near Three Forks	MDFWP	H	-	-	6	-	-
06041000	Madison River below Ennis Lake, near McAllister	MDFWP	H	-	-	6	-	-
06052500	Gallatin River at Logan	MDFWP	H	-	-	6	-	-
06054500	Missouri River at Toston	MDFWP, USGS	H	4	4	6	4	0
06058502	Missouri River below Canyon Ferry Dam, near Helena	USGS	H	4	-	0	-	0
06088300	Muddy Creek near Vaughn	WPRS	H	4	0	0	-	0
06088500	Muddy Creek at Vaughn	WPRS	H	4	0	0	-	0
06089000	Sun River near Vaughn	USGS	H	4	-	0	-	0
06090500	Belt Creek near Monarch	MDFWP	H	-	-	6	-	-
06090600	Belt Creek near Portage	WPRS	H	4	4	6	-	4
06090720	Highwood Creek near Portage	WPRS	H	4	4	6	-	4
06090800	Missouri River at Ft. Benton	WPRS	H	4	4	6	4	4
06091700	Two Medicine River below South Fork, near Browning	BIA	H	-	-	-	-	4
06093200	Badger Creek below Four Horns Canal, near Browning	USGS	H	-	-	-	-	4
06098100	Birch Creek near Valier	USGS	H	4	-	0	-	0
06099500	Marias River near Shelby	USGS	H	-	-	-	-	4
06101500	Marias River near Chester	USGS	H	4	4	0	4	0
06109500	Missouri River at Virgelle	USGS, MDFWP	H	4	4	6	4	0
06115200	Missouri River near Landusky	USGS, USAE	F	4	0	0	4	0
06126450	Rehder Creek near Klein	BLM	B	4	4	4	-	4
06126470	Half Breed Creek near Klein	BLM	B	4	4	4	-	4

Table 2.--Surface-water-quality stations in operation as of October 1980--Continued

Station number	Station name	Coop- era- tion	Oper- ating office	Sampling frequency				Spe- cific con- duc- tance
				Chem- ical	Sedi- ment	Tem- per- ature	Bio- log- ical	
<u>Part 6--Continued</u>								
06126500	Musselshell River near Roundup	BLM	B	4	4	4	-	4
06127150	East Parrot Creek near Roundup	BLM	B	4	4	4	-	4
06127160	West Parrot Creek near Roundup	BLM	B	4	4	4	-	4
06127300	Fattig Creek near Delphia	BLM	B	4	4	4	-	4
06130500	Musselshell River at Mosby	USGS	F	4	4	0	4	0
06131000	Big Dry Creek near Van Norman	USAE	F	5	-	5	-	5
06132000	Missouri River below Fort Peck Dam	USGS	F	4	4	0	4	0
06134000	North Milk River near international boundary	WWT	I	5	-	5	-	-
06137570	Boxelder Creek near Rocky Boy	USGS	H	5	5	5	5	5
06154400	Peoples Creek near Hays	BIA	F	-	-	-	-	4
06154410	Little Peoples Creek near Hays	USGS	F	5	5	5	5	5
06164510	Milk River at Juneburg Bridge near Saco	USGS	F	4	-	0	-	0
06166000	Beaver Creek below Guston Coulee, near Saco	USFWS	F	5	-	5	-	-
06169500	Rock Creek below Horse Creek at international boundary	USGS	F	4	4	4	4	4
06174000	Willow Creek near Glasgow	USGS	F	-	-	-	-	4
06174500	Milk River at Nashua	USGS	F	4	4	0	4	0
06177000	Missouri River near Wolf Point	MDFWP	F	-	-	6	-	-
06177500	Redwater River at Circle	USGS	F	4	4	4	-	4
06177825	Redwater River near Vida	USGS	F	4	4	4	-	4
06178000	Poplar River at international boundary	USGS, EPA	F	4	4	4	-	4
06178500	East Poplar River at international boundary	WWT	F	4	4	6	4	4
06179000	East Fork Poplar River near Scobey	USGS, EPA	F	4	4	4	-	4
06179200	Poplar River above West Fork, near Bredette	USGS, EPA	F	4	4	4	-	4
06179500	West Fork Poplar River at international boundary	USGS	F	5	-	5	-	-
06180400	West Fork Poplar River near Bredette	BIA	F	4	4	4	-	4
06181000	Poplar River near Poplar	USGS, EPA	F	4	4	4	-	4
06181995	Beaver Creek at international boundary	WWT	F	5	5	5	-	5
06183450	Big Muddy Creek near Antelope	USGS	F	4	4	4	-	4
06185150	Hardscrabble Creek near Culbertson	BLM	F	4	4	4	-	4
06185500	Missouri River near Culbertson	USGS	F	4	4	0	4	0

Table 2.--Surface-water-quality stations in operation as of October 1980--Continued

Station number	Station name	Coop- era- tion	Oper- ating office	Sampling frequency				
				Chem- ical	Sedi- ment	Tem- per- ature	Bio- log- ical	Spe- cific con- duc- tance
<u>Part 6--Continued</u>								
06191500	Yellowstone River at Corwin Springs	MDFWP	B	-	-	6	-	-
06192500	Yellowstone River near Livingston	USGS	B	4	4	6	4	0
06207500	Clarks Fork Yellowstone River near Belfry	USGS	B	4	-	4	-	4
06207510	Big Sand Coulee at Wyoming-- Montana State line	USGS	B	5	1	1	-	5
06208800	Clarks Fork Yellowstone River near Silesia	MDFWP	B	-	-	6	-	-
06214500	Yellowstone River at Billings	USGS	B	4	0	0	4	0
06216000	Pryor Creek at Pryor	USGS	B	-	-	-	-	4
06216900	Pryor Creek near Huntley	USGS	B	-	-	-	-	4
06217500	Yellowstone River at Huntley	EPA	B	4	-	4	0	4
06217750	Fly Creek at Pompeys Pillar	USGS	B	4	-	0	-	0
06217950	Buffalo Creek near Custer	USGS	B	-	-	-	-	4
06287000	Bighorn River near St. Xavier	USGS	B	4	-	0	-	0
06289000	Little Bighorn at State line, near Wyola	USGS	B	-	-	-	-	4
06290500	Little Bighorn River below Pass Creek, near Wyola	USGS	B	-	-	-	-	4
06291000	Owl Creek near Lodge Grass	USGS	B	-	-	-	-	4
06294700	Bighorn River at Bighorn	USGS	B	4	4	6	4	0
06294920	East Fork Sarpy Creek near Colstrip	BLM	B	4	4	4	-	4
06294940	Sarpy Creek near Hysham	USGS	B	4	4	4	-	4
06294980	East Fork Armells Creek near Colstrip	BLM	B	4	4	4	-	4
06294995	Armells Creek near Forsyth	BLM	B	4	4	4	-	4
06295000	Yellowstone River at Forsyth	USGS	B	4	0	4	-	4
06295113	Rosebud Creek at reservation boundary, near Kirby	BLM	B	4	4	4	-	4
06295250	Rosebud Creek near Colstrip	BLM	B	4	4	4	-	4
06295380	Cow Creek near Colstrip	BLM	B	4	4	4	-	4
06295420	Snider Creek near Brandenburg	BLM	B	4	4	4	-	4
06296003	Rosebud Creek at mouth, near Rosebud	BLM	B	4	4	4	-	4
06296120	Yellowstone River near Miles City	USGS	B	4	4	0	4	0
06306100	Squirrel Creek near Decker	USGS	B	4	4	4	-	4
06306300	Tongue River at State line near Decker	USGS	B	4	-	4	4	4
06306900	Spring Creek near Decker	BLM	B	4	4	4	-	4

Table 2.--Surface-water-quality stations in operation as of October 1980--Continued

Station number	Station name	Coop- era- tion	Oper- ating office	Sampling frequency				Spe- cific con- duc- tance
				Chem- ical	Sedi- ment	Tem- pera- ture	Bio- log- ical	
<u>Part 6--Continued</u>								
06307500	Tongue River at Tongue River Dam, near Decker	BLM	B	4	4	4	-	4
06307528	Prairie Dog Creek near Birney	BLM	B	4	4	4	-	4
06307540	Hanging Woman Creek at State line, near Otter	BLM	B	4	4	4	-	4
06307545	Waddle Creek near Otter	BLM	B	4	4	4	-	4
06307550	Trail Creek near Otter	BLM	B	4	4	4	-	4
06307560	East Trail Creek near Otter	BLM	B	4	4	4	-	4
06307563	Corral Creek near Otter	BLM	B	4	4	4	-	4
06307567	Horse Creek near Birney	BLM	B	4	4	4	-	4
06307570	Hanging Woman Creek below Horse Creek, near Birney	BLM	B	4	4	4	-	4
06307600	Hanging Woman Creek near Birney	BLM	B	4	4	4	-	4
06307616	Tongue River at Birney Day School Bridge, near Birney	USGS	B	4	4	4	-	4
06307665	Otter Creek near Otter	BLM	B	4	4	4	-	4
06307717	Otter Creek below Fifteenmile Creek, near Otter	BLM	B	4	4	4	-	4
06307735	Home Creek near Ashland	BLM	B	4	4	4	-	4
06307740	Otter Creek at Ashland	BLM	B	7	4	4	-	4
06307830	Tongue River below Brandenburg Bridge, near Ashland	BLM	B	4	0	0	-	4
06308400	Pumpkin Creek near Miles City	BLM	B	4	4	4	-	4
06308500	Tongue River at Miles City	USGS	B	-	0	6	4	0
06309000	Yellowstone River at Miles City	MDFWP	B	-	-	6	-	-
06324500	Powder River at Moorhead	USGS	W	4	1	4	-	4
06324710	Powder River at Locate	USGS	B	-	1	-	-	-
06326300	Mizpah Creek near Mizpah	USGS	B	4	4	4	-	7
06326500	Powder River near Locate	USGS	B	4	0	0	4	0
06326507	Locate Creek near Ismay	BLM	B	4	4	4	-	4
06326520	Powder River at mouth, near Terry	MDFWP	B	-	-	6	-	-
06326530	Yellowstone River near Terry	USGS	B	4	4	4	-	4
06326555	Cherry Creek near Terry	BLM	B	4	4	4	-	4
06326600	O'Fallon Creek near Ismay	USGS	B	4	4	4	-	4
06327850	Glendive Creek near Glendive	BLM	F	4	4	4	-	4
06329000	Cottonwood Creek near Intake	BLM	F	4	4	4	-	4
06329500	Yellowstone River near Sidney	USGS, USAE	F	4	0	6	4	0
06329520	Fox Creek near Lambert	BLM	F	4	4	4	-	4
06329540	Lone Tree Creek near Sidney	BLM	F	4	4	4	-	4
06336500	Beaver Creek at Wibaux	BLM	F	4	4	4	-	4

Table 2.--Surface-water-quality stations in operation as of October 1980--Continued

Station number	Station name	Coop- era- tion	Oper- ating office	Sampling frequency				
				Chem- ical	Sedi- ment	Tem- per- ature	Bio- log- ical	Spe- cific con- duc- tance
<u>Part 6--Continued</u>								
---	Huntley Project Drain No. 7 near Worden	USGS	B	4	-	4	-	4
---	Lake Bowdoin near Malta	USFWS	F	5	-	5	-	-
---	Dry Lake near Saco	USFWS	F	5	-	5	-	5
---	Fort Peck Lake above Hell Creek, near Jordan	USAE	F	5	-	5	-	5
---	Fort Peck Lake near Fort Peck Dam, near Fort Peck	USAE	F	5	-	5	-	5
<u>Part 12</u>								
12300110	Lake Koocanusa at international boundary	USAE	K	2	-	2	2	2
12301300	Tobacco River near Eureka	USAE	K	-	-	6	-	-
12301830	Lake Koocanusa at Tenmile Creek near Libby	USAE	K	2	-	2	2	2
12301919	Lake Koocanusa at Forebay, near Libby	USAE	K	2	-	2	2	2
12301933	Kootenai River below Libby Dam, near Libby	USAE	K	2	-	2	-	2
12302055	Fisher River near Libby	USAE	K	-	-	6	-	-
12304500	Yaak River near Troy	USAE	K	-	-	6	-	-
12324200	Clark Fork at Deer Lodge	MDFWP	H	-	-	6	-	-
12331900	Clark Fork near Clinton	MDFWP	H	-	-	6	-	-
12334510	Rock Creek near Clinton	MDFWP	H	-	-	6	-	-
12340500	Clark Fork above Missoula	MDFWP	K	-	-	6	-	-
12353000	Clark Fork below Missoula	USGS	K	4	4	6	4	0
12355000	Flathead River at Flathead, British Columbia	USGS	K	4	4	6	4	0
12355500	North Fork Flathead River near Columbia Falls	MDFWP	K	-	-	6	-	-
12362500	South Fork Flathead River near Columbia Falls	MDFWP	K	-	-	6	-	-
12363000	Flathead River at Columbia Falls	USGS	K	4	4	6	4	0
12365000	Stillwater River near Whitefish	MDFWP	K	-	-	6	-	-
12365800	Swift Creek near Whitefish	MDFWP	K	-	-	6	-	-
12366000	Whitefish River near Kalispell	MDFWP	K	-	-	6	-	-
12372000	Flathead River near Polson	MDFWP	K	-	-	6	-	-

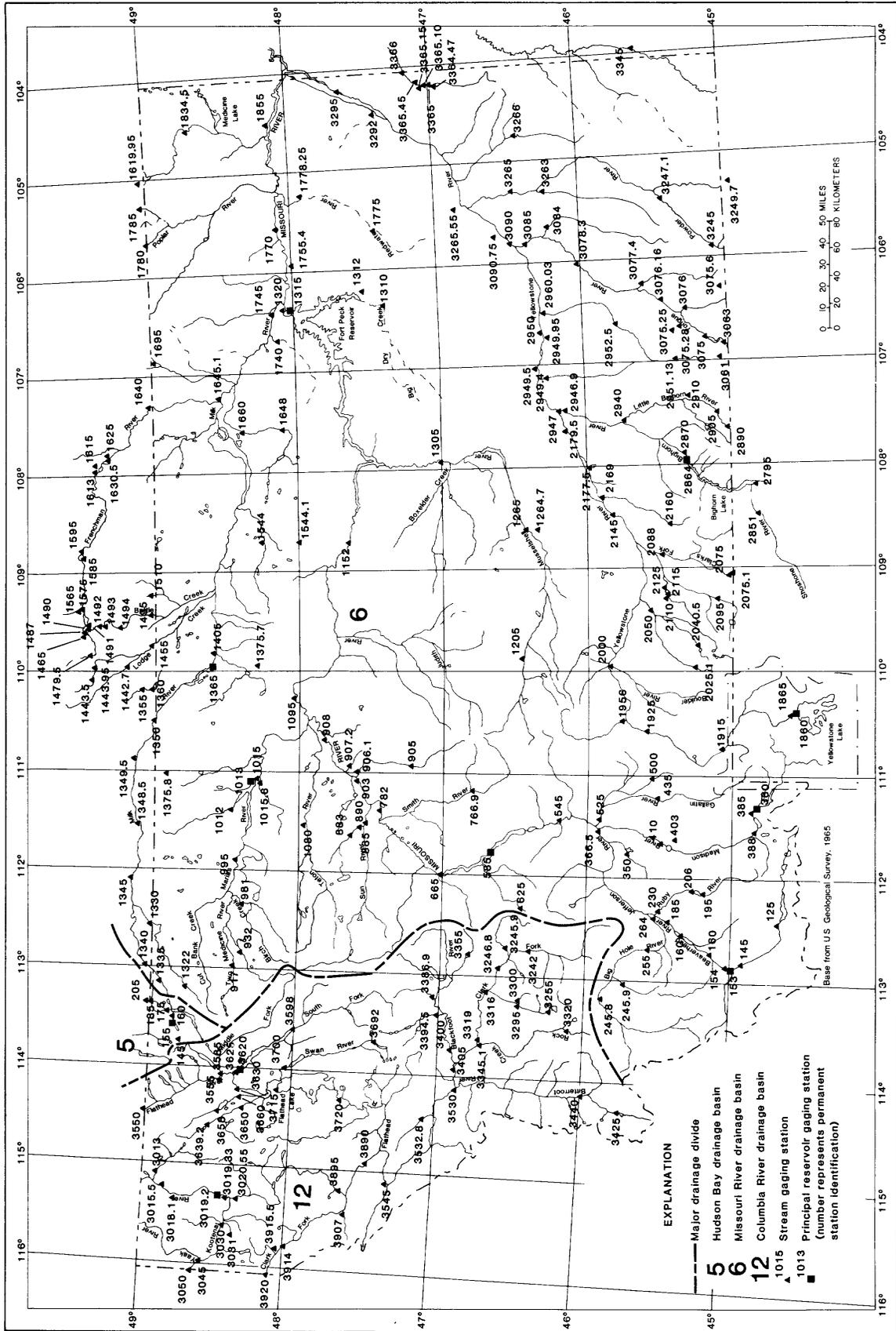


Figure 2.--Locations of surface-water gaging stations, October 1980.

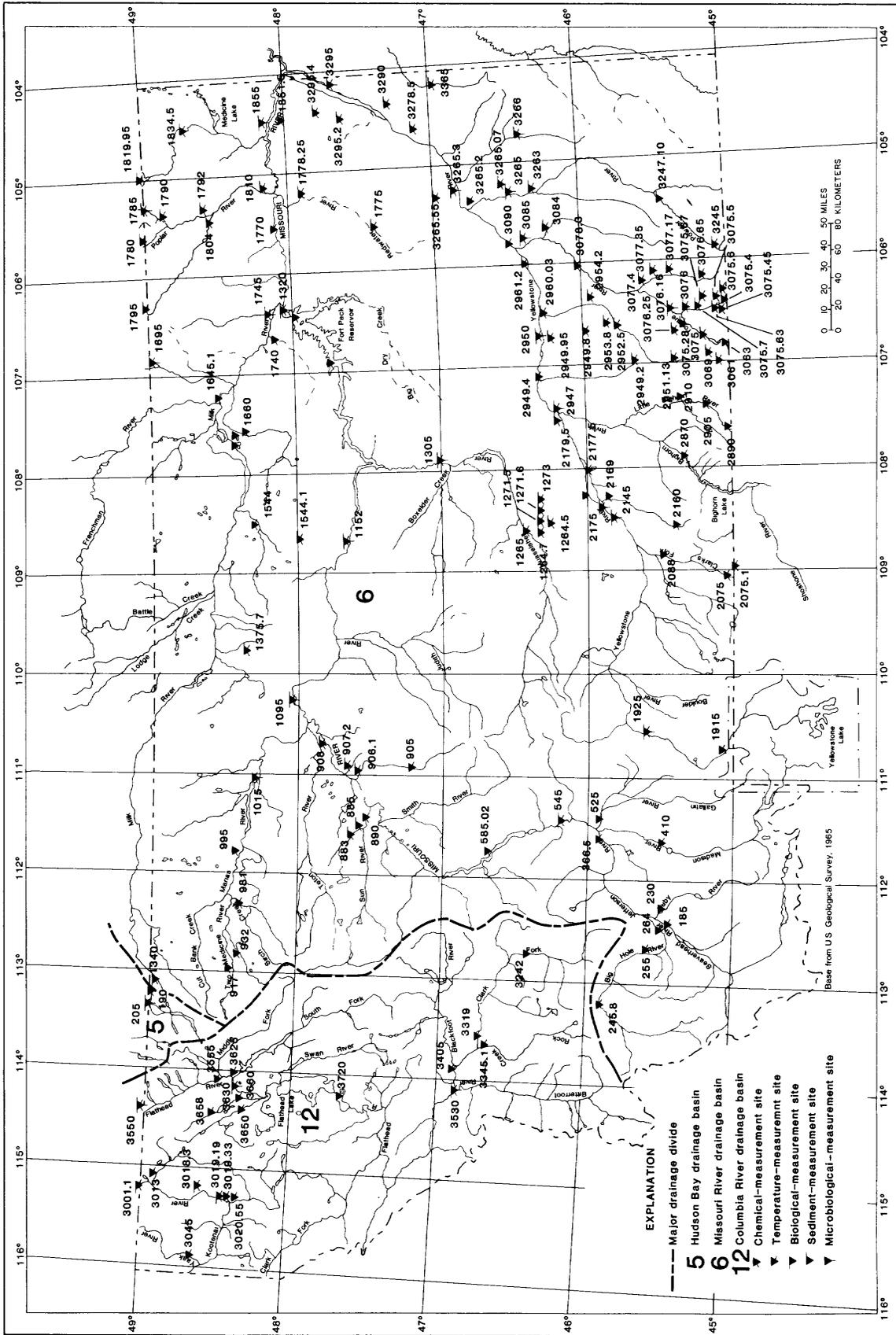


Figure 3.--Locations of surface-water-quality stations, October 1980.