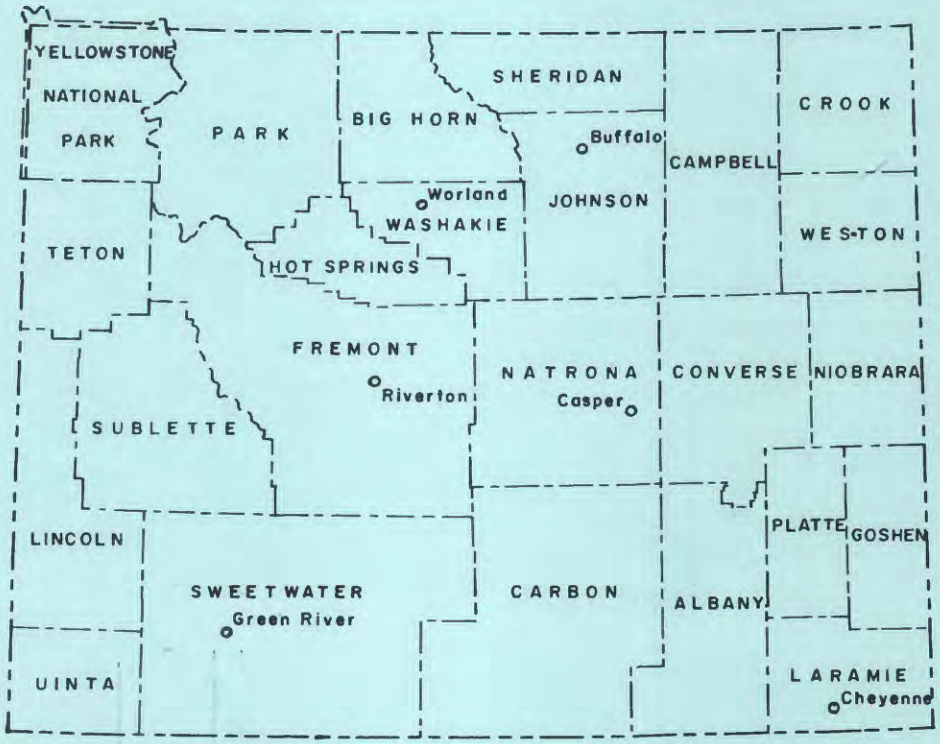
WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN WYOMING, FISCAL YEAR 1978



U.S. GEOLOGICAL SURVEY

Open-File Report 78-239

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN WYOMING, FISCAL YEAR 1978

By F. C. Boner

OPEN-FILE REPORT 78-239

Cheyenne, Wyoming

February 1978

UNITED STATES DEPARTMENT OF THE INTERIOR

CECIL D. ANDRUS, Secretary

GEOLOGICAL SURVEY

W. A. Radlinski, Acting Director

COOPERATING AGENCIES

State Agencies

Wyoming Conservation Commission
Wyoming Department of Agriculture
Wyoming Department of Economic Planning and Development
Wyoming Department of Environmental Quality
Wyoming Highway Department
Wyoming State Engineer
Wyoming Water Resources Research Institute

Municipality

City of Cheyenne

Federal Agencies

Bureau of Land Management
Bureau of Reclamation
Corps of Engineers
Department of Energy
Environmental Protection Agency
National Park Service

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WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN WYOMING, FISCAL YEAR 1978

by F. C. Boner

INTRODUCTION

The U.S. Geological Survey, in cooperation with the State of Wyoming, the city of Cheyenne, and other Federal agencies, have five data-collection activities and 29 water-resources appraisal projects under way in Wyoming during fiscal year 1978 (October 1, 1977 through September 30, 1978).

The data-collection activities include: (1) Continuous records of streamflow and reservoir storage; (2) peak-flow information at partial-record sites; (3) sampling and chemical analyses of water from streams and wells; (4) sampling and sediment analysis of surface water; and (5) measurements of water levels in wells. This report contains lists of monitoring sites for these five data-collection activities.

Water-resources appraisal projects described in the report include the 29 projects currently being conducted during fiscal year 1978 and three projects completed in fiscal year 1977 for which progress statements are available. The projects include: (1) Flood investigations in Wyoming; (2) Study of flood hydrographs for small drainage basins in Wyoming; (3) Hydrologic evaluation of the Arikaree Formation near Lusk, Wyoming; (4) Water resources of Weston County, Wyoming; (5) Monitoring wastewater effluent in Yellowstone and Grand Teton National Parks, Wyoming; (6) Water and its relation to economic development in the Green River and Great Divide basins in Wyoming; (7) Impacts of economic development and water use on water resources in the Hanna basin in Wyoming; (8) Water resources of the Powder River structural basin in Wyoming in relation to energy development; (9) Hydrology of Paleozoic rocks in the Powder River basin and adjacent areas, northeastern Wyoming; (10) Evaluation of Paleozoic and alluvial aquifers in the Bighorn Basin, Wyoming; (11) Algal-growth potential of principal North Platte River reservoirs in Wyoming; (12) Hydrology of the Sweetwater River basin, central Wyoming; (13) Quantitative study of the Tertiary aquifers in southern Laramie County, Wyoming; (14) Water-resources monitoring in the Powder River, south-central, and southwestern coal regions in Wyoming; (15) Digital model to predict the effects of pumping from the Arikaree aquifer in Uva area, southeastern Wyoming; (16) Effects of herbicide usage on water quality in the upper North Platte River,

south-central Wyoming; (17) Evaluation of hydrologic impacts of in-situ coal-gasification experiment near Hanna, Wyoming; (18) A preliminary hydrologic investigation on an in-situ oil-shale retorting site near Rock Springs, Wyoming; (19) Digital model of the Arikaree aquifer in Muleshoe Flat, southeastern Wyoming; (20) Digital model of the alluvial aquifer in Bates Hole, central Wyoming; (21) Digital model of the hydrologic system in the La Grange area, southeastern Wyoming; (22) Yampa River basin assessment, northwestern Colorado and south-central Wyoming; (23) Effects of mining and related activities on the shallow ground-water system; (24) Availability of ground water from aquifers in the Cretaceous and Tertiary systems in the Fort Union Coal Region; (25) Hydrology of the aquifer(s) in the Madison Group; (26) Geochemical survey of waters of the western coal regions; (27) Bedload transport research; (28) Reconnaissance techniques for evaluation of rehabilitation potential of energy resource lands; (29) Sorption of residual organic substances in retort waters by spent oil-shale residues; (30) Hydrology of the Madison Limestone and associated rocks in parts of Montana, North Dakota, South Dakota, and Wyoming; (31) Northern Great Plains regional aquifer assessment; and (32) High Plains regional aquifer-system analysis.

The purpose of this report is to describe the water-resources work being done in Wyoming, especially in the coal and oil-shale development areas. The report also is intended to inform cooperating officials and the public about accomplishments in the various investigations during the fiscal year 1977 (October 1, 1976 through September 30, 1977). It is one phase of an effort to coordinate the water-resources investigations of the U.S. Geological Survey with those of other organizations. Additional information about the water-resources program of the Geological Survey or closer coordination of the water-resources studies may be obtained by contacting the District Chief, Water Resources Division, U.S. Geological Survey, 2120 Capitol Avenue, P.O. Box 1125, Cheyenne, Wyoming 82001. The commercial telephone number is 307-778-2220, extension 2153, and the FTS number is 328-2153.

DATA-COLLECTION ACTIVITIES

Basic data currently being collected are shown as follows: Table 1, streamflow and reservoir stations; table 2, peak-flow partial-record stations; table 3, chemical-quality stations; table 4, sediment stations; and table 5, observation wells.

Stations in the first four tables are listed in downstream order. Identification numbers have been assigned to conform with the standard downstream order for listing stations within each hydrologic region. The location of each data site is given in the tables. In table 5, observation wells are listed in numerical order by counties.

The headings of the columns in the five tables are slightly different to accomodate the type of sites in each list. In order to include the variety of information required by the many users of the lists, abbreviations and codes were used to conserve space in the tables. Explanations of the abbreviations and codes are given preceeding each table.

The locations of surface-water data sites are shown in figures 1-5. Observation well locations are shown in figures 6-9.

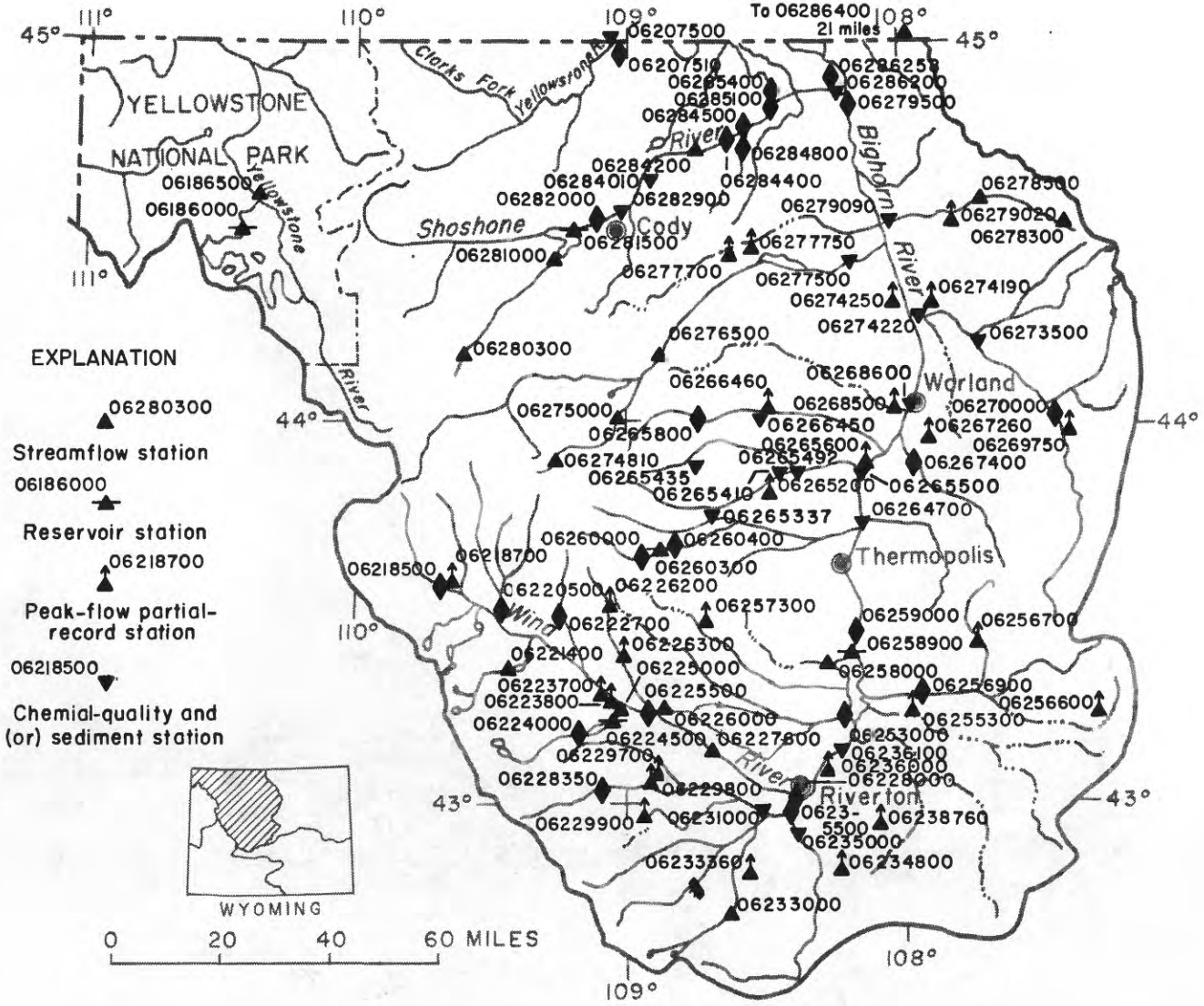


Figure 1.—Location of surface-water data sites in the Yellowstone River, Clarks Fork Yellowstone River, and Bighorn River basins.

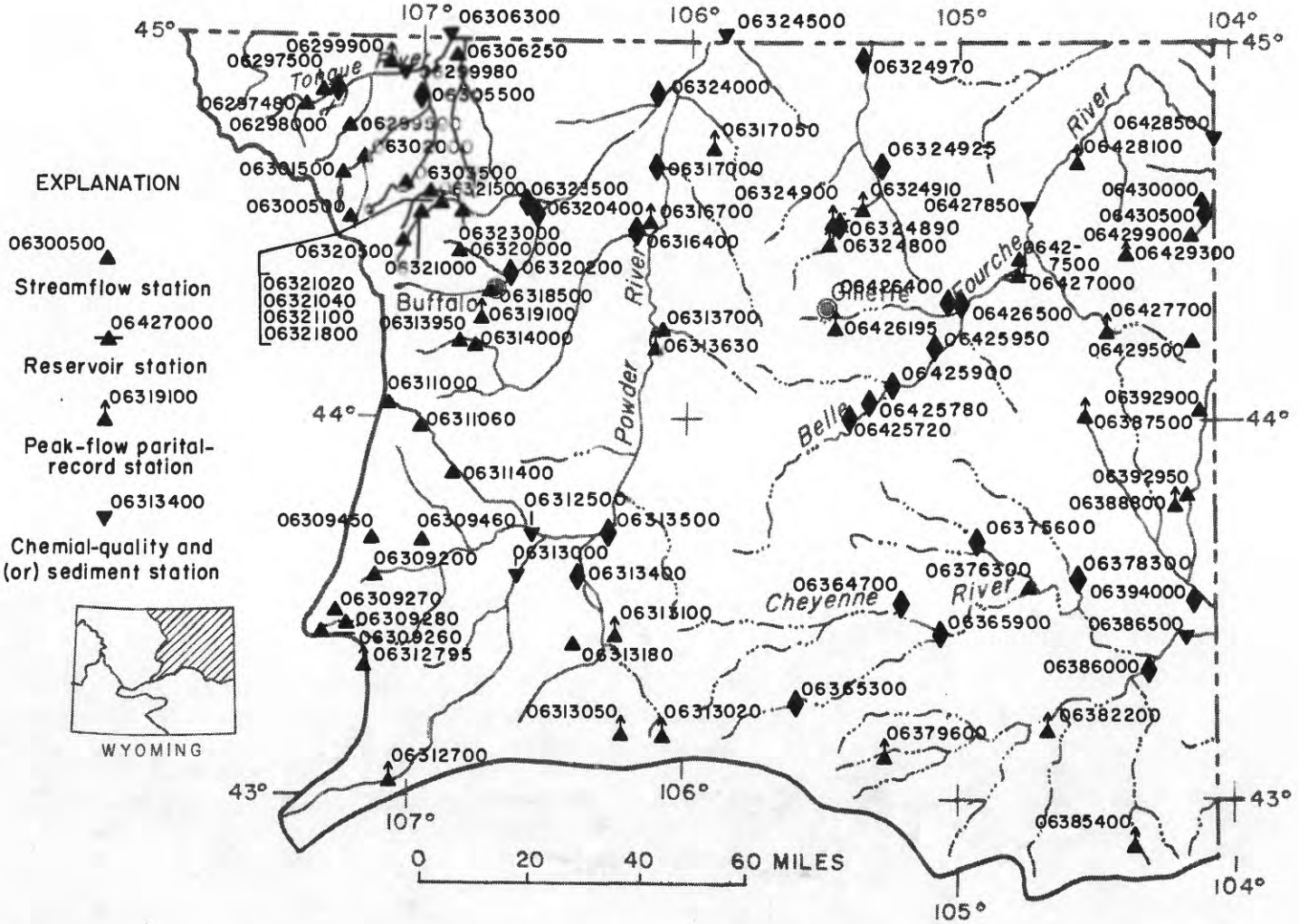


Figure 2.—Location of surface-water data sites in the Tongue River, Powder River, Belle Fourche River, and Cheyenne River basins.

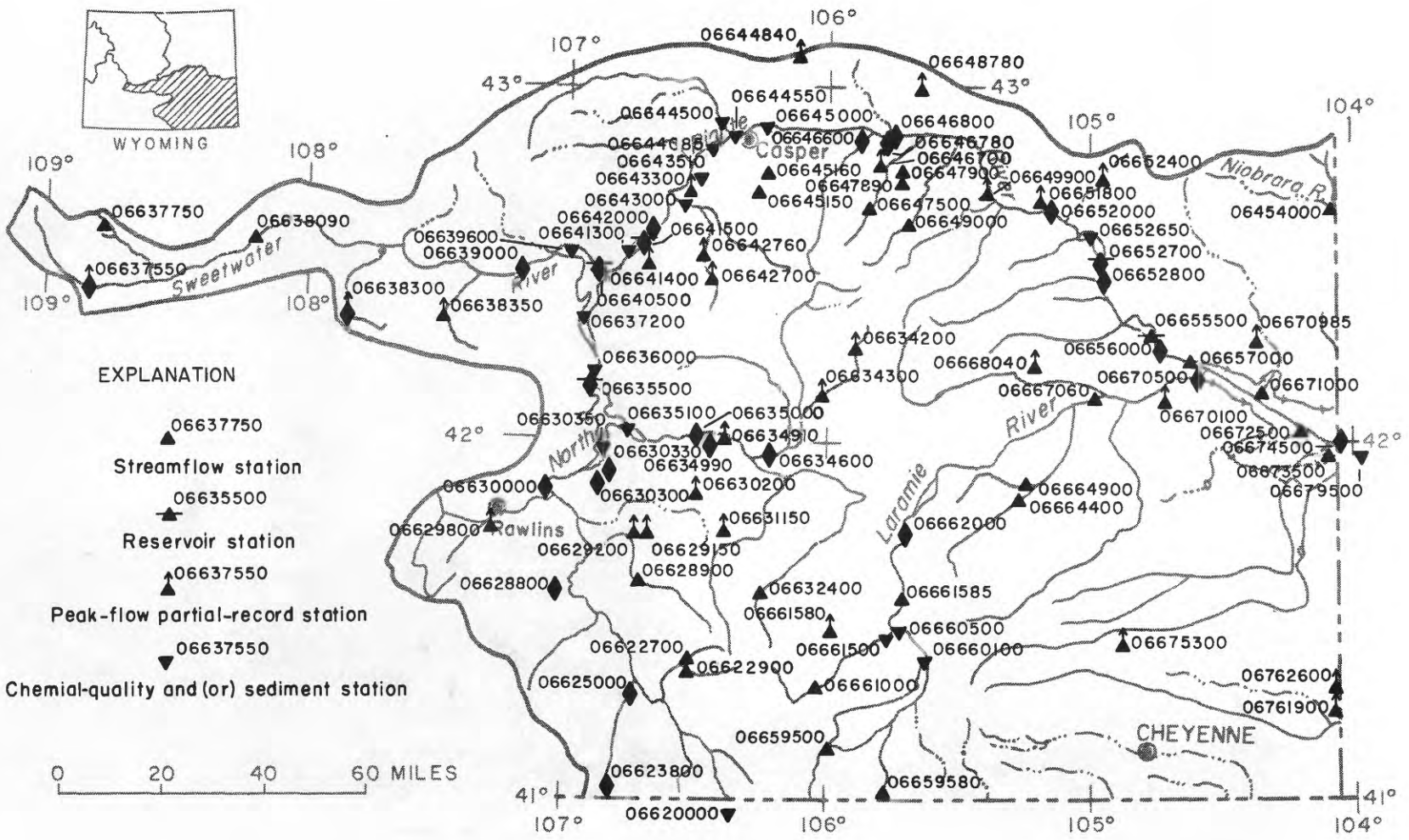


Figure 3.—Location of surface-water data sites in the Niobrara River and Platte River basins.

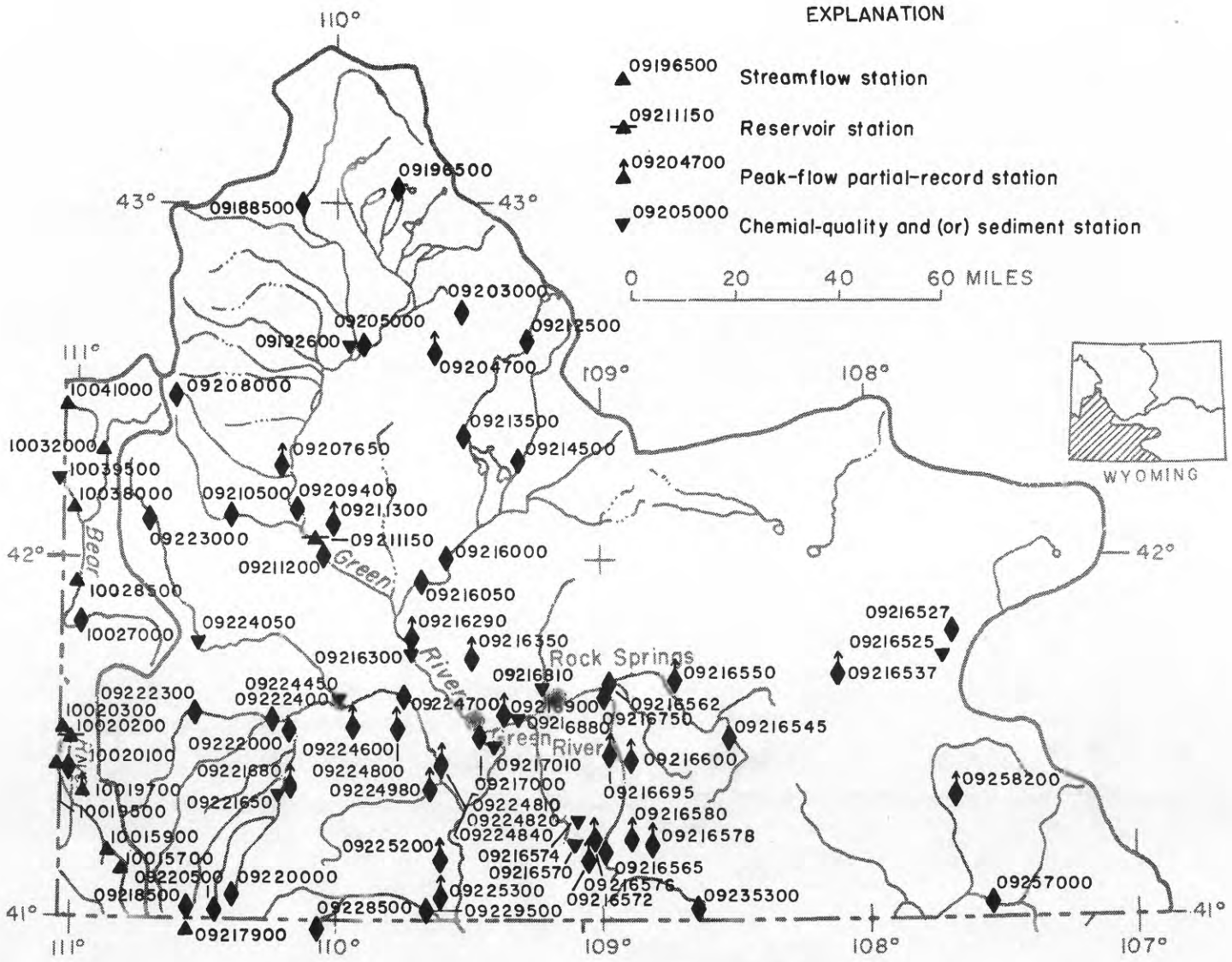


Figure 4.—Location of surface-water data sites in the Green River and Bear River basins.

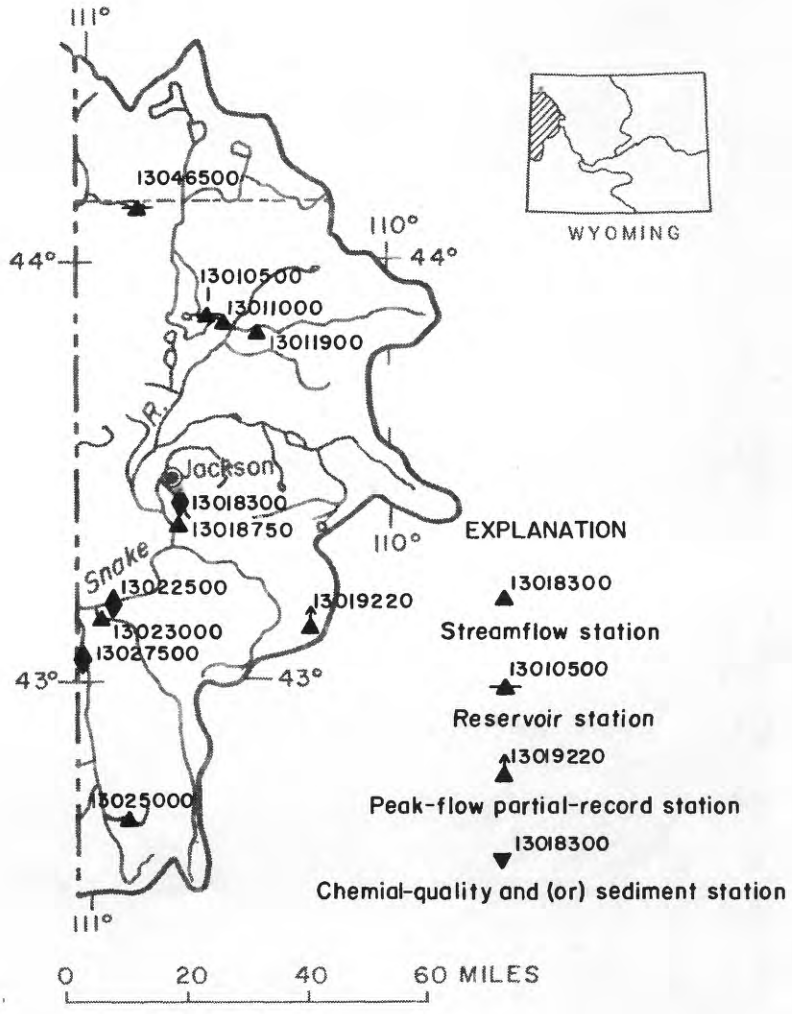


Figure 5.—Location of surface-water data sites in the Snake River basin.

Streamflow and Reservoir Stations

Explanation of abbreviations and codes used in table 1.

Purpose:
- B, bench-mark or long-term-trend station
- C, current-purpose station such as accounting, operation, forecasting, disposal, water quality, compact or legal, research or special study
- H, hydrologic station
- P, principal-stream station
- R, regulated station

Period of Record: The dates given are the calendar years in which records began or ended. Breaks of less than a year are not shown.

Location:
- SE, section
- TSP, township
- RNGE, range

Gage Equipment:
- D, digital recorder
- G, graphic recorder
- M, manometer gage
- O, observer record only
- T, pressure-transducer gage
- W, well gage

Current Record Type:
- S, seasonal operation (no winter records)
- Y, full-year operation

Field Office:
- B, Buffalo
- C, Casper
- CF, Cheyenne Field Unit
- CT, Contractor
- GR, Green River
- I, Idaho District
- M, Montana District
- N, Nebraska District
- R, Riverton
- S, Wyoming State Engineer
- SD, South Dakota District
- W, Worland
- U, Utah District

Cooperator:
- BLM, Bureau of Land Management
- BRUC, Bureau of Reclamation, Upper Colorado Region
- BRUM, Bureau of Reclamation, Upper Missouri Region
- CE, Corps of Engineers
- DEPD, Wyoming Department of Economic Planning and Development
- MRB, Geological Survey, Missouri River Basin Program
- USE, Utah State Engineer
- USGS, Geological Survey, Federal Program
- WSE, Wyoming State Engineer

Remarks: USBR, U.S. Bureau of Reclamation

Table 1. Streamflow and reservoir stations

STATION NUMBER	STATION NAME	PURPOSE	DRAINAGE AREA MI²	PERIOD OF RECORD	LOCATION SE	LOCATION TSP	LOCATION RNGE	GAGE EQUIPMENT	CURRENT RECORD TYPE	FIELD OFFICE	COOPERATOR	REMARKS
YELLOWSTONE RIVER BASIN												
06186000	YELLOWSTONE LAKE AT BRIDGE BAY, YNP	P	1006	1921-	-	-	-	O	Y	M	-	
06186500	YELLOWSTONE R AT YELLOWSTONE LAKE OUTLET, YNP	P	1006	1922-25, 1926-	-	-	-	GW	Y	M	-	
*#06207510	BIG SAND COULEE AT WYOMING-MONTANA STATE LINE	CR	134	1973-	32	9S	22E	GM	S	W	BLM	
*06218500	WIND RIVER NEAR DUBOIS	C	232	1945-	25	42N	108W	DW	Y	R	WSE	
*#06220500	EAST FORK WIND RIVER NEAR DUBOIS	C	427	1950-57, 1975-	34	6N	6W	GM	Y	R	MRB	
06221400	DINWOODY CREEK ABOVE LAKES, NEAR BURRIS	H	88.2	1957-	1	4N	6W	DW	Y	R	WSE	
*06222700	CROW CREEK NEAR TIPPERARY	H	30.2	1962-	20	7N	4W	GM	Y	R	MRB	
*06224000	BULL LAKE CREEK ABOVE BULL LAKE	H	187	1941-53, 1966-	2	2N	4W	DW	Y	R	MRB	
06224500	BULL LAKE NEAR LENORE	C	210	1938-	30	3N	2W	GM	Y	R	MRB, BRUM	
06225000	BULL LAKE CREEK NEAR LENORE	C	213	1918-	17	3N	2W	DGM	Y	R	BRUM	
#06225500	WIND RIVER NEAR CROWHEART	CP	1891	1945-	16	3N	2W	DGW	Y	R	BRUM	
06226000	WYOMING CANAL NEAR LENORE	CR	-	1941-45, 1949-	17	3N	1W	DW	S	R	BRUM	APR THRU OCT
06227600	WIND RIVER NEAR KINNEAR	CR	2194	1974-	13	2N	1W	GM	S	R	BRUM	
*06228000	WIND RIVER AT RIVERTON	CR	2309	1906-08, 1911-	2	1S	4E	DGM	Y	R	C E	
*06228350	SF LITTLE WIND R AB WASHAKIE RE NR FT WASHAKIE	H		1976-	18	1S	2W	DW	Y	R	MRB	
06233000	LITTLE POPO AGIE RIVER NEAR LANDER	C	125	1946-	27	32N	99W	GW	S	S	WSE	
*06235500	LITTLE WIND RIVER NEAR RIVERTON	CR	1904	1941-	11	1S	4E	DW	Y	R	C E	
*06253000	FIVEMILE CREEK NEAR SHOSHONI	C	418	1941-42, 1948-	19	3N	6E	GM	Y	R	BRUM	
*#06256900	DRY CREEK NEAR BONNEVILLE	CH	52.6	1965-	8	38N	92W	GW	Y	R	BLM	
06258000	MUDDY CREEK NEAR SHOSHONI	C	332	1949-68, 1972-	34	4N	5E	GM	Y	R	BRUM	
06258900	BOYSEN RESERVOIR	C	7700	1951-	16	5N	6E	-	-	-	MRB	FURNISHED BY USBR
*06259000	WIND RIVER BELOW BOYSEN RESERVOIR	CR	7701	1951-	9	5N	6E	DM	Y	W	BRUM	
*#06260000	SOUTH FORK OWL CREEK NEAR ANCHOR	CH	85.5	1932, 1939-43, 1959-	28	43N	100W	GM	Y	W	MRB	
06260300	ANCHOR RESERVOIR	C	131	1960-	26	43N	100W	-	-	-	MRB	FURNISHED BY USBR
*06260400	SOUTH FORK OWL CREEK BELOW ANCHOR RESERVOIR	CR	131	1959-	25	43N	100W	GW	Y	W	MRB	
*#06265800	GOOSEBERRY CREEK AT DICKIE	H	95.0	1957-	32	47N	99W	GW	Y	W,S	WSE	
06267400	EAST FORK NOWATER CREEK NEAR COLTER	H	149	1971-	31	46N	92W	GM	Y	W	WSE	
*#06270000	NOWOOD RIVER NEAR TEN SLEEP	P	803	1938-43, 1950-55, 1972-	27	47N	88W	DGM	Y	W	WSE	
06274810	WOOD RIVER AT KIRWIN	CH	11.4	1975-	-	-	-	GM	Y	W	DEPD	
06275000	WOOD RIVER AT SUNSHINE	CH	194	1945-	15	47N	101W	GM	Y	W	WSE	
06276500	GREYBULL RIVER AT MEETEETSE	CP	681	1897, 1903, 1920-	4	48N	100W	DGM	S	S	WSE	
06278300	SHELL CREEK ABOVE SHELL RESERVOIR	BCH	23.1	1956-	1	52N	88W	DW	Y	W	WSE	
06278500	SHELL CREEK NEAR SHELL	CH	145	1940-	17	53N	90W	GW	S	S	WSE	
*#06279500	BIGHORN RIVER AT KANE	CR	15765	1928-	9	55N	94W	GM	Y	W	MRB	
06280300	SOUTH FORK SHOSHONE RIVER NEAR VALLEY	BH	297	1956-	24	49N	106W	DW	Y	W	USGS	
06281000	SOUTH FORK SHOSHONE RIVER ABOVE BUFFALO BILL RES	P	585	1903, 1905-08, 1921-26, 1973-	33	52N	103W	GM	Y	W	WSE	
06281500	BUFFALO BILL RESERVOIR	C	1498	1909-	12	52N	103W	-	-	-	MRB	FURNISHED BY USBR

* Also chemical-quality station
\# Also sediment station

Table 1. Streamflow and reservoir stations (continued)

STATION NUMBER	STATION NAME	PURPOSE	DRAINAGE AREA MI^2	PERIOD OF RECORD	LOCATION SE	LOCATION TSP	LOCATION RNGE	GAGE EQUIPMENT	CURRENT RECORD TYPE	FIELD OFFICE	COOPERATOR	REMARKS
YELLOWSTONE RIVER BASIN (Continued)												
*06282000	SHOSHONE RIVER BELOW BUFFALO BILL RESERVOIR	CR	1538	1921-	3	52N	102W	DW	Y	W	BRUM	
06284200	SHOSHONE RIVER AT WILLWOOD	CR	1980	1974-	34	55N	99W	GM	Y	W	BRUM	
*06284400	SHOSHONE RIVER NEAR GARLAND	CR	2036	1958-	13	55N	98W	GM	Y	W	MRB	
*06284500	BITTER CREEK NEAR GARLAND	C	80.5	1950-53, 1957-60, 1968-	7	55N	97W	DW	Y	W	MRB	
*06284800	WHISTLE CREEK NEAR GARLAND	C	101	1958-60, 1968-	30	55N	97W	GM	Y	W	MRB	
*#06285100	SHOSHONE RIVER NEAR LOVELL	CR	2350	1966-	16	56N	96W	GM	Y	W	MRB	
*06285400	SAGE CREEK AT SIDON CANAL, NEAR DEAVER	C	341	1958-60, 1968-	34	57N	97W	GM	Y	W	MRB	
*#06286258	BIG COULEE NEAR LOVELL	CH	28.8	1969-	34	58N	95W	GW	Y	W	MRB	
06286400	BIGHORN LAKE NEAR ST. XAVIER, MT	C	19626	1965-	18	6S	31E	-	-	-	MRB	FURNISHED BY USBR
06297480	TONGUE R AT TONGUE CANYON CAMPGROUND, NR DAYTON	C	202	1974-	10	56N	87W	GM	Y	B	USGS	
06297500	HIGHLINE DITCH NEAR DAYTON	C	-	1919-23, 1940-	11	56N	87W	GW	S	B	WSE	
*06298000	TONGUE RIVER NEAR DAYTON	BCH	204	1918-29, 1940-	11	56N	87W	DW	Y	B	WSE	
06299500	WOLF CREEK AT WOLF	CH	37.8	1945-	4	55N	86W	GW	S	S	WSE	
06300500	EAST FORK BIG GOOSE CREEK NEAR BIG HORN	CH	20.1	1953-	28	53N	86W	GM	S	S	WSE	
06301500	WEST FORK BIG GOOSE CREEK NEAR BIG HORN	C	24.4	1953-	30	54N	86W	GM	S	S	WSE	
06302000	BIG GOOSE CREEK NEAR SHERIDAN	C	120	1929-	35	55N	86W	GW	S	S	WSE	
06303500	LITTLE GOOSE CREEK IN CANYON, NEAR BIG HORN	CH	51.6	1941-	1	53N	85W	GW	S	S	WSE	
*#06305500	GOOSE CREEK BELOW SHERIDAN	C	392	1941-	15	56N	84W	DW	Y	B	WSE	
06306250	PRAIRIE DOG CREEK NEAR ACME	C	358	1970-	23	58N	83W	GW	Y	M	-	
06309200	MIDDLE FORK POWDER RIVER NEAR BARNUM	H	45.2	1961-	26	42N	86W	GM	Y	C	WSE	
06309260	BUFFALO CREEK AB N F BUFFALO CREEK, NEAR ARMINTO	C	8.80	1974-	20	40N	86W	GM	Y	C	USGS	
06309270	NORTH FORK BUFFALO CREEK NEAR ARMINTO	C	8.10	1974-	17	40N	86W	GW	Y	C	USGS	
06309280	BUFFALO CREEK BL N F BUFFALO CREEK, NEAR ARMINTO	C	18.6	1974-	21	40N	86W	GM	Y	C	USGS	
06309450	BEAVER CREEK BELOW BAYER CREEK, NEAR BARNUM	C	10.9	1974-	28	43N	85W	GW	Y	C	USGS	
06309460	BEAVER CREEK AB WHITE PANTHER DITCH, NEAR BARNUM	C	24.2	1974-	16	43N	84W	GM	Y	C	USGS	
06311000	NORTH FORK POWDER RIVER NEAR HAZELTON	BCH	24.5	1946-	21	47N	85W	GW	Y	B,S	WSE	WSE OPERATE APR-SEP
06311060	N FORK POWDER RIVER BL BULL CREEK, NR HAZELTON	C	32.3	1974-	25	47N	85W	GM	Y	B	USGS	
06311400	N FORK POWDER RIVER BL PASS CREEK, NR MAYOWORTH	CH	100	1974-	36	46N	84W	GM	Y	B	WSE	
06313180	DUGOUT CREEK TRIBUTARY NEAR MIDWEST	H	.8	1974-	14	40N	80W	GW	Y	C	USGS	
*#06313400	SALT CREEK NEAR SUSSEX	C	769	1975-	8	42N	79W	GM	Y	C	USGS	
*#06313500	POWDER RIVER AT SUSSEX	CP	3090	1938-40, 1950-57, 1977-	13	43N	79W	DGM	Y	CT	USGS	
06313700	DEAD HORSE CREEK NEAR BUFFALO	H	151	1971-	15	49N	77W	GM	Y	B	WSE	
06313950	N F CRAZY WOMAN CREEK BL POLE CREEK, NR BUFFALO	CH	43.4	1973-	28	49N	83W	GM	Y	B	DEPD	
06314000	NORTH FORK CRAZY WOMAN CREEK NEAR BUFFALO	CH	44.9	1942-49, 1973-	27	49N	83W	GM	Y	B	DEPD	AUXILIARY WELL GAGE
*#06316400	CRAZY WOMAN CREEK AT UPPER STATION,NEAR ARVADA	CP	945	1963-70, 1977-	18	52N	77W	DGW	Y	CT	USGS	
*#06317000	POWDER RIVER AT ARVADA	CP	6050	1919-	21	54N	77W	GM	Y	B	WSE	
06318500	CLEAR CREEK NEAR BUFFALO	C	120	1894, 1896-99, 1917-27, 1938-	6	50N	82W	GW	Y	B	DEPD	
06320000	ROCK CREEK NEAR BUFFALO	CR	60.0	1941-	29	52N	83W	GW	S	S	WSE	
*#06320200	CLEAR CREEK BELOW ROCK CREEK, NEAR BUFFALO	C	322	1975-	30	51N	81W	GW	Y	B,S	USGS	WSE OPERATE APR-SEP
*#06320400	CLEAR CREEK AT UCROSS	C	409	1975-	19	53N	80W	GM	Y	B	USGS	
06320500	SOUTH PINEY CREEK AT WILLOW PARK	CR	33.6	1945-57, 1959-	24	52N	85W	GW	S	S	WSE	

* Also chemical-quality station
\# Also sediment station

Table 1. Streamflow and reservoir stations (continued)

STATION NUMBER	STATION NAME	PURPOSE	DRAINAGE AREA MI^2	PERIOD OF RECORD	LOCATION SE	LOCATION TSP	LOCATION RNGE	GAGE EQUIPMENT	CURRENT RECORD TYPE	FIELD OFFICE	COOPERATOR	REMARKS
	YELLOWSTONE RIVER BASIN (Continued)											
06321000	SOUTH PINEY CREEK NEAR STORY	C	69.4	1951-	23	53N	84W	GM	Y	B	WSE	
06321020	MEAD-COFFEEN DITCH ABOVE FISH HATCHERY, NR STORY	C	-	1974-	13	53N	84W	DW	Y	B	USGS	
06321040	MEAD-COFFEEN DITCH BELOW FISH HATCHERY, NR STORY	C	-	1974-	13	53N	84W	DW	Y	B	USGS	
06321100	S PINEY CREEK BL MEAD-COFFEEN DITCH, NEAR STORY	C	69.5	1974-	13	53N	84W	GM	Y	B	USGS	
06321500	NORTH PINEY CREEK NEAR STORY	CH	36.8	1951-	15	53N	84W	DW	Y	B	DEPD	
06321800	SPRING CREEK NEAR STORY	C	-	1974-	13	53N	84W	DW	Y	B	USGS	
06323000	PINEY CREEK AT KEARNY	CR	118	1902-06, 1910-17, 1919-23, 1940-	26	53N	83W	GW	Y	S	WSE	
*06323500	PINEY CREEK AT UCROSS	CR	267	1917-23, 1950-	18	53N	80W	GW	Y	B	DEPD	
*#06324000	CLEAR CREEK NEAR ARVADA	C	1110	1915-19, 1928-29, 1939-	36	57N	77W	DW	Y	B	DEPD	
*#06324890	LITTLE POWDER R BELOW CORRAL C NEAR WESTON	CP		1977-	12	52N	72W	DGM	Y	CT	USGS	
*#06324925	LITTLE POWDER RIVER NEAR WESTON	CP		1977-	19	54N	70W	DGM	Y	CT	USGS	
*#06324970	LITTLE POWDER RIVER ABOVE DRY CREEK, NEAR WESTON	P	1230	1972-	13	57N	71W	GM	Y	C	WSE	
	CHEYENNE RIVER BASIN											
*#06364700	ANTELOPE CREEK NEAR TECKLA	CP		1977-	35	41N	70W	DGM	Y	CT	USGS	
*#06365300	DRY FORK CHEYENNE RIVER NEAR BILL	C	128	1976-	31	38N	73W	GM	Y	C	BLM	
*#06365900	CHEYENNE RIVER NEAR OULL CENTER	C	1527	1975-	20	40N	68W	GM	Y	C	USGS	
*#06375600	LITTLE THUNDER CREEK NEAR HAMPSHIRE	CP		1977-	33	43N	67W	DGM	Y	CT	USGS	
06376300	BLACK THUNDER CREEK NEAR HAMPSHIRE	H	535	1972-	31	42N	65W	GM	Y	C	WSE	
*#06378300	LODGEPOLE CREEK NEAR HAMPSHIRE	CP		1977-	5	41N	64W	DGM	Y	CT	USGS	
*#06386000	LANCE CREEK NEAR SPENCER	P	2070	1948-54, 1956-	14	39N	62W	GMW	Y	C	BLM	
06392900	BEAVER CREEK AT MALLO CAMP, NEAR FOUR CORNERS	C	10.3	1974-	4	47N	60W	GM	Y	SD	USGS	
06392950	STOCKADE BEAVER CREEK NEAR NEWCASTLE	C	107	1974-	19	45N	60W	GM	Y	SD	USGS	
*06394000	BEAVER CREEK NEAR NEWCASTLE	BP	1320	1943-	18	41N	60W	DGW	Y	C	USGS	
*#06425720	BELLE FOURCHE RIVER BEL RATTLESNAKE CR, NR PINEY	C	495	1975-	9	46N	71W	GM	Y	C	BLM	
*#06425780	BELLE FOURCHE RIVER ABOVE DRY CREEK, NEAR PINEY	C	594	1975-	25	47N	71W	GM	Y	C	BLM	
*#06425900	CABALLO CREEK AT MOUTH, NEAR PINEY	CR		1977-	4	47N	70W	DGM	Y	CT	USGS	
*#06425950	RAVEN CREEK NEAR MOORCROFT	CH		1977-	1	48N	69W	DGM	Y	CT	USGS	
*#06426400	DONKEY CREEK NEAR MOORCROFT	CR		1977-	30	50N	68W	DGM	Y	CT	USGS	
*#06426500	BELLE FOURCHE RIVER BELOW MOORCROFT	C	1670	1943-70 1975-	24	50N	68W	GM	Y	C	BLM	
06427000	KEYHOLE RESERVOIR NEAR MOORCROFT	C	2000	1952-	27	51N	66W	-	-	-	MRB	FURNISHED BY USBR
06427500	BELLE FOURCHE RIVER BELOW KEYHOLE RESERVOIR	CR	2000	1951-	21	51N	66W	GW	Y	C	BRUM	
06429500	COLD SPRINGS CREEK AT BUCKHORN	C	19.0	1974-	9	48N	60W	GM	Y	SD	USGS	
06429900	SAND CREEK AT RANCH A, NEAR BEULAH	C	260	1974-	18	52N	60W	GM	Y	SD	USGS	
06430000	MURRAY DITCH AT WYOMING-SOUTH DAKOTA STATE LINE	C	-	1954-	7	7N	1E	GW	Y	SD	WSE	
#06430500	REDWATER CR AT WYOMING-SOUTH DAKOTA STATE LINE	CH	471	1929-31, 1936-37, 1954-	18	7N	1E	GW	Y	SD	WSE	
06454000	NIOBRARA RIVER AT WYOMING-NEBRASKA STATE LINE	BCH	450	1955-	15	31N	60W	DW	Y	N	-	
	PLATTE RIVER BASIN											
06622700	NORTH BRUSH CREEK NEAR SARATOGA	H	37.4	1960-	8	16N	81W	GW	Y	CF	WSE	AUX TRANSDUCER GAGE
06622900	SOUTH BRUSH CREEK NEAR SARATOGA	C	22.8	1960-	20	16N	81W	GW	S	S	WSE	
*#06623800	ENCAMPMENT R AB HOG PARK CREEK, NEAR ENCAMPMENT	BH	72.7	1964-	10	12N	84W	GM	Y	CF	USGS	HYDRO BENCHMARK STA
*06625000	ENCAMPMENT RIVER AT MOUTH, NEAR ENCAMPMENT	CH	265	1940-	3	15N	83W	DW	Y	CF	WSE	
*#06628800	SAGE CREEK NEAR SARATOGA	C	263	1973-	32	19N	85W	GM	S	CF	BLM	
06628900	PASS CREEK NEAR ELK MOUNTAIN	CH	91.5	1957-	27	19N	82W	GM	Y	CF	WSE	
*06630000	N PLATTE RIVER AB SEMINOE RESERVOIR, NR SINCLAIR	CP	8134	1939-	13	22N	86W	GW	Y	CF	WSE	
*#06630300	BIG OITCH NEAR COYOTE SPRINGS	C	110	1975-	30	23N	83W	GM	Y	CF	BLM	

* Also chemical-quality station
\# Also sediment station

Table 1. Streamflow and reservoir stations (continued)

STATION NUMBER	STATION NAME	PUR-POSE	DRAINAGE AREA MI²	PERIOD OF RECORD	LOCATION SE	LOCATION TSP	LOCATION RNGE	GAGE EQUIPMENT	CURRENT RECORD TYPE	FIELD OFFICE	COOPERATOR	REMARKS
	PLATTE RIVER BASIN (Continued)											
*#06630330	NORTH DITCH NEAR COYOTE SPRINGS	C	22.6	1976-	19	23N	83E	GM	Y	CF	BLM	
06632400	ROCK CREEK ABOVE KING CANYON CANAL, NR ARLINGTON	BCH	62.9	1965-	25	19N	79W	GM	Y	CF,S	WSE	
*#06634600	LITTLE MEDICINE BOW RIVER NEAR MEDICINE BOW	P	963	1973-	22	23N	78W	GW	Y	CF	WSE	
*#06634990	HANNA DRAW NEAR HANNA	C	21.6	1975-	34	24N	81W	GM	Y	CF	BLM	
*#06635000	MEDICINE BOW R AB SEMINOE RESERVOIR, NEAR HANNA	CP	2338	1939-	34	24N	81W	GW	Y	CF	WSE	
*06635500	SEMINOE RESERVOIR NEAR LEO	C	7230	1939-	8	25N	84W	-	-	-	MRB	FURNISHED BY USBR
06637750	ROCK CREEK ABOVE ROCK CREEK RESERVOIR	CH	9.2	1962-	27	30N	100W	DGW	Y	R	WSE	
06638090	SWEETWATER RIVER NEAR SWEETWATER STATION	P	849	1973-	12	29N	96W	GM	Y	R	WSE	
*#06639000	SWEETWATER RIVER NEAR ALCOVA	CP	2327	1913-24, 1938-	25	29N	87W	GW	S	S	WSE	
*06640500	PATHFINDER RESERVOIR NEAR ALCOVA	C	10711	1909-	24	29N	84W	-	-	-	MRB	FURNISHED BY USBR
*06641500	ALCOVA RESERVOIR AT ALCOVA	C	10766	1938-	24	30N	83W	-	-	-	MRB	FURNISHED BY USBR
*06642000	NORTH PLATTE RIVER AT ALCOVA	CR	10812	1904-05, 1934-	17	30N	82W	DW	Y	C	WSE	
06645150	SMITH CREEK ABOVE OTTER CREEK, NEAR CASPER	C	9.91	1974-	15	31N	78W	GM	Y	C	USGS	
06645160	SMITH CREEK AT OTTER CREEK, NEAR CASPER	C	10.9	1974-	14	31N	78W	DTW	Y	C	USGS	
*06646600	DEER CREEK BELOW MILLAR WASTEWAY, AT GLENROCK	CH	213	1961-	4	33N	75W	GW	Y	C,S	WSE	
*#06646780	SAND CREEK NEAR GLENROCK	CH		1977-	5	33N	74W	DGM	Y	CT	USGS	
*06646800	NORTH PLATTE RIVER NEAR GLENROCK	CR	13538	1959-	17	33N	74W	DW	Y	C,S	WSE	
06647500	BOX ELDER CREEK AT BOXELDER	H	63.0	1946-51, 1961-67, 1971-	32	31N	75W	GW	Y	C	WSE	
06647890	LITTLE BOX ELDER CREEK NEAR CAREYHURST	C	7.18	1974-	8	32N	74W	DW	Y	C	USGS	
06647900	L BOX ELDER C AT L BOX ELDER CAVE, NR CAREYHURST	C	8.47	1974-	9	32N	74W	GW	Y	C	USGS	
06649000	LAPRELE CREEK NEAR DOUGLAS	C	135	1919-	5	31N	73W	GW	S	S	WSE	
*#06652000	NORTH PLATTE RIVER AT ORIN	CR	14888	1895-99, 1917-18, 1924, 1958-	17	31N	69W	DW	Y	C	WSE	
*06652700	GLENDO RESERVOIR NEAR GLENDO	C	15545	1957-	24	29N	68W	-	-	-	MRB	FURNISHED BY USBR
*06652800	NORTH PLATTE RIVER BELOW GLENDO RESERVOIR	CR	15548	1957-	30	29N	67W	DW	Y	C,S	WSE	
06655500	GURNSEY RESERVOIR NEAR GUERNSEY	C	16224	1928-	27	27N	66W	-	-	-	MRB	FURNISHED BY USBR
*06656000	NORTH PLATTE RIVER BELOW GUERNSEY RESERVOIR	CR	16237	1900-	27	27N	66W	DMW	Y	C,S	WSE	
06657000	NORTH PLATTE R BELOW WHALEN DIVERSION DAM	CR	16425	1909-	12	26N	65W	GM	Y	C,S	WSE	
06659500	LARAMIE RIVER AND PIONEER CANAL NEAR WOODS	CR	434	1912-24, 1926-27, 1931-	36	14N	77W	GW	S	S	WSE	
06659580	SAND CREEK AT COLORADO-WYOMING STATE LINE	C	29.2	1968-	1	12N	75W	GW	S	S	WSE	
06661000	LITTLE LARAMIE RIVER NEAR FILMORE	CH	157	1902-03, 1911-26, 1932-	4	15N	77W	GW	S	S	WSE	
06661585	LARAMIE RIVER NEAR BOSLER	CR	1790	1972-	10	18N	74W	GW	Y	S	WSE	
*06662000	LARAMIE RIVER NEAR LOOKOUT	CR	2174	1912-17, 1921-27, 1932-	27	21N	74W	GW	S	S	WSE	
06664400	SYBILLE CREEK ABOVE MULE CREEK, NEAR WHEATLAND	CH	194	1974-	27	22N	70W	GW	S	S	WSE	
06664900	BLUEGRASS CREEK NEAR WHEATLAND	CR	139	1958-63, 1968-	22	22N	70W	GW	S	S	WSE	
06667060	LARAMIE RIVER ABOVE NORTH LARAMIE RIVER, NR UVA	CP	3131	1973-	19	25N	67W	GM	Y	C	DEPD	
*#06670500	LARAMIE RIVER NEAR FORT LARAMIE	CR	4495	1915-	25	26N	65W	GM	Y	C	WSE	
06671000	RAWHIDE CREEK NEAR LINGLE	C	522	1928-	20	25N	62W	GW	S	S	WSE	
06672500	CHERRY CREEK DRAIN NEAR TORRINGTON	C	356	1931-33, 1935-	23	24N	61W	GW	S	S	WSE	
06673500	KATZER DRAIN NEAR HENRY, NB	C	45.9	1928-	10	23N	60W	GW	S	S	WSE	
*#06674500	NORTH PLATTE R AT WYOMING-NEBRASKA STATE LINE	CR	22218	1929-	4	23N	58W	GW	Y	C	WSE	

* Also chemical-quality station
\# Also sediment station

Table 1. Streamflow and reservoir stations (continued)

STATION NUMBER	STATION NAME	PURPOSE	DRAINAGE AREA MI²	PERIOD OF RECORD	LOCATION SE	LOCATION TSP	LOCATION RNGE	GAGE EQUIPMENT	CURRENT RECORD TYPE	FIELD OFFICE	COOPERATOR	REMARKS
GREEN RIVER BASIN												
*#09188500	GREEN RIVER AT WARREN BRIDGE, NEAR DANIEL	C	468	1931-	8	35N	111W	GM	Y	GR	WSE	
*#09196500	PINE CREEK ABOVE FREMONT LAKE	BCH	75.8	1954-	S	35N	108W	DW	Y	GR	USGS	
*#09203000	EAST FORK RIVER NEAR BIG SANDY	C	79.2	1938-	7	31N	105W	DW	Y	GR	WSE	
*#09205000	NEW FORK RIVER NEAR BIG PINEY	P	1230	1954-	22	30N	110W	DW	Y	GR	WSE	
*#09208000	LABARGE CREEK NR LABARGE MEADOWS RANGER STATION	BCH	6.3	1940-42, 1950-	8	29N	116W	GM	Y	GR	USGS	
*#09209400	GREEN RIVER NEAR LABARGE	CP	3910	1963-	33	26N	112W	DW	Y	GR	WSE	
*#09210500	FONTENELLE CR NR HERSCHLER RANCH, NR FONTENELLE	CH	152	1951-	2	24N	115W	GM	Y	GR	USGS	
09211150	FONTENELLE RESERVOIR NEAR FONTENELLE	C	4280	1964-	25	24N	112W	-	-	-	-	FURNISHED BY USBR
*#09211200	GREEN RIVER BELOW FONTENELLE RESERVOIR	CR	4280	1963-	31	24N	111W	GM	Y	GR	BRUC	
*#09212500	BIG SANDY RIVER AT LECKIE RANCH, NEAR BIG SANDY	C	94.0	1910-11, 1939-	18	30N	104W	GM	S	GR	WSE	
*#09213500	BIG SANDY RIVER NEAR FARSON	CR	322	1914-17, 1920-24, 1926-34, 1935-	17	27N	106W	GW	S	GR	WSE	
*#09214500	LITTLE SANDY CREEK ABOVE EDEN	C	134	1954-	11	26N	105W	GW	Y	GR	BLM	
*#09216000	BIG SANDY RIVER BELOW EDEN	CR	1610	1954-	31	24N	107W	DW	Y	GR	BRUC	
*#09216050	BIG SANDY RIVER AT GASSON BRIDGE, NEAR EDEN	CR	1720	1972-	29	23N	108W	GW	Y	GR	BRUC	
*#09216527	SEPARATION CREEK NEAR RINER	C	55.3	1975-	32	20N	90W	GW	Y	CF	BLM	
*#09216545	BITTER CREEK NEAR BITTER CREEK	C	308	1975-	36	18N	99W	GM	Y	GR	USGS	
*#09216562	BITTER CREEK AB SALT WELLS CREEK, NR SALT WELLS	C	836	1975-	2	19N	103W	GM	Y	GR	BLM	
*#09216565	SALT WELLS CREEK NEAR SOUTH BAXTER	C	34.7	1976-	15	14N	103W	GM	Y	GR	BLM	
*#09216750	SALT WELLS CREEK NEAR SALT WELLS	C	526	1975-	14	19N	103W	GM	Y	GR	BLM	
*#09217000	GREEN RIVER NEAR GREEN RIVER	CR	14000	1951-	26	18N	107W	GW	Y	GR	USGS	
09217900	BLACKS FORK NEAR ROBERTSON	H	130	1937-39, 1966-	27	3N	12E	GM	Y	GR	USE	
*#09218500	BLACKS FORK NEAR MILLBURNE	C	152	1939-	11	12N	117W	GM	Y	GR	WSE	
#09220000	EAST FORK OF SMITH FORK NEAR ROBERTSON	CH	53.0	1939-	5	12N	115W	GW	S	S	WSE	
#09220500	WEST FORK OF SMITH FORK NEAR ROBERTSON	CH	37.2	1939-	15	12N	116W	GW	S	S	WSE	
*#09222000	BLACKS FORK NEAR LYMAN	CR	821	1937-57, 1962-	15	17N	113W	DW	Y	GR	BRUC	
*#09222300	LITTLE MUDDY CREEK NEAR GLENCOE	C	416	1975-	31	19N	116W	GM	Y	GR	BLM	
*#09222400	MUDDY CREEK NEAR HAMPTON	C	963	1975-	18	18N	113W	GM	Y	GR	BLM	
*#09223000	HAMS FORK BELOW POLE CREEK, NEAR FRONTIER	CH	128	1952-	35	25N	117W	GM	Y	GR	USGS	
*#09224700	BLACKS FORK NEAR LITTLE AMERICA	CR	3100	1962-	15	18N	109W	DW	Y	GR	USGS	
*#09228500	BURNT FORK NEAR BURNTFORK	CH	52.8	1943-	36	3N	16E	GM	S	S	WSE	
*#09229500	HENRYS FORK NEAR MANILA, UT	CP	520	1928-	23	12N	109W	GW	Y	GR	USGS	
*#09235300	VERMILLION CREEK NEAR HIAWATHA, CO	C	196	1975-	15	12N	100W	GM	Y	GR	BLM	
*#09257000	LITTLE SNAKE RIVER NEAR DIXON	CP	988	1910-23, 1938-	8	12N	90W	GM	S	CF,S	WSE	
BEAR RIVER BASIN												
10015700	SULPHUR CREEK ABOVE RESERVOIR, NEAR EVANSTON	CH	64.2	1957-	35	14N	119W	GW	Y	U	-	
10015900	SULPHUR CREEK BELOW RESERVOIR, NEAR EVANSTON	C	69.2	1958-	28	14N	119W	DW	Y	U	-	
10019500	CHAPMAN CANAL AT STATE LINE, NEAR EVANSTON	C	-	1942-	36	17N	121W	GW	Y	U	-	
*10020100	BEAR RIVER ABOVE RESERVOIR, NEAR WOODRUFF, UT	CR	752	1961-	29	17N	120W	GW	Y	U	-	
10020200	WOODRUFF NARROWS RESERVOIR NEAR WOODRUFF, UT	C	784	1965-	32	18N	120W	-	-	-	-	
10020300	BEAR RIVER BELOW RESERVOIR, NEAR WOODRUFF, UT	CR	784	1961-	25	23N	120W	DW	Y	U	-	
**10027000	TWIN CREEK AT SAGE	C	246	1943-52, 1976-	7	21N	119W	GM	Y	GR	BLM	
10028500	BEAR RIVER BELOW PIXLEY DAM, NEAR COKEVILLE	CR	2032	1941-43, 1952-56, 1958-				GW	S	U	-	
10032000	SMITHS FORK NEAR BORDER	BCH	165	1942-	33	27N	118W	GW	Y	U	-	

* Also chemical-quality station
\# Also sediment station

Table 1. Streamflow and reservoir stations (continued)

STATION NUMBER	STATION NAME	PURPOSE	DRAINAGE AREA MI^2	PERIOD OF RECORD	LOCATION SE	LOCATION TSP	LOCATION RNGE	GAGE EQUIPMENT	CURRENT RECORD TYPE	FIELD OFFICE	COOPERATOR	REMARKS
BEAR RIVER BASIN (Continued)												
10038000	BEAR RIVER BELOW SMITHS FORK, NEAR COKEVILLE	C	2447	1954-	28	25N	119W	GW	Y	U	-	
10041000	THOMAS FORK NEAR WYOMING-IDAHO STATE LINE	CH	113	1949-	19	28N	119W	DW	Y	U	-	
SNAKE RIVER BASIN												
13010500	JACKSON LAKE NEAR MORAN	C	807	1908-	18	45N	114W	-	-	I	-	FURNISHED BY USBR
13011000	SNAKE RIVER NEAR MORAN	BCR	807	1903-	18	45N	114W	DW	Y	I	-	
13011900	BUFFALO FORK ABOVE LAVA CREEK, NEAR MORAN	H	323	1965-	29	45N	113W	GM	Y	I	-	
13018750	SNAKE RIVER BELOW FLAT CREEK NEAR JACKSON	CR	2342	1975-	3	39N	116W	DGM	Y	I	-	
*#13018300	CACHE CREEK NEAR JACKSON	BH	10.6	1962-	1	40N	116W	GW	Y	GR	USGS	HYDRO BENCHMARK STA
*13022500	SNAKE RIVER ABOVE RESERVOIR, NEAR ALPINE	CR	3465	1917-18, 1937-39, 1953-	-	-	-	GW	Y	I	-	
13023000	GREYS RIVER ABOVE RESERVOIR, NEAR ALPINE	CP	448	1917-18, 1937-39, 1953-	34	37N	118W	GM	Y	I	-	
13025000	SWIFT CREEK NEAR AFTON	CH	27.4	1942-	29	32N	118W	GW	S	S	WSE	
*13027500	SALT RIVER ABOVE RESERVOIR, NEAR ETNA	CR	829	1953-	28	36N	119W	DW	Y	I	-	
13046500	GRASSY LAKE NEAR MORAN	C	10.4	1939-	18	48N	116W	-	-	-	-	FURNISHED BY USBR

* Also chemical-quality station
\# Also sediment station

Peak-Flow Partial-Record Stations

Explanation of abbreviations and codes used in table 2.

Location: SE, section
TSP, township
RNGE, range

Period of Record: The dates given are the calendar years in which records began or ended. Breaks of less than a year are not shown.

Gage Equipment: CSI, crest-stage indicator
S-R, stage-rainfall recorder

Field Office: B, Buffalo
C, Casper
CF, Cheyenne Field Unit
GR, Green River
R, Riverton
W, Worland

Cooperator: BLM, Bureau of Land Management
WHD, Wyoming Highway Department

Table 2. Peak-flow partial-record stations

STATION NUMBER	STATION NAME	DRAINAGE AREA MI²	LOCATION SE	TSP	RNGE	PERIOD OF RECORD	GAGE EQUIPMENT	FIELD OFFICE	COOPERATOR	REMARKS
YELLOWSTONE RIVER BASIN										
06218700	WAGON GULCH NEAR DUBOIS	4.89	30	42N	107W	1961-	CSI	R	WHD	
06223700	SAND DRAW NEAR CROWHEART	12.8	2	3N	3W	1961-	CSI	R	WHD	
06223800	WIND RIVER TRIBUTARY NO 2 NEAR CROWHEART	3.16	18	3N	2W	1961-	CSI	R	WHD	
06226200	LITTLE DRY CREEK NEAR CROWHEART	10.5	35	7N	3W	1961-	CSI	R	WHD	
06226300	DRY CREEK NEAR CROWHEART	97.9	19	5N	2W	1959, 1961-	CSI	R	WHD	
06229700	NORKOK MEADOWS CREEK NEAR FORT WASHAKIE	15.4	8	1N	1W	1965-	CSI	R	WHD	
06229800	SAND DRAW NEAR FORT WASHAKIE	.99	18	1N	1W	1961-	CSI	R	WHD	
06229900	TROUT CREEK NEAR FORT WASHAKIE	16.1	15	56N	94W	1961-68, 1970-	CSI	R	WHD	
06233360	MONUMENT DRAW AT LOWER STATION, NEAR HUDSON	8.38	21	33N	98W	1965-73, 1973-	S-R CSI	R	WHD	
06234800	BOBCAT DRAW NEAR SAND DRAW	2.89	21	33N	95W	1969, 1971-	CSI	R	WHD	
06236000	KIRBY DRAW NEAR RIVERTON	129	3	1N	5E	1951-53, 1961-	CSI	R	WHD	
06238760	W F DRY CHEYENNE C AT UPPER STATION, NR RIVERTON	.69	4	34N	94W	1965-73, 1973-	S-R CSI	R	WHD	
06255300	POISON CREEK TRIBUTARY NEAR SHOSHONI	.39	33	38N	93W	1959-	CSI	R	WHD	
06256600	RED CREEK NEAR ARMINTO	7.15	19	38N	87W	1963-	CSI	C	WHD	
06256700	SOUTH BRIDGER CREEK NEAR LYSITE	10.0	9	40N	91W	1960-	CSI	R	WHD	
06257300	SHOTGUN CREEK TRIBUTARY NEAR PAVILLION	2.57	27	6N	1E	1961-	CSI	R	WHD	
06265200	SAND DRAW NEAR THERMOPOLIS	6.33	2	44N	97W	1960-	CSI	W	WHD	
06265600	TIE DOWN GULCH NEAR WORLAND	1.78	10	45N	94W	1961-	CSI	W	WHD	
06266460	MURPHY DRAW NEAR GRASS CREEK	2.32	28	47N	97W	1965-73, 1973-	S-R CSI	W	WHD	
06267260	NORTH PRONG EAST FORK NOWATER CREEK NEAR WORLAND	3.77	18	46N	91W	1964-73, 1973-	S-R CSI	W	WHD	
06268500	FIFTEEN MILE CREEK NEAR WORLAND	518	27	47N	93W	1951-72, 1972-	CSI	W	WHD	
06269750	NOWOOD RIVER TRIBUTARY NEAR TEN SLEEP	.42	11	46N	88W	1960-	CSI	W	WHD	
06274190	NOWOOD RIVER TRIBUTARY NO 2 NEAR BASIN	1.51	28	50N	92W	1965-73, 1973-	S-R CSI	W	WHD	
06274250	ELK CREEK NEAR BASIN	96.9	16	50N	93W	1959-	CSI	W	WHD	
06277700	TWENTYFOUR MILE CREEK NEAR EMBLEM	12.8	23	52N	98W	1960-	CSI	W	WHD	
06277750	DRY CREEK TRIBUTARY NEAR EMBLEM	.65	19	52N	97W	1960-68, 1970-	CSI	W	WHD	
06279020	RED GULCH NEAR SHELL	47.8	32	53N	91W	1967, 1970-	CSI	W	WHD	
06299900	SLATER CREEK NEAR MONARCH	18.0	18	57N	84W	1967-	CSI	B	WHD	
06312700	SOUTH FORK POWDER RIVER NEAR POWDER RIVER	262	3	35N	85W	1961-	CSI	C	WHD	
06312795	SANCHEZ CREEK ABOVE RESERVOIR, NEAR ARMINTO	5.53	20	39N	86W	1970-	CSI	C	WHD	
06313020	BOBCAT CREEK NEAR EDGERTON	8.29	10	37N	77W	1965-73, 1973-	S-R CSI	C	WHD	
06313050	EAST TEAPOT CREEK NEAR EDGERTON	5.44	16	37N	78W	1965-72, 1973-	S-R CSI	C	WHD	
06313100	COAL DRAW NEAR MIDWEST	11.4	8	40N	78W	1961-	CSI	C	WHD	
06313630	VAN HOUTEN DRAW NEAR BUFFALO	10.8	33	49N	77W	1971-	CSI	B	WHD	
06316700	POWDER RIVER TRIBUTARY NEAR BUFFALO	1.64	9	52N	77W	1965-73, 1973-	S-R CSI	B	WHD	
06317050	RUCKER DRAW NEAR SPOTTED HORSE	3.98	28	55N	75W	1961-	CSI	B	WHD	
06319100	BULL CREEK NEAR BUFFALO	10.8	29	50N	82W	1969-	CSI	B	WHD	
06324800	LITTLE POWDER RIVER TRIBUTARY NEAR GILLETTE	.81	36	52N	72W	1960-	CSI	C	WHD	
06324900	CEDAR DRAW NEAR GILLETTE	3.45	6	52N	71W	1959-	CSI	C	WHD	
06324910	COW CREEK TRIBUTARY NEAR WESTON	.72	26	53N	71W	1971-	CSI	C	WHD	

Table 2. Peak-flow partial-record stations (continued)

STATION NUMBER	STATION NAME	DRAINAGE AREA MI²	LOCATION SE	LOCATION TSP	LOCATION RNGE	PERIOD OF RECORD	GAGE EQUIPMENT	FIELD OFFICE	COOPERATOR	REMARKS
CHEYENNE RIVER BASIN										
06379600	BOX CREEK NEAR BILL	112	9	36N	70W	1956-58, 1959, 1961-	CSI	C	WHD	
06382200	PRITCHARD DRAW NEAR LANCE CREEK	5.1	8	37N	65W	1964-72, 1972-	S-R CSI	C	WHD	
06385400	COTTONWOOD CREEK AT HAT CREEK	14.5	12	34N	63W	1972-	CSI	C	WHD	
06387500	TURNER CREEK NEAR OSAGE	47.8	26	47N	64W	1959-	CSI	C	WHD	
06388800	BLACKTAIL CREEK TRIBUTARY NEAR NEWCASTLE	.25	16	44N	61W	1960-	CSI	C	WHD	
06426195	DONKEY CREEK TRIB ABOVE RESERVOIR, NEAR GILLETTE	.2	29	50N	71W	1970-	CSI	C	WHD	
06427700	INYAN KARA CREEK NEAR UPTON	96.5	17	49N	63W	1959-	CSI	C	WHD	
06428100	BELLE FOURCHE RIVER TRIBUTARY NO 2 NEAR HULETT	10.2	3	54N	64W	1962-	CSI	C	WHD	
06429300	OGDEN CREEK NEAR SUNDANCE	8.42	30	52N	62W	1962-72, 1972-	S-R CSI	C	WHD	
PLATTE RIVER BASIN										
06629150	COAL BANK DRAW TRIBUTARY NEAR WALCOTT	3.65	3	20N	83W	1962-	CSI	CF	WHD	
06629200	COAL BANK DRAW TRIBUTARY NO 2 NEAR WALCOTT	2.41	4	20N	83W	1962-	CSI	CF	WHD	
06629800	COAL CREEK NEAR RAWLINS	7.32	30	21N	87W	1959-	CSI	CF	WHD	
06630200	BIG DITCH TRIBUTARY NEAR HANNA	7.42	21	22N	81W	1959-70, 1970-72, 1972-	CSI S-R CSI	CF	WHD	
06631150	THIRD SAND CREEK NEAR MEDICINE BOW	10.8	29	21N	79W	1965-73, 1973-	S-R CSI	CF	WHD	
06634200	SHEEP CREEK NEAR MARSHALL	61.0	30	27N	75W	1961-	CSI	CF	WHD	
06634300	SHEEP CREEK NEAR MEDICINE BOW	174	19	25N	76W	1961-	CSI	CF	WHD	
06634910	MEDICINE BOW RIVER TRIBUTARY NEAR HANNA	3.01	35	24N	81W	1965-73, 1973-	S-R CSI	CF	WHD	
#06637550	SWEETWATER RIVER NEAR SOUTH PASS CITY	177	28	28N	101W	1958-73, 1974-	CSI	R	WHD	
#06638300	WEST FORK CROOKS CREEK NEAR JEFFREY CITY	11.6	31	28N	92W	1961-	CSI	R	WHD	
06638350	COAL CREEK NEAR MUDDY GAP	6.08	4	27N	89W	1961-	CSI	R	WHD	
06641400	BEAR SPRINGS CREEK NEAR ALCOVA	9.33	30	30N	82W	1960-	CSI	C	WHD	
06642700	LAWN CREEK NEAR ALCOVA	11.5	8	29N	80W	1961-	CSI	C	WHD	
06642760	STINKING CREEK NEAR ALCOVA	117	30	30N	80W	1961-	CSI	C	WHD	
06643300	COAL CREEK NEAR GOOSE EGG	5.39	27	32N	81W	1960-	CSI	C	WHD	
06644840	MCKENZIE DRAW TRIBUTARY NEAR CASPER	2.02	12	36N	78W	1965-73, 1973-	S-R CSI	C	WHD	
06646700	EAST FORK DRY CREEK TRIBUTARY NEAR GLENROCK	2.60	26	33N	75W	1961-	CSI	C	WHD	
06648780	SAGE CREEK TRIBUTARY NEAR ORPHA	1.38	18	35N	73W	1965-73, 1973-	S-R CSI	C	WHD	
06649900	NORTH PLATTE RIVER TRIBUTARY NEAR DOUGLAS	8.53	5	31N	71W	1961-	CSI	C	WHD	
06651800	SAND CREEK NEAR ORIN	27.8	11	31N	70W	1955, 1961-	CSI	C	WHD	
06652400	WATSON DRAW NEAR LOST SPRINGS	6.95	12	32N	68W	1960-70, 1970-72, 1972-	CSI S-R CSI	C	WHD	
06661580	SEVENMILE CREEK NEAR CENTENNIAL	11.2	11	17N	77W	1962-	CSI	CF	WHD	
06668040	RABBIT CREEK NEAR WHEATLAND	1.3	22	26N	70W	1965-72, 1972-	S-R CSI	C	WHD	
06670100	LARAMIE RIVER TRIBUTARY NEAR GUERNSEY	1.97	7	25N	65W	1971-	CSI	C	WHD	
06670985	DRY RAWHIDE CREEK NEAR LINGLE	20	21	27N	62W	1969-	CSI	C	WHD	
06675300	HORSE CREEK TRIBUTARY NEAR LITTLE BEAR	8.16	10	17N	67W	1961-	CSI	CF	WHD	
06761900	LODGEPOLE CREEK TRIBUTARY NEAR PINE BLUFFS	.44	21	15N	60W	1960-	CSI	CF	WHD	
06762600	LODGEPOLE CREEK TRIBUTARY NO 2 NEAR ALBIN	5.69	28	16N	60W	1960-	CSI	CF	WHD	

Also sediment station

Table 2. Peak-flow partial-record stations (continued)

STATION NUMBER	STATION NAME	DRAINAGE AREA MI²	LOCATION SE	TSP	RNGE	PERIOD OF RECORD	GAGE EQUIPMENT	FIELD OFFICE	COOPERATOR	REMARKS
GREEN RIVER BASIN										
*#09204700	SAND SPRINGS DRAW TRIBUTARY NEAR BOULDER	2.77	8	30N	107W	1961-	CSI	GR	WHD	
*#09207650	DRY BASIN CREEK NEAR BIG PINEY	47.2	12	28N	112W	1971-	CSI	GR	WHD	
*#09211300	FOURMILE GULCH TRIBUTARY NEAR FONTENELLE	14.2	15	24N	111W	1971-	CSI	GR	WHD	
*#09216290	EAST OTTERSON WASH NEAR GREEN RIVER	16.6	23	21N	109W	1969-	CSI	GR	WHD	
*#09216350	SKUNK CANYON CREEK NEAR GREEN RIVER	15.7	8	20N	107W	1965, 1971-	CSI	GR	WHD	
#09216537	DELANEY DRAW NEAR RED DESERT	34.5	8	19N	95W	1961-	CSI	GR	WHD	
*#09216550	DEADMAN WASH NEAR POINT OF ROCKS	152	25	20N	101W	1961-	CSI	GR	WHD	
*#09216572	BEANS SPRING CREEK NEAR SOUTH BAXTER	4.92	25	14N	104W	1975-	CSI	CP	BLM	
*#09216576	GAP CREEK BL BEANS SPRING CR, NEAR SOUTH BAXTER	35.9	7	14N	103W	1976-	CSI	GR	BLM	
*#09216578	DRY CANYON NEAR SOUTH BAXTER	3.69	5	14N	102W	1976-	S-R	GR	BLM	
*#09216580	BIG FLAT DRAW NEAR ROCK SPRINGS	19.5	4	15N	102W	1973-	CSI	GR	WHD	
*#09216600	CUTTHROAT DRAW NEAR ROCK SPRINGS	7.88	17	17N	102W	1959-70, 1970-72, 1972-	CSI S-R CSI	GR	WHD	
*#09216695	NO NAME CREEK NEAR ROCK SPRINGS	18.2	1	17N	103W	1973-	CSI	GR	WHD	
*09216900	BITTER CREEK TRIBUTARY NEAR GREEN RIVER	1.65	16	18N	106W	1959-	CSI	GR	WHD	
*#09221680	MUD SPRING HOLLOW NEAR CHURCH BUTTE, NEAR LYMAN	8.83	7	16N	113W	1965-73, 1973-	S-R CSI	GR	WHD	
*09224600	BLACKS FORK TRIBUTARY NEAR GRANGER	5.03	15	18N	111W	1959-	CSI	GR	WHD	
*#09224800	MEADOW SPRINGS WASH TRIBUTARY NEAR GREEN RIVER	5.22	18	18N	109W	1962-65, 1968-	CSI CSI	GR	WHD	
*#09224810	BLACKS FORK TRIBUTARY NO 2 NEAR GREEN RIVER	12.0	8	17N	108W	1965-	CSI	GR	WHD	
*#09224820	BLACKS FORK TRIBUTARY NO 3 NEAR GREEN RIVER	3.59	28	17N	108W	1965-	CSI	GR	WHD	
*#09224840	BLACKS FORK TRIBUTARY NO 4 NEAR GREEN RIVER	1.26	33	17N	108W	1965-	CSI	GR	WHD	
*#09224980	SUMMERS DRY CREEK NEAR GREEN RIVER	423	13	16N	109W	1965-	CSI	GR	WHD	
*#09225200	SQUAW HOLLOW NEAR BURNTFORK	6.57	29	14N	108W	1965-	CSI	GR	WHD	
*#09225300	GREEN RIVER TRIBUTARY NO 2 NEAR BURNTFORK	13.0	31	13N	108W	1959, 1961-	CSI	GR	WHD	
*#09258200	DRY COW CREEK NEAR BAGGS	49.7	19	16N	91W	1970-	CSI	CF	WHD	
BEAR RIVER BASIN										
10019700	WHITNEY CANYON CREEK NEAR EVANSTON	8.93	27	17N	120W	1965-	CSI	GR	WHD	
SNAKE RIVER BASIN										
13019220	SOUR MOOSE CREEK NEAR BONDURANT	2.77	26	37N	112W	1964-	CSI	GR	WHD	

* Also chemical-quality station
\# Also sediment station

Chemical-Quality 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. Breaks of less than a year are not shown.

Location:
- SE, section
- TSP, township
- RNGE, range

Cooperator:
- BLM, Bureau of Land Management
- BRUC, Bureau of Reclamation, Upper Colorado Region
- BRUM, Bureau of Reclamation, Upper Missouri Region
- EPA, Environmental Protection Agency, Region 8
- MRB, Geological Survey, Missouri River Basin Program
- USGS, Geological Survey, Federal Program
- WDA, Wyoming Department of Agriculture
- WDEQ, Wyoming Department of Environmental Quality

Sampling Frequency:
- C, continuous (recorder)
- D, daily
- BW, biweekly
- M, monthly
- MW, monthly, except weekly during irrigation season
- MQ, monthly during summer, quarterly during winter
- Q, quarterly
- HL, high and low flow samples only
- SA, semiannual
- I, infrequent or as requested

Analysis Schedule:
1. salinity (major constituents)
2. specific conductance
3. daily temperature (observed)
4. bacteria or chemical oxygen demand
5. field determinations of: pH, specific conductance, dissolved oxygen, temperature, and (or) turbidity
6. total coliform, fecal coliform, and (or) fecal streptococcus
7. nutrient
8. trace metals
9. pesticides
10. radiochemical
11. biological
12. miscellaneous

Field Office:
- C, Casper
- CF, Cheyenne Field Unit
- CH, Cheyenne Hydrologic Surveillance Section
- CP, Cheyenne project personnel
- CT, Contractor
- GR, Green River
- R, Riverton
- W, Worland

Table 3. Chemical-quality stations

STATION NUMBER	STATION NAME	DRAINAGE AREA MI²	PERIOD OF RECORD	LOCATION SE TSP RNGE	COOPERATOR	SAMPLING FREQUENCY	ANALYSIS SCHEDULE	FIELD OFFICE	REMARKS
YELLOWSTONE RIVER BASIN									
@06207500	CLARKS FORK YELLOWSTONE RIVER NEAR BELFRY, MT	1154	1965-	31 9S 22E	WDA	M	1	W	
#@06207510	BIG SAND COULEE AT WYOMING-MONTANA STATE LINE	134	1976-	32 9S 22E	BLM	Q	1,5,7,	W	
@06218500	WIND RIVER NEAR DUBOIS	232	1947-50,	25 42N 108W	WDA	M	1	R	
			1965-		WDEQ	M	5,6	R	
					WDA	HL	9	CH	
#@06220500	EAST FORK WIND RIVER NEAR DUBOIS	427	1975-	34 6N 6W	MRB	M	5	R	
@06222700	CROW CREEK NEAR TIPPERARY	30.2	1974-	20 7N 4W	MRB	M	5	R	
@06224000	BULL LAKE CREEK ABOVE BULL LAKE	187	1974-	2 2N 4W	MRB	M	5	R	
@06228000	WIND RIVER AT RIVERTON	2309	1947-50,	2 1S 4E	WDA	M	1	R	
			1953,		WDEQ	M	5,6	R	
			1965-						
@06228350	SF LITTLE WIND R AB WASHAKIE RE NR FT WASHAKIE		1976-	18 1S 2W	MRB	M	1,5	R	
06231000	LITTLE WIND RIVER ABOVE ARAPAHOE	660	1966-	22 1S 3E	WDA	M	1	R	
06235000	BEAVER CREEK NEAR ARAPAHOE	354	1967-	29 1S 4E	WDA	M	1	R	
@06235500	LITTLE WIND RIVER NEAR RIVERTON	1904	1965-	11 15N 4E	WDA	M	1	R	
06236100	WIND RIVER ABOVE BOYSEN RESERVOIR, NR SHOSHONI	4390	1974-	25 2N 5E	WDEQ	M	1,5,6	R	
					WDA	HL	9	CH	
@06253000	FIVEMILE CREEK NEAR SHOSHONI	418	1949-51,	19 3N 6E	WDA	M	1	R	
			1953,						
			1965-						
#@06256900	DRY CREEK NEAR BONNEVILLE	52.6	1976-	8 38N 92W	BLM	M	1,5	W	
@06259000	WIND RIVER BELOW BOYSEN RESERVOIR	7701	1953-54,	9 5N 6E	WDA	D	2,3	W	
			1960-		WDA	M	1	W	
					WDEQ	M	5,6	W	
					WDA	HL	9	CH	
					EPA	Q	10	W	
					EPA	HL	8	W	
#@06260000	SOUTH FORK OWL CREEK NEAR ANCHOR	85.5	1974-	28 43N 100W	MRB	M	5	W	
					BLM	I	1,5,6	W	6 SAMPLES PER YR
@06260400	SOUTH FORK OWL CREEK BELOW ANCHOR RESERVOIR	131	1974-	25 43N 100W	MRB	M	5	W	
06264700	BIGHORN RIVER AT LUCERNE	-	1966-	32 44N 94W	WDA	M	1	W	
#06265337	COTTONWOOD C AT COUNTY BR NR HAMILTON DOME		1976-	24 44N 99W	BLM	I	1,5,6	W	4 SAMPLES PER YR
#06265410	COTTONWOOD C AT ST HWY 120 NR HAMILTON DOME		1976-	26 45N 97W	BLM	I	1,5,6	W	6 SAMPLES PER YR
#06265435	GRASS CREEK ABOVE LITTLE GRASS C NR GRASS CREEK		1976-	6 45N 99W	BLM	I	1,5,6	W	4 SAMPLES PER YR
#06265492	GRASS CREEK NR MOUTH NR HAMILTON DOME		1976-	17 45N 96W	BLM	I	1,5,6	W	4 SAMPLES PER YR
#06265500	COTTONWOOD CREEK AT WINCHESTER		1976-	17 45N 94W	BLM	I	1,5,6	W	6 SAMPLES PER YR
#@06265800	GOOSEBERRY CREEK AT DICKIE	95.0	1976-	32 47N 99W	BLM	I	1,5,6	W	6 SAMPLES PER YR
#06266450	GOOSEBERRY C AT ST HWY 431 NEAR GRASS CREEK		1976-	32 47N 97W	BLM	I	1,5,6	W	6 SAMPLES PER YR
#@06267400	EAST FORK NOWATER NEAR COLTER	149	1977-	31 46N 92W	BLM	M	1	W	8 SAMPLES PER YR
					BLM	HL	7,8	W	
06268600	BIGHORN RIVER AT WORLAND	10810	1966-	25 47N 93W	WDA	M	1	W	
#@06270000	NOWOOD RIVER NEAR TEN SLEEP	803	1967-	27 47N 88W	WDA	M	1	W	
06273500	PAINT ROCK CREEK NEAR MOUTH, BELOW HYATTVILLE	376	1951-53,	19 49N 90W	WDA	M	1	W	
			1967-						
06274220	NOWOOD RIVER AT MANDERSON	2000	1965-	30 50N 92W	WDA	M	1	W	
06277500	GREYBULL RIVER NEAR BASIN	1115	1951-53,	8 51N 94W	WDA	M	1	W	
			1965-		WDA	HL	9	CH	
06279090	SHELL CREEK NEAR GREYBULL	560	1951,	4 52N 93W	WDA	M	1	CH	
			1965-		WDEQ	M	5,6	CH	
#@06279500	BIGHORN RIVER AT KANE	15765	1947-53,	9 55N 94W	WDA	M	1	CH	
			1955-57,		WDEQ	M	5,6	CH	
			1960-		WDA	HL	9	CH	
@06282000	SHOSHONE RIVER BELOW BUFFALO BILL RESERVOIR	1538	1947-49,	3 52N 102W	WDA	M	1	CH	
			1964-		WDEQ	M	5,6	CH	
					WDA	HL	9	CH	
					MRB	C	3	W	

Also sediment station
@ Also streamflow station

Table 3. Chemical-quality stations (continued)

STATION NUMBER	STATION NAME	DRAINAGE AREA MI²	PERIOD OF RECORD	LOCATION SE	LOCATION TSP	LOCATION RNGE	COOPERATOR	SAMPLING FREQUENCY	ANALYSIS SCHEDULE	FIELD OFFICE	REMARKS
YELLOWSTONE RIVER BASIN (Continued)											
06282900	SHOSHONE RIVER ABOVE DRY CREEK, NEAR CODY	-	1974-	13	53N	101W	WDEQ	M	1,5,6	CH	
#06284010	SHOSHONE RIVER BELOW WILLWOOD DAM, NEAR RALSTON	-	1972-	8	54N	100W	BRUM	I	12	W	
@06284400	SHOSHONE RIVER NEAR GARLAND	2036	1974-	13	55N	98W	BRUM	M	5	W	
@06284500	BITTER CREEK NEAR GARLAND	80.5	1958-60, 1969-	7	55N	97W	MRB	D	2,3	CH	
							MRB	M	1,7	CH	
							WDEQ	M	5,6	CH	
@06284800	WHISTLE CREEK NEAR GARLAND	101	1959-60, 1969-	30	55N	97W	MRB	D	2,3	CH	
							MRB	M	1,7	CH	
#@06285100	SHOSHONE RIVER NEAR LOVELL	2350	1966-	16	56N	96W	MRB	D	2,3	CH	
							MRB	M	1,7	CH	
@06285400	SAGE CREEK AT SIDON CANAL, NEAR DEAVER	341	1958-60, 1969-	34	57N	97W	MRB	D	2,3	CH	
							MRB	M	1,7	CH	
06286200	SHOSHONE RIVER AT KANE	2989	1976-	6	56N	95W	WDA	HL	9	CH	
#@06286258	BIG COULEE NEAR LOVELL	30.1	1974-	34	58N	95W	MRB	M	5	W	
@06298000	TONGUE RIVER NEAR DAYTON	204	1966-	11	56N	87W	WDA	M	1	CH	
							WDEQ	M	5,6	CH	
06299980	TONGUE RIVER AT MONARCH	-	1973-	20	57N	84W	EPA	M	1,4,5,6,7	CH	
							EPA	M	11	CH	ONE WINTER SMPL
							EPA	HL	8	CH	
#@06305500	GOOSE CREEK BELOW SHERIDAN	392	1959-60, 1961-64, 1967-	15	56N	84W	WDA	M	1	CH	
							WDEQ	M	5,6	CH	
							EPA	M	4,6,7	CH	
							EPA	HL	8	CH	
@06306300	TONGUE RIVER AT STATE LINE, NEAR DECKER, MT	1477	1965-	33	9S	40E	WDA	M	1	CH	
							WDEQ	M	5,6	CH	
							EPA	M	6,7,11	CH	ONE WINTER SMPL
							EPA	HL	8	CH	
06312500	POWDER RIVER NEAR KAYCEE	980	1968-	13	43N	81W	WDA	M	1	CH	
							WDEQ	M	5,6	CH	
06313000	SOUTH FORK POWDER RIVER NEAR KAYCEE	1150	1968-	9	42N	81W	WDA	M	1	CH	
							WDEQ	M	5,6	CH	
#@06313400	SALT CREEK NEAR SUSSEX	769	1967-	8	42N	79W	WDA	M	1	CH	
							USGS	M	4,5,7	CH	
							USGS	Q	8	CH	
#@06313500	POWDER RIVER AT SUSSEX	3090	1949-53, 1977-	13	43N	79W	USGS	M	1,5,6,7	CT	
							USGS	M	11	CT	
							USGS	Q	8	CT	
							USGS	SA	10	CT	
#@06316400	CRAZY WOMAN CREEK AT UPPER STATION, NEAR ARVADA	945	1966-	18	52N	77W	USGS	M	1,5,6,7	CT	
							USGS	M	11	CT	
							USGS	Q	8	CT	
							USGS	SA	10	CT	
#@06317000	POWDER RIVER AT ARVADA	6050	1946-53, 1967-	21	54N	77W	WDA	M	1	CH	
							WDEQ	Q	5,6	CH	
#@06320200	CLEAR CREEK BELOW ROCK CREEK, NEAR BUFFALO	322	1975-	30	51N	81W	USGS	M	1,4,5,7	CH	
							USGS	Q	8	CH	
#@06320400	CLEAR CREEK AT UCROSS	409	1975-	19	53N	80W	USGS	M	1,4,5,7	CH	
							USGS	Q	8	CH	
@06323500	PINEY CREEK AT UCROSS	267	1975-	18	53N	80W	EPA	M	1,5,6,7	CH	
							EPA	HL	9	CH	
#@06324000	CLEAR CREEK NEAR ARVADA	1110	1950-54, 1966-	36	57N	77W	WDA	M	1	CH	
							EPA	M	5,6,7	CH	
							EPA	HL	8	CH	

Also sediment station
@ Also streamflow station

Table 3. Chemical-quality stations (continued)

STATION NUMBER	STATION NAME	DRAINAGE AREA MI²	PERIOD OF RECORD	LOCATION SE	LOCATION TSP	LOCATION RNGE	COOPERATOR	SAMPLING FREQUENCY	ANALYSIS SCHEDULE	FIELD OFFICE	REMARKS
YELLOWSTONE RIVER BASIN (Continued)											
#@06324500	POWDER RIVER AT MOOREHEAD, MT	8088	1976-	8	9S	48E	WDA	HL	9	CH	
#@06324890	LITTLE POWDER R BELOW CORRAL C NEAR WESTON		1975-	12	52N	72W	USGS	M	1,5,6,7	CT	
							USGS	M	11	CT	
							USGS	Q	8	CT	
							USGS	SA	10	CT	
#@06324925	LITTLE POWDER RIVER NEW WESTON		1976-	19	54N	70W	USGS	M	1,5,6,7	CT	
							USGS	M	11	CT	
							USGS	Q	8	CT	
							USGS	SA	10	CT	
#@06324970	LITTLE POWDER RIVER ABOVE DRY CREEK, NR WESTON	1230	1975-	13	57N	71W	EPA	M	1,5,6,7	CH	
							EPA	HL	8	CH	
CHEYENNE RIVER BASIN											
#@06364700	ANTELOPE CREEK NEAR TECKLA		1977-	35	41N	70W	USGS	M	1,5,6,7	CT	
							USGS	M	11	CT	
							USGS	Q	8	CT	
							USGS	SA	10	CT	
#@06365300	DRY FORK CHEYENNE RIVER NEAR BILL	128	1976-	31	38N	73W	BLM	M	1,4,5,7,8	CH	SAMPLE WHEN FLOW
#@06365900	CHEYENNE RIVER NEAR DULL CENTER	1527	1975-	20	40N	68W	USGS	M	1,4,5,7	CH	
							USGS	Q	8	CH	
#@06375600	LITTLE THUNDER CREEK NEAR HAMPSHIRE		1977-	33	43N	67W	USGS	M	1,5,6,7	CT	
							USGS	M	11	CT	
							USGS	Q	8	CT	
							USGS	SA	10	CT	
#@06378300	LODGEPOLE CREEK NEAR HAMPSHIRE		1977-	5	41N	64W	USGS	M	1,5,6,7	CT	
							USGS	M	11	CT	
							USGS	Q	8	CT	
							USGS	SA	10	CT	
#@06386000	LANCE CREEK NEAR SPENCER	2070	1975-	14	39N	62W	BLM	M	1,4,5,7	CH	
							BLM	Q	8	CH	
06386500	CHEYENNE RIVER NEAR SPENCER	5270	1975-	25	40N	61W	EPA	M	1,5,6,7	CH	
							EPA	Q	10	CH	
							EPA	HL	8	CH	
@06394000	BEAVER CREEK NEAR NEWCASTLE	1320	1949-53, 1967-	18	41N	60W	WDA	M	1	C	
#@06425720	BELLE FOURCHE RIVER BL RATTLESNAKE CR, NR PINEY	495	1975-	9	46N	71W	BLM	-	1,4,5,7,8	CH	SAMPLE WHEN FLOW
#@06425780	BELLE FOURCHE RIVER ABOVE DRY CREEK, NEAR PINEY	594	1975-	25	47N	71W	BLM	-	1,4,5,7,8	CH	SAMPLE WHEN FLOW
#@06425900	CABALLO CREEK AT MOUTH, NEAR PINEY		1977-	4	47N	70W	USGS	M	1,5,6,7	CT	
							USGS	M	11	CT	
							USGS	Q	8	CT	
							USGS	SA	10	CT	
#@06425950	RAVEN CREEK NEAR MOORCROFT		1977-	1	48N	69W	USGS	M	1,5,6,7	CT	
							USGS	M	11	CT	
							USGS	O	8	CT	
							USGS	SA	10	CT	
#@06426400	DONKEY CREEK NEAR MOORCROFT		1977-	30	50N	68W	USGS	M	1,5,6,7	CT	
							USGS	M	11	CT	
							USGS	Q	8	CT	
							USGS	SA	10	CT	
#@06426500	BELLE FOURCHE RIVER BELOW MOORCROFT	1670	1975-	24	50N	68W	EPA	M	1,4,5,6,7	CH	
							EPA	M	11	CH	ONE WINTER SMPL
							BLM	M	1,4,5,7	CH	
							EPA	HL	8	CH	
							BLM	HL	8	CH	
06427850	BELLE FOURCHE RIVER AT DEVILS TOWER		1967-	7	53N	65W	WDA	M	1	CH	

Also sediment station
@ Also streamflow station

Table 3. Chemical-quality stations (continued)

STATION NUMBER	STATION NAME	DRAINAGE AREA MI²	PERIOD OF RECORD	LOCATION SE	LOCATION TSP	LOCATION RNGE	COOPERATOR	SAMPLING FREQUENCY	ANALYSIS SCHEDULE	FIELD OFFICE	REMARKS
CHEYENNE RIVER BASIN (Continued)											
@06428500	BELLE FOURCHE R AT WYO-SOUTH DAKATO STATE LINE	3280	1965-	18	9N	1E	WDA	M	1	C	
							WDEQ	M	5,6	CH	
							EPA	M	6,7	CH	
							EPA	M	11	CH	ONE WINTER SMPL
							EPA	HL	8	CH	
PLATTE RIVER BASIN											
@06620000	NORTH PLATTE RIVER NEAR NORTHGATE, CO	1431	1965-	11	11N	80W	WDA	M	1	CH	
							WDEQ	M	5,6	CH	
							WDA	HL	9	CH	
#@06623800	ENCAMPMENT RIVER AB HOG PARK CR, NR ENCAMPMENT	72.7	1967-	10	12N	84W	USGS	M	1,5,6,7	CF	
							USGS	HL	8,9	CF	
							USGS	A	10	CF	
@06625000	ENCAMPMENT RIVER AT MOUTH, NEAR ENCAMPMENT	265	1965-	3	15N	83W	WDA	M	1	CH	
							WDEQ	M	5,6	CH	
#@06628800	SAGE CREEK NEAR SARATOGA	263	1972-	32	19N	85W	BLM	M	1	CF	NO WINTER SAMPLE
@06630000	NORTH PLATTE RIVER AB SEMINOE RES, NR SINCLAIR	8134	1960-	13	22N	86W	WDA	M	1	CH	
							WDEQ	M	5,6	CH	
#@06630300	BIG DITCH NEAR COYOTE SPRINGS	110	1974-	30	23N	83W	BLM	M	1,5,7	CF	
							BLM	Q	8	CF	
							BLM	A	10	CF	
#@06630330	NORTH DITCH NEAR COYOTE SPRINGS	22.6	1976-	19	23N	83W	BLM	M	1,5,7	CF	
							BLM	Q	8	CF	
							BLM	A	10	CF	
06630350	SEMINOE RES IN N PLATTE R ARM NR SEMINOE BOAT C	-	1972-	35	24N	84W	MRB	MQ	5,7,11	CP	
							WDA	HL	9	CH	
#@06634600	LITTLE MEDICINE BOW RIVER NEAR MEDICINE BOW	966	1965-	21	23N	78W	WDA	M	1	CF	
							EPA	Q	10	CF	
							EPA	HL	8	CF	
#@06634990	HANNA DRAW NEAR HANNA	21.6	1974-	34	24N	81W	BLM	M	1,5,7,	CF	
							BLM	Q	8	CF	
							BLM	A	10	CF	
#@06635000	MEDICINE BOW RIVER ABOVE SEMINOE RES, NR HANNA	2338	1965-	34	24N	81W	WDA	M	1	CF	
							EPA	Q	10	CF	
							EPA	HL	8	CF	
06635100	SEMINOE RE-MEDICINE BOW R ARM NR SEMINOE BOAT C	-	1972-	13	24N	83W	MRB	MQ	5,7,11	CP	
@06635500	SEMINOE RESERVOIR NEAR LEO	7230	1972-	8	25N	84W	MRB	MQ	5,7,11	CP	
06636000	NORTH PLATTE RIVER ABOVE PATHFINDER RESERVOIR	7241	1969-	34	26N	84W	MRB	M	5	CH	
06637200	PATHFINDER RE IN N PLATTE ARM NR SAND CR POINT	-	1972-	20	28N	84W	MRB	MQ	5,7,11	CP	
#@06639000	SWEETWATER RIVER NEAR ALCOVA	2327	1964-	25	29N	87W	WDA	M	1	CH	
							WDEQ	M	5,6	CH	
							EPA	Q	10	CH	
							EPA	HL	8	CH	
06639600	PATHFINOER RE IN SWEETWATER R ARM NR BISHOP PT	-	1972-	20	29N	84W	MRB	MQ	5,7,11	CP	
@06640500	PATHFINDER RESERVOIR NEAR ALCOVA	10711	1972-	24	29N	84W	MRB	MQ	5,7,11	CP	
06641300	ALCOVA RE AT MOUTH OF FREMONT CANYON, NR ALCOVA	-	1972-	3	29N	83W	MRB	MQ	5,7,11	CP	
@06641500	ALCOVA RESERVOIR AT ALCOVA	10776	1972-	24	30N	83W	MRB	MQ	5,7,11	CP	
@06642000	NORTH PLATTE RIVER AT ALCOVA	10812	1965-	17	30N	82W	WDA	M	1	CH	
							WDEQ	M	5,6	CH	
06643000	BATES CREEK NEAR ALCOVA	393	1970-	1	31N	82W	MRB	M	5	CH	
06643510	NORTH PLATTE R AB POISON SPIDER C NR GOOSE EGG		1977-	3	32N	81W	EPA	BW	5,5,7	C	
							EPA	M	8	C	
							EPA	Q	1,10	C	
06644085	NORTH PLATTE RIVER AT MILLS	-	1970-	7	33N	79W	MRB	MW	5	C	
06644500	CASPER CREEK AT CASPER	668	1970-	7	33N	79W	MRB	MW	5	C	
							MRB	A	1	C	

Also sediment station
@ Also streamflow station

Table 3. Chemical-quality stations (continued)

STATION NUMBER	STATION NAME	DRAINAGE AREA MI²	PERIOD OF RECORD	LOCATION SE	LOCATION TSP	LOCATION RNGE	COOPERATOR	SAMPLING FREQUENCY	ANALYSIS SCHEDULE	FIELD OFFICE	REMARKS
PLATTE RIVER BASIN (Continued)											
#06644550	NORTH PLATTE RIVER AT CASPER	-	1971-	4	33N	79W	MRB	MW	5	C	
06645000	NORTH PLATTE RIVER BELOW CASPER	12574	1950-52, 1957-59, 1967-	4	33N	78W	WDA	M	1	C	
							WDEQ	BW	5,6	C	
							EPA	BW	5,6	C	
							EPA	BW	7	C	
							EPA	M	8	C	
							EPA	Q	10	C	
@06646600	DEER CREEK BELOW MILLAR WASTEWAY, AT GLENROCK	213	1967-	4	33N	75W	WDA	M	1	C	
#@06646780	SAND CREEK NEAR GLENROCK		1977-	5	33N	74W	USGS	M	1,5,6,7	CT	
							USGS	M	11	CT	
							USGS	Q	8	CT	
							USGS	SA	10	CT	
@06646800	NORTH PLATE RIVER NEAR GLENROCK	13538	1960-	17	33N	74W	WDA	M	1	C	
#@06652000	NORTH PLATTE RIVER AT ORIN	14888	1966-	17	31N	69W	WDA	M	1	CH	
							WDEQ	M	5,6	CH	
							EPA	Q	10	CH	
							EPA	HL	8	CH	
06652650	GLENDO RES OPPOSITE COTTONWOOD CR ARM NR GLENDO	-	1972-	12	29N	68W	MRB	MQ	5,7,11	CP	
							WDA	HL	9	CH	
@06652700	GLENDO RESERVOIR NEAR GLENDO	15545	1972-	13	29N	68W	MRB	MQ	5,7,11	CP	
@06652800	NORTH PLATTE RIVER BELOW GLENDO RESERVOIR	15548	1966-	30	29N	67W	WDA	M	1	CH	
							WDEQ	M	5,6	CH	
@06656000	NORTH PLATTE RIVER BELOW GUERNSEY RESERVOIR	16237	1950-58, 1965-	27	27N	66W	WDA	M	1	CF	
06660100	LARAMIE RIVER AT HOWELL	-	1974-	30	17N	73W	WDEQ	M	1,5,6	CH	
06660500	LARAMIE RIVER AT TWO RIVERS	1224	1966-	5	17N	74W	WDA	M	1	CH	
06661500	LITTLE LARAMIE RIVER AT TWO RIVERS	376	1965-	6	17N	74W	WDA	M	1	CH	
@06662000	LARAMIE RIVER NEAR LOOKOUT	2174	1976-	27	21N	74W	WDA	HL	9	CH	
#@06670500	LARAMIE RIVER NEAR FORT LARAMIE	4495	1965-	25	26N	65W	WDA	M	1	CH	
							WDEQ	M	5,6	CH	
							WDA	HL	9	CH	
#@06674500	NORTH PLATTE R AT WYOMING-NEBRASKA STATE LINE	22218	1965-	4	23N	58W	WDA	M	1	CH	
							WDEQ	M	5,6	CH	
@06679500	NORTH PLATTE RIVER AT MITCHELL NE	24300	1976-	33	33N	56W	WDA	HL	9	CH	
GREEN RIVER BASIN											
#@09188500	GREEN RIVER AT WARREN BRIDGE, NEAR DANIEL	468	1962-64, 1967-73, 1974-	8	35N	111W	WDEQ	M	1,5,6	CH	
							USGS	M	11	CH	
#09192600	GREEN RIVER NEAR BIG PINEY	-	1967-	21	30N	110W	WDA	M	1	GR	
							USGS	M	5	GR	
#@09196500	PINE CREEK ABOVE FREMONT LAKE	75.8	1975-	5	35N	108W	USGS	M	5	GR	
#@09203000	EAST FORK RIVER NEAR BIG SANDY	79.2	1975-	7	31N	105W	USGS	M	5	GR	
#@09204700	SAND SPRINGS DRAW TRIBUTARY NEAR BOULDER	2.77	1975-	8	30N	107W	USGS	M	5	GR	
#@09205000	NEW FORK RIVER NEAR BIG PINEY	1230	1965-	22	30N	110W	WDA	M	1	GR	
							USGS	M	5	GR	
							USGS	M	11	CH	
#@09207650	DRY BASIN CREEK NEAR BIG PINEY	47.2	1975-	12	28N	112W	USGS	M	5	GR	
#@09208000	LABARGE CREEK NR LABARGE MEADOWS RANGER STATION	6.3	1975-	8	29N	116W	USGS	M	5	GR	
#@09209400	GREEN RIVER NEAR LABARGE	3910	1963-	33	26N	112W	WDA	M	1	CH	
							WDEQ	M	5,6	CH	
							EPA	M	1,5,6,7	CH	
							WDA	HL	9	CH	
							EPA	HL	8	CH	
							EPA	M	11	CH	ONE WINTER SMPL
#@09210500	FONTENELLE CR NR HERSCHLER RANCH, NR FONTENELLE	152	1975-	2	24N	115W	USGS	M	5	GR	

Also sediment station
@ Also streamflow station

Table 3. Chemical-quality stations (continued)

STATION NUMBER	STATION NAME	DRAINAGE AREA MI^2	PERIOD OF RECORD	LOCATION SE	LOCATION TSP	LOCATION RNGE	COOPERATOR	SAMPLING FREQUENCY	ANALYSIS SCHEDULE	FIELD OFFICE	REMARKS
GREEN RIVER BASIN (Continued)											
#@09211200	GREEN RIVER BELOW FONTENELLE RESERVOIR	4280	1967-	31	24N	111W	WDA	M	1	CH	
							WDEQ	M	5,6	CH	
							EPQ	M	1,5,6,7	CH	
							EPQ	HL	8	CH	
							USGS	M	11	CH	
							EPA	Q	11	CH	ONE WINTER SMPL
#@09211300	FOURMILE GULCH TRIBUTARY NEAR FONTENELLE	14.2	1975-	15	24N	111W	USGS	M	5	GR	
#@09212500	BIG SANDY RIVER AT LECKIE RANCH, NEAR BIG SANDY	94.0	1975-	18	30N	104W	USGS	M	5	GR	
#@09213500	BIG SANDY RIVER NEAR FARSON	322	1975-	17	27N	106W	USGS	M	5	GR	
#@09214500	LITTLE SANDY CREEK ABOVE EDEN	134	1976-	11	26N	105W	BLM	M	1,5	CH	
							BLM	Q	7	CH	
							BLM	A	8	CH	
#@09216000	BIG SANDY RIVER BELOW EDEN	1610	1961-64, 1967-	31	24N	107W	WDA	M	1	CH	
							EPA	M	1,5,6,7	CH	
							EPA	HL	8	CH	
							WDA	HL	9	CH	
#@09216050	BIG SANDY RIVER AT GASSON BRIDGE, NEAR EDEN	1720	1975-	29	23N	109W	USGS	M	1,5	CH	
							USGS	M	11	CH	
#@09216290	EAST OTTERSON WASH NEAR GREEN RIVER	16.6	1975-	23	21N	109W	USGS	M	5	GR	
#09216300	GREEN RIVER AT BIG ISLAND, NEAR GREEN RIVER	-	1966-	26	21N	109W	WDA	M	1	CH	
							USGS	M	11	CH	
#@09216350	SKUNK CANYON CREEK NEAR GREEN RIVER	15.7	1975-	8	20N	107W	USGS	M	5	GR	
#09216525	SEPARATION CREEK AT UPPER STATION, NEAR RINER	41.8	1975-	9	19N	90W	BLM	M	5	CF	
#@09216527	SEPARATION CREEK NEAR RINER	55.3	1975-	32	20N	90W	BLM	M	1,4,5,7	CH	
							BLM	Q	8	CH	
#@09216545	BITTER CREEK NEAR BITTER CREEK	308	1975-	36	18N	99W	USGS	M	1,4,5,7	CH	
							USGS	Q	8	CH	
#@09216550	DEADMAN WASH NEAR POINT OF ROCKS	152	1975-	25	20N	101W	USGS	M	5	GR	
#@09216562	BITTER CREEK AB SALT WELLS CREEK, NR SALT WELLS	836	1975-	2	19N	103W	BLM	M	1,4,5,7	CH	
							BLM	Q	8	CH	
#@09216565	SALT WELLS CREEK NEAR SOUTH BAXTER	-	1975-	15	14N	103W	BLM	M	1,4,5,7	CH	
							BLM	Q	8	CH	
#09216570	GAP CREEK AB BEANS SPRING CR, NEAR SOUTH BAXTER	22.0	1975-	18	14N	103W	USGS	M	5	GR	
#@09216572	BEANS SPRING CREEK NEAR SOUTH BAXTER	4.92	1975-	25	14N	104W	USGS	M	5	GR	
#09216574	BEANS SPRING CREEK AT MOUTH, NEAR SOUTH BAXTER	13.1	1975-	18	14N	103W	USGS	M	5	GR	
#@09216576	GAP CREEK BL BEANS SPRING CR, NEAR SOUTH BAXTER	35.9	1975-	7	14N	103W	USGS	M	5	GR	
#@09216578	DRY CANYON NEAR SOUTH BAXTER	3.69	1976-	5	14N	102W	BLM	M	5	GR	
#@09216580	BIG FLAT DRAW NEAR POINT OF ROCKS	19.5	1975-	4	15N	102W	USGS	M	5	GR	
#@09216600	CUTTHROAT DRAW NEAR ROCK SPRINGS	7.88	1975-	17	17N	102W	USGS	M	5	GR	
#@09216695	NO NAME CREEK NEAR ROCK SPRINGS	18.2	1975-	1	17N	103W	USGS	M	5	GR	
#@09216750	SALT WELLS CREEK NEAR SALT WELLS	526	1975-	14	19N	103W	BLM	M	1,4,5,7	CH	
							BLM	Q	8	CH	
09216810	KILLPECKER CREEK AT ROCK SPRINGS	-	1975-	26	19N	105W	EPA	M	1,5,6,7	CH	
							EPA	HL	8	CH	
09216880	BITTER CREEK BEL LITTLE BITTER CREEK, NR KANDA	-	1975-	7	18N	105W	EPA	M	1,5,6,7	CH	
							EPA	HL	8	CH	
@09216900	BITTER CREEK TRIBUTARY NEAR GREEN RIVER	1.65	1975-	16	18N	106W	USGS	M	5	GR	
#@09217000	GREEN RIVER NEAR GREEN RIVER	14000	1951-	26	18N	107W	USGS	D	2,3	CH	
							USGS	M	1	CH	
							WDEQ	M	5,6	CH	
							EPA	M	1,5,6,7	CH	
							EPA	HL	8	CH	

Also sediment station
@ Also streamflow station

Table 3. Chemical-quality stations (continued)

STATION NUMBER	STATION NAME	DRAINAGE AREA MI²	PERIOD OF RECORD	LOCATION SE	LOCATION TSP	LOCATION RNGE	COOPERATOR	SAMPLING FREQUENCY	ANALYSIS SCHEDULE	FIELD OFFICE	REMARKS
GREEN RIVER BASIN (Continued)											
09217010	GREEN RIVER BELOW GREEN RIVER	-	1973-	36	18N	107W	WDEQ	M	1,5,6	CH	
							EPA	M	1,4,5,6,7	CH	
							EPA	HL	8	CH	
							WDA	HL	9	CH	
							USGS	M	11	CH	
							EPA	M	11	CH	ONE WINTER SMPL
#@09218500	BLACKS FORK NEAR MILLBURNE	152	1975-	11	12N	117W	USGS	M	5	GR	
#09221650	SMITHS FORK NEAR LYMAN	-	1974-	12	16N	114W	WDEQ	M	1,5,6	CH	
#@09221680	MUD SPRING HOLLOW NEAR CHURCH BUTTE, NEAR LYMAN	8.83	1975-	7	16N	116W	USGS	M	5	GR	
#@09222000	BLACKS FORK NEAR LYMAN	821	1962-	15	17N	113W	BRUC	D	2,3	CH	
							BRUC	M	1,5,6	CH	
							WDEQ	M	5,6	CH	
#@09222300	LITTLE MUDDY CREEK NEAR GLENCOE	416	1975-	31	19N	116W	BLM	M	1,4,5,7	CH	
							BLM	Q	8	CH	
#@09222400	MUDDY CREEK NEAR HAMPTON	963	1975-	18	18N	113W	BLM	M	1,4,5,7	CH	
							BLM	Q	8	CH	
#@09223000	HAMS FORK BELOW POLE CREEK, NEAR FRONTIER	128	1975-	35	25N	117W	USGS	M	5	GR	
09224050	HAMS FORK NEAR DIAMONDVILLE	-	1975-	36	21N	116W	EPA	M	1,4,5,6,7	CH	
							EPA	HL	8	CH	
#09224450	HAMS FORK NEAR GRANGER	670	1965-	30	19N	111W	WDA	M	1	CH	
@09224600	BLACKS FORK TRIBUTARY NEAR GRANGER	5.03	1975-	15	18N	111W	USGS	M	5	GR	
#@09224700	BLACKS FORK NEAR LITTLE AMERICA	3100	1951-	15	18N	109W	USGS	D	2,3	CH	
							USGS	M	1	CH	
							WDEQ	M	5,6	CH	
							WDA	HL	9	CH	
#@09224800	MEADOW SPRINGS WASH TRIBUTARY NEAR GREEN RIVER	5.22	1975-	18	18N	109W	USGS	M	5	GR	
#@09224810	BLACKS FORK TRIBUTARY NO 2 NEAR GREEN RIVER	12.0	1975-	8	17N	108W	USGS	M	5	GR	
#@09224820	BLACKS FORK TRIBUTARY NO 3 NEAR GREEN RIVER	3.59	1975-	28	17N	108W	USGS	M	5	GR	
#@09224840	BLACKS FORK TRIBUTARY NO 4 NEAR GREEN RIVER	1.26	1975-	33	17N	108W	USGS	M	5	GR	
#@09224980	SUMMERS DRY CREEK NEAR GREEN RIVER	423	1975-	13	16N	109W	USGS	M	5	GR	
#@09225200	SQUAW HOLLOW NEAR BURNTFORK	6.57	1975-	29	14N	108W	USGS	M	5	GR	
#@09225300	GREEN RIVER TRIBUTARY NO 2 NEAR BURNTFORK	13.0	1975-	31	13N	108W	USGS	M	5	GR	
#@09228500	BURNT FORK NEAR BURNTFORK	52.8	1975-	36	3N	16E	USGS	M	5	GR	
#@09229500	HENRYS FORK NEAR MANILA, UT	520	1951-	23	12N	109W	USGS	D	2,3	GR	
							USGS	M	1	GR	
#@09235300	VERMILLION CREEK NEAR HIAWATHA, CO	196	1975-	15	12N	100W	BLM	M	1,4,5,7	CH	
							BLM	Q	8	CH	
#@09257000	LITTLE SNAKE RIVER NEAR DIXON	988	1975-	8	12N	90W	USGS	M	5	CF	
#@09258200	DRY COW CREEK NEAR BAGGS	49.7	1975-	19	16N	91W	USGS	M	5	CF	
BEAR RIVER BASIN											
@10020100	BEAR RIVER ABOVE RESERVOIR, NEAR WOODRUFF, UT	752	1968-	29	17N	120W	WDA	M	1	CH	
#@10027000	TWIN CREEK AT SAGE	246	1967-69, 1975-	7	21N	119W	EPA	M	1,5,6,7	CH	
							EPA	HL	8	CH	
							BLM	M	1,4,5,7	CH	
							BLM	Q	8	CH	
@10039500	BEAR RIVER AT BORDER	2490	1965-	15	14S	46E	WDA	M	1	CH	
							WDEQ	M	5,6	CH	
							WDA	HL	9	CH	
SNAKE RIVER BASIN											
#@13018300	CACHE CREEK NEAR JACKSON	10.6	1965-	1	40N	116W	USGS	M	1,5,6,7	GR	
							USGS	HL	8,9	GR	
							USGS	A	10	GR	
#@13022500	SNAKE RIVER ABOVE RESERVOIR, NEAR ALPINE	3465	1965-	-	-	-	WDA	M	1	CH	
							WDEQ	M	5,6	CH	
@13027500	SALT RIVER ABOVE RESERVOIR, NEAR ETNA	829	1965-	28	36N	119W	WDA	M	1	CH	
							WDEQ	M	5,6	CH	
							WDA	HL	9	CH	

Also sediment station
@ Also streamflow station

Sediment Stations

Explanation of abbreviations and codes used in table 4.

Period of Record: The dates given are the calendar years in which records began or ended. Breaks of less than a year are not shown.

Location:
SE, section
TSP, township
RNGE, range

Sampling Equipment:
H, hydrographer sample
O, observer sample
P, pumping sampler
S, single-stage samplers

Suspended Sediment Sampling Frequency:
1, samples collected by observer once daily except during periods of rapidly changing flow when additional samples are collected.
2, sampled by hydrographer at least once a month all year, with additional samples collected during periods of rapidly changing flow.
3, sampled by hydrographer at least once a month during open-water period and at least twice during extended periods of ice cover.
6, samples collected as requested by cooperator.
7, pumping sampler serviced monthly or more often during periods of high runoff.
8, single-stage sampler serviced at least monthly. Samples collected by hydrographer if there is flow at time of visit.
9, infrequent sampling, sample when visiting station operated by WSE personnel.

Bed Material Sampling Frequency:
3, sample the surficial bed material in the cross section at least three times per year (high, medium, and low flow).
4, manual in-situ measurement and analysis of streambed material (pebble count), at a frequency of once per year (or longer), at the discretion of the District sediment specialist.

Laboratory: W, Worland

Cooperator:
BLM, Bureau of Land Management
BRUM, Bureau of Reclamation, Upper Missouri Region
MRB, Geological Survey, Missouri River Basin Program
USGS, Geological Survey, Federal Program
WSE, Wyoming State Engineer

Field Office:
B, Buffalo
C, Casper
CF, Cheyenne Field Unit
CH, Cheyenne Hydrologic Surveillance Section
CT, Contractor
GR, Green River
R, Riverton
W, Worland

Table 4. Sediment stations

STATION NUMBER	STATION NAME	DRAINAGE AREA MI²	PERIOD OF RECORD	LOCATION SE	TSP	RNGE	SAMPLING EQUIPMENT	SUSPENDED SAMPLING FREQ	BED MATERIAL SAMPLING FREQ	LABORATORY	COOPERATOR	FIELD OFFICE	REMARKS
	YELLOWSTONE RIVER BASIN												
*@06207510	BIG SAND COULEE AT WYOMING-MONTANA STATE LINE	134	1973-	32	9S	22E	O	1	3	W	BLM	W	
*@06220500	EAST FORK WIND RIVER NEAR DUBOIS	427	1975-	34	6N	6W	H	3	4	W	MRB	R	
@06225500	WIND RIVER NEAR CROWHEART	1891	1971-	16	3N	2W	H	3	4	W	WSE	R	
*@06256900	DRY CREEK NEAR BONNEVILLE	52.6	1965-	8	38N	92W	H	1	3	W	BLM	R	
*@06260000	SOUTH FORK OWL CREEK NEAR ANCHOR	85.5	1977-	28	43N	100W	H	6	-	W	BLM	W	6 SAMPLES PER YR
*06265337	COTTONWOOD C AT COUNTY BR NR HAMILTON DOME		1976-	24	44N	99W	H	6	-	W	BLM	W	4 SAMPLES PER YR
*06265410	COTTONWOOD C AT ST HWY 120 NR HAMILTOM DOME		1976-	26	45N	97W	H	6	-	W	BLM	W	6 SAMPLES PER YR
*06265435	GRASS CREEK ABOVE LITTLE GRASS C NR GRASS CREEK		1976-	6	45N	99W	H	6	-	W	BLM	W	4 SAMPLES PER YR
*06265492	GRASS CREEK NR MOUTH NR HAMILTON DOME		1976-	17	45N	96W	H	6	-	W	BLM	W	4 SAMPLES PER YR
*06265500	COTTONWOOD CREEK AT WINCHESTER		1976-	17	45N	94W	H	6	-	W	BLM	W	6 SAMPLES PER YR
*@06265800	GOOSEBERRY CREEK AT DICKIE	95.0	1976-	32	47N	99W	H	6	-	W	BLM	W	6 SAMPLES PER YR
*06266450	GOOSEBERRY C AT ST HWY 431 NEAR GRASS CREEK		1976-	32	47N	97W	H	6	-	W	BLM	W	6 SAMPLES PER YR
*@06267400	EAST FORK NOWATER CREEK NEAR COLTER	149	1977-	31	46N	92W	H	6	-	W	BLM	W	8 SAMPLES PER YR
*@06270000	NOWOOD RIVER NEAR TEN SLEEP	803	1971-	27	47N	88W	H	3	4	W	WSE	W	
*@06279500	BIGHORN RIVER AT KANE	15765	1946-64, 1969-	9	55N	94W	H	6	3	W	MRB	W	
*06284010	SHOSHONE RIVER BELOW WILLWOOD DAM, NEAR RALSTON	-	1972-	8	54N	100W	H	6	-	W	BRUM	W	
*@06285100	SHOSHONE RIVER NEAR LOVELL	2350	1971-	16	56N	96W	H	3	4	W	WSE	W	
*@06286258	BIG COULEE NEAR LOVELL	30.1	1970-	34	58N	95W	O	1	3	W	MRB	W	
*@06305500	GOOSE CREEK BELOW SHERIDAN	392	1971-	15	56N	84W	H	3	4	W	WSE	B	
*@06313400	SALT CREEK NEAR SUSSEX	769	1976-	8	42N	79W	H	3	3	W	USGS	C	
*@06313500	POWDER RIVER AT SUSSEX	3090	1949-53, 1976-	13	43N	79W	H	3	3	W	USGS	CT	
*@06316400	CRAZY WOMAN CREEK AT UPPER STATION, NEAR ARVADA	945	1977-	18	52N	77W	H	3	3	W	USGS	CT	
*@06317000	POWDER RIVER AT ARVADA	6050	1946-57, 1967-	21	54N	77W	O	1	3	W	BLM	B	
*@06320200	CLEAR CREEK BELOW ROCK CREEK, NEAR BUFFALO	322	1976-	30	51N	81W	H	3	4	W	USGS	B	
*@06320400	CLEAR CREEK AT UCROSS	409	1976-	19	53N	80W	H	3	4	W	USGS	B	
*@06324000	CLEAR CREEK NEAR ARVADA	1110	1950-53, 1975-	36	57N	77W	H	3	4	W	BLM	B	
*@06324890	LITTLE POWDER R BELOW CORRAL C NEAR WESTON		1977-	12	52N	72W	H	3	3	W	USGS	CT	
*@06324925	LITTLE POWDER RIVER NEAR WESTON		1977-	19	54N	70W	H	3	3	W	USGS	CT	
*@06324970	LITTLE POWDER RIVER ABOVE DRY CREEK, NEAR WESTON	1230	1975-	13	57N	71W	H	3	4	W	WSE	C	
	CHEYENNE RIVER BASIN												
*@06364700	ANTELOPE CREEK NEAR TECKLA		1977-	35	41N	70W	H	3	3	W	USGS	CT	
*@06365300	DRY FORK CHEYENNE RIVER NEAR BILL	128	1976-	31	38N	73W	H	3	4	W	BLM	C	
*@06365900	CHEYENNE RIVER NEAR DULL CENTER	1527	1976-	20	40N	68W	H	3	3	W	USGS	C	
*@06375600	LITTLE THUNDER CREEK NEAR HAMPSHIRE		1977-	33	43N	67W	H	8	3	W	USGS	CT	
*@06378300	LODGEPOLE CREEK NEAR HAMPSHIRE		1977-	5	41N	64W	H	8	3	W	USGS	CT	
*@06386000	LANCE CREEK AT SPENCER	2070	1976-	14	39N	62W	H	3	3	W	BLM	C	
*@06425720	BELLE FOURCHE RIVER BEL RATTLESNAKE CR, NR PINEY	495	1975-	9	46N	71W	P	7	3	W	BLM	C	
*@06425780	BELLE FOURCHE RIVER ABOVE DRY CREEK, NEAR PINEY	594	1975-	25	47N	71W	P	7	3	W	BLM	C	
*@06425900	CABALLO CREEK AT MOUTH, NEAR PINEY		1977-	4	47N	70W	H	8	3	W	USGS	CT	
*@06425950	RAVEN CREEK NEAR MOORCROFT		1977-	1	48N	69W	H	3	8	W	USGS	CT	
*@06426400	DONKEY CREEK NEAR MOORCROFT		1977-	30	50N	68W	H	8	3	W	USGS	CT	
*@06426500	BELLE FOURCHE RIVER BELOW MOORCROFT	1670	1976-	24	50N	68W	H	3	3	W	BLM	C	
@06430500	REDWATER CR AT WYOMING-SOUTH DAKOTA STATE LINE	471	1971-	18	7N	1E	H	3	4	W	WSE	C	
	PLATTE RIVER BASIN												
*@06623800	ENCAMPMENT RIVER AB HOG PARK CR, NEAR ENCAMPMENT	72.7	1964-	10	12N	84W	H	2	4	W	USGS	CF	
*@06628800	SAGE CREEK NEAR SARATOGA	263	1972-	32	19N	85W	H	3	3	W	BLM	CF	
*@06630300	BIG DITCH NEAR COYOTE SPRINGS	110	1974-	30	23N	83W	HS	3	3	W	BLM	CF	
*@06630330	NORTH DITCH NEAR COYOTE SPRINGS	22.6	1976-	19	23N	83W	H	3	3	W	BLM	CF	
*@06634600	LITTLE MEDICINE BOW RIVER NEAR MEDICINE BOW	963	1971-	22	23N	78W	H	3	3	W	WSE	CF	
*@06634990	HANNA DRAW NEAR HANNA	21.6	1974-	34	24N	81W	H	3	3	W	BLM	CF	
*@06635000	MEDICINE BOW R AB SEMINOE RESERVOIR, NEAR HANNA	2338	1971-	34	24N	81W	H	3	4	W	WSE	CF	
@06637550	SWEETWATER RIVER NEAR SOUTH PASS CITY	177	1975-	28	28N	101W	H	3	4	W	BLM	R	

* Also chemical-quality station
@ Also streamflow station

Table 4. Sediment stations (continued)

STATION NUMBER	STATION NAME	DRAINAGE AREA MI²	PERIOD OF RECORD	LOCATION SE	LOCATION TSP	LOCATION RNGE	SAMPLING EQUIPMENT	SUSPENDED SAMPLING FREQ	BED MATERIAL SAMPLING FREQ	LABORATORY	COOPERATOR	FIELD OFFICE	REMARKS
PLATTE RIVER BASIN (Continued)													
@06638300	WEST FORK CROOKS CREEK NEAR JEFFREY CITY	11.6	1975-	31	28N	92W	S	8	3	W	BLM	R	
*@06639000	SWEETWATER RIVER NEAR ALCOVA	2327	1974-	25	29N	87W	M	3	3	W	WSE	C	
*06644550	NORTH PLATTE RIVER AT CASPER	-	1971-	4	33N	79W	M	3	4	W	WSE	C	
*@06646780	SAND CREEK NEAR GLENROCK		1977-	5	33N	74W	M	8	3	W	USGS	CT	
*@06652000	NORTH PLATTE RIVER AT ORIN	14888	1971-	17	31N	69W	M	3	3	W	WSE	C	
*@06670500	LARAMIE RIVER NEAR FORT LARAMIE	4495	1971-	25	26N	65W	M	3	4	W	WSE	C	
*@06674500	NORTH PLATTE RIVER AT WYOMING-NEBRASKA ST LINE	22218	1971-	4	23N	58W	M	3	3	W	WSE	C	
GREEN RIVER BASIN													
*@09188500	GREEN RIVER AT WARREN BRIDGE, NEAR DANIEL	468	1975-	8	35N	111W	M	3	4	W	USGS	GR	
*09192600	GREEN RIVER NEAR BIG PINEY		1975-	21	30N	110W	M	3	4	W	USGS	GR	
*@09196500	PINE CREEK ABOVE FREMONT LAKE	75.8	1975-	5	35N	108W	M	3	4	W	USGS	GR	
*@09203000	EAST FORK RIVER NEAR BIG SANDY	79.2	1975-	7	31N	105W	M	3	4	W	USGS	GR	
*@09204700	SAND SPRINGS DRAW TRIBUTARY NEAR BOULDER	2.77	1975-	8	30N	107W	S	8	3	W	USGS	GR	
*@09205000	NEW FORK RIVER NEAR BIG PINEY	1230	1975-	22	30N	110W	M	3	4	W	USGS	GR	
*@09207650	DRY BASIN CREEK NEAR BIG PINEY	47.2	1975-	12	28N	112W	S	8	3	W	USGS	GR	
*@09208000	LABARGE CREEK NEAR LABARGE MEADOWS RANGER STA	6.3	1975-	8	29N	116W	M	3	4	W	USGS	GR	
*@09209400	GREEN RIVER NEAR LABARGE	3910	1974-	33	26N	112W	M	3	4	W	WSE	GR	
*@09210500	FONTENELLE CR NR HERSCHLER RANCH, NR FONTENELLE	152	1975-	2	24N	115W	M	3	4	W	USGS	GR	
*@09211200	GREEN RIVER BELOW FONTENELLE RESERVOIR	4280	1975-	31	24N	111W	M	3	4	W	USGS	GR	
*@09211300	FOURMILE GULCH TRIBUTARY NEAR FONTENELLE	14.2	1975-	15	24N	111W	S	8	3	W	USGS	GR	
*@09212500	BIG SANDY RIVER AT LECKIE RANCH, NEAR BIG SANDY	94.0	1975-	18	30N	104W	M	3	4	W	USGS	GR	
*@09213500	BIG SANDY RIVER NEAR FARSON	322	1971-	17	27N	106W	M	3	3	W	WSE	GR	
*@09214500	LITTLE SANDY CREEK ABOVE EDEN	134	1975-	11	26N	105W	M	3	3	W	BLM	GR	
*@09216000	BIG SANDY RIVER BELOW EDEN	1610	1971-	31	24N	107W	M	3	3	W	WSE	GR	
*@09216050	BIG SANDY RIVER AT GASSON BRIDGE, NEAR EDEN	1720	1975-	29	23N	108W	M	3	3	W	USGS	GR	
*@09216290	EAST OTTERSON WASH NEAR GREEN RIVER	16.6	1975-	23	21N	109W	S	8	3	W	USGS	GR	
*09216300	GREEN RIVER AT BIG ISLAND, NEAR GREEN RIVER		1975-	26	21N	109W	M	3	4	W	USGS	CH	
*@09216350	SKUNK CANYON CREEK NEAR GREEN RIVER	15.7	1975-	8	20N	107W	S	8	3	W	USGS	GR	
*09216525	SEPARATION CREEK AT UPPER STATION, NEAR RINER	41.8	1975-	9	19N	90W	S	8	3	W	BLM	CF	
*@09216527	SEPARATION CREEK NEAR RINER	55.3	1975-	32	20N	90W	P	7	3	W	BLM	CF	
@09216537	DELANEY DRAW NEAR RED DESERT	32.8	1975-	8	19N	95W	S	8	3	W	BLM	GR	
*@09216545	BITTER CREEK NEAR BITTER CREEK	308	1976-	36	18N	99W	S	8	3	W	USGS	GR	
*@09216550	DEADMAN WASH NEAR POINT OF ROCKS	152	1975-	25	20N	101W	S	8	3	W	USGS	GR	
*@09216562	BITTER CREEK ABOVE SALT WELLS CR, NR SALT WELLS	836	1976-	2	19N	103W	M	3	3	W	BLM	GR	
*@09216565	SALT WELLS CREEK NEAR SOUTH BAXTER	34.7	1975-	15	14N	103W	P	7	3	W	BLM	GR	
*09216570	GAP CREEK ABOVE BEANS SPRING CR, NR SOUTH BAXTER	22.0	1975-	18	14N	103W	M	3	3	W	USGS	GR	
*@09216572	BEANS SPRING CREEK NEAR SOUTH BAXTER	4.92	1975-	25	14N	104W	S	8	3	W	USGS	GR	
*09216574	BEANS SPRING CREEK AT MOUTH, NEAR SOUTH BAXTER	13.1	1975-	18	14N	103W	M	3	3	W	USGS	GR	
*@09216576	GAP CREEK BELOW BEANS SPRING CR, NR SOUTH BAXTER	35.9	1975-	7	14N	103W	S	3	3	W	USGS	GR	
*@09216578	DRY CANYON NEAR SOUTH BAXTER	3.69	1976-	5	14N	102W	HS	8	3	W	BLM	GR	
*@09216580	BIG FLAT DRAW NEAR POINT OF ROCKS	19.5	1975-	4	15N	102W	S	8	3	W	USGS	GR	
*@09216600	CUTTHROAT DRAW NEAR ROCK SPRINGS	7.88	1975-	17	17N	102W	S	8	3	W	USGS	GR	
*@09216695	NO NAME CREEK NEAR ROCK SPRINGS	18.2	1975-	1	17N	103W	S	8	3	W	USGS	GR	
*@09216750	SALT WELLS CREEK NEAR SALT WELLS	526	1976-	14	19N	103W	M	3	3	W	BLM	GR	
*@09217000	GREEN RIVER NEAR GREEN RIVER	14000	1951-	26	18N	107W	O	1	4	W	USGS	GR	
*@09218500	BLACKS FORK NEAR MILLBURNE	152	1975-	11	12N	117W	M	3	4	W	USGS	GR	
@09220000	EAST FORK OF SMITH FORK NEAR ROBERTSON	53.0	1975-	5	12N	115W	M	9	4	W	USGS	GR	
@09220500	WEST FORK OF SMITH FORK NEAR ROBERTSON	37.2	1975-	15	12N	116W	M	9	4	W	USGS	GR	
*09221650	SMITH FORK NEAR LYMAN		1975-	12	16N	114W	M	3	4	W	USGS	CH	
*@09221680	MUD SPRING HOLLOW NEAR CHURCH BUTTE, NEAR LYMAN	8.83	1975-	7	16N	113W	S	8	3	W	USGS	GR	
*@09222000	BLACKS FORK NEAR LYMAN	821	1971-	15	17N	113W	M	3	3	W	USGS	GR	
*@09222300	LITTLE MUDDY CREEK NEAR GLENCOE	416	1976-	31	19N	116W	M	3	3	W	BLM	GR	
*@09222400	MUDDY CREEK NEAR HAMPTON	963	1976-	18	18N	113W	M	3	3	W	BLM	GR	
*@09223000	HAMS FORK BELOW POLE CREEK, NEAR FRONTIER	128	1975-	35	25N	117W	M	3	4	W	USGS	GR	
*09224450	HAMS FORK NEAR GRANGER	670	1971-	30	19N	111W	M	3	4	W	WSE	CH	

* Also chemical-quality station
@ Also streamflow station

Table 4. Sediment stations (continued)

STATION NUMBER	STATION NAME	DRAINAGE AREA MI^2	PERIOD OF RECORD	LOCATION			SAMPLING EQUIPMENT	SUSPENDED SAMPLING FREQ	BED MATERIAL SAMPLING FREQ	LABORATORY	COOPERATOR	FIELD OFFICE	REMARKS
				SE	TSP	RNGE							
GREEN RIVER BASIN (Continued)													
*@09224700	BLACKS FORK NEAR LITTLE AMERICA	3100	1967-	15	18N	109W	H	3	4	W	WSE	GR	
*@09224800	MEADOW SPRINGS WASH TRIBUTARY NEAR GREEN RIVER	5.22	1975-	18	18N	109W	S	8	3	W	USGS	GR	
*@09224810	BLACKS FORK TRIBUTARY NO 2 NEAR GREEN RIVER	12.0	1975-	8	17N	108W	S	8	3	W	USGS	GR	
*@09224820	BLACKS FORK TRIBUTARY NO 3 NEAR GREEN RIVER	3.59	1975-	28	17N	108W	S	8	3	W	USGS	GR	
*@09224840	BLACKS FORK TRIBUTARY NO 4 NEAR GREEN RIVER	1.26	1975-	33	17N	108W	S	8	3	W	USGS	GR	
*@09224980	SUMMERS DRY CREEK NEAR GREEN RIVER	423	1975-	13	16N	109W	S	8	3	W	USGS	GR	
*@09225200	SQUAW HOLLOW NEAR BURNTFORK	6.57	1975-	29	14N	108W	S	8	3	W	USGS	GR	
*@09225300	GREEN RIVER TRIBUTARY NO 2 NEAR BURNTFORK	13.0	1975-	31	13N	108W	S	8	3	W	USGS	GR	
*@09228500	BURNT FORK NEAR BURNTFORK	52.8	1975-	36	3N	16E	H	3	4	W	USGS	GR	
*@09229500	HENRYS FORK NEAR MANILA, UT	520	1975-	23	12N	109W	H	3	4	W	USGS	GR	
*@09235300	VERMILLION CREEK NEAR HIAWATHA, CO	196	1976-	15	12N	100W	H	3	3	W	BLM	GR	
*@09257000	LITTLE SNAKE RIVER NEAR DIXON	988	1971-	8	12N	90W	H	3	4	W	WSE	CF	
*@09258200	DRY COW CREEK NEAR BAGGS	49.7	1975-	19	16N	91W	S	8	3	W	USGS	CF	
BEAR RIVER BASIN													
*@10027000	TWIN CREEK AT SAGE	246	1976-	7	21N	119W	H	3	3	W	BLM	GR	
SNAKE RIVER BASIN													
*@13018300	CACHE CREEK NEAR JACKSON	10.6	1968-	1	40N	116W	H	3	4	W	USGS	GR	

* Also chemical-quality station
@ Also streamflow station

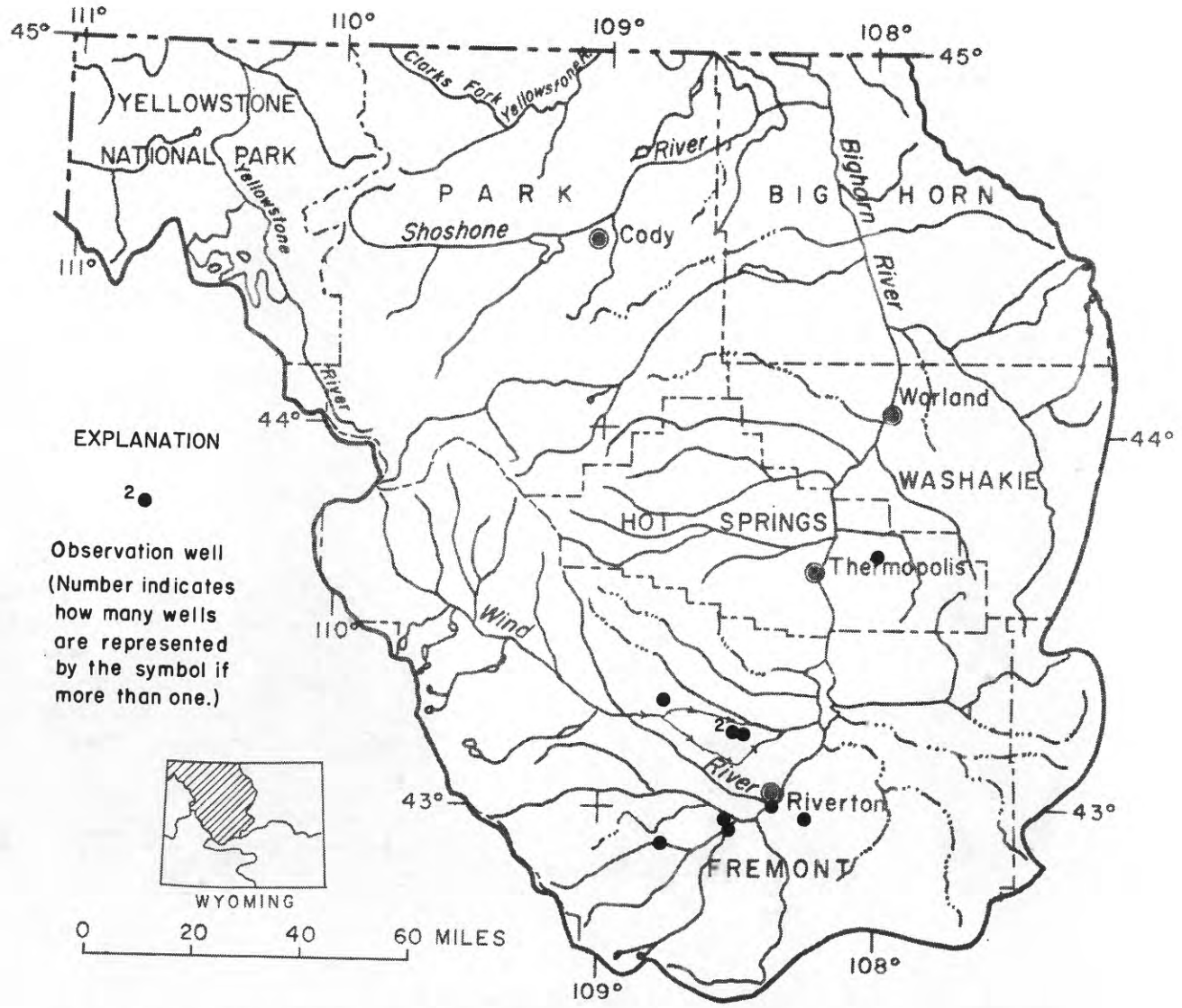


Figure 6.—Location of observation wells in the Yellowstone River, Clarks Fork Yellowstone River, and Bighorn River basins.

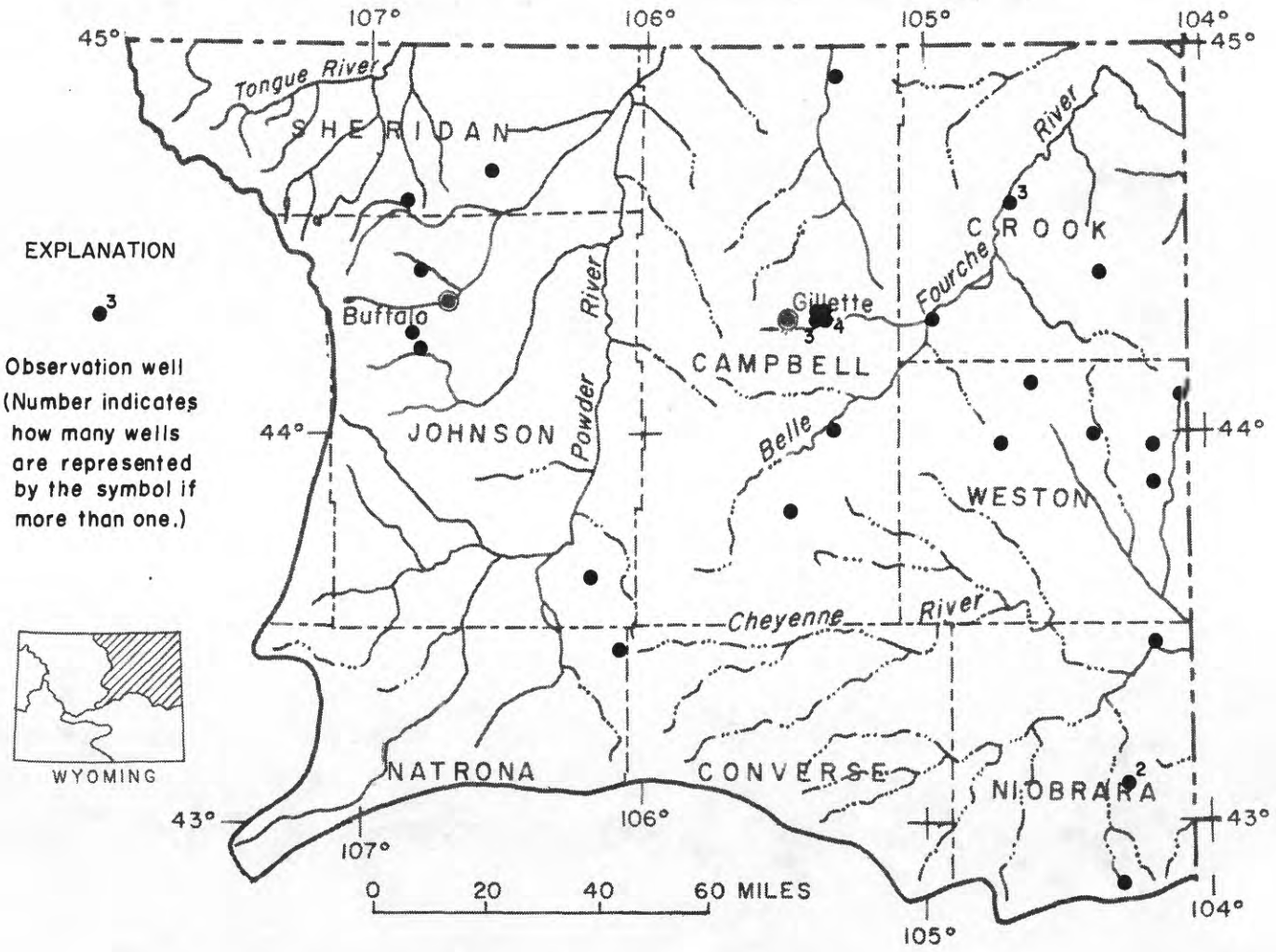


Figure 7.—Location of observation wells in the Tongue River, Powder River, Belle Fourche River, and Cheyenne River basins.

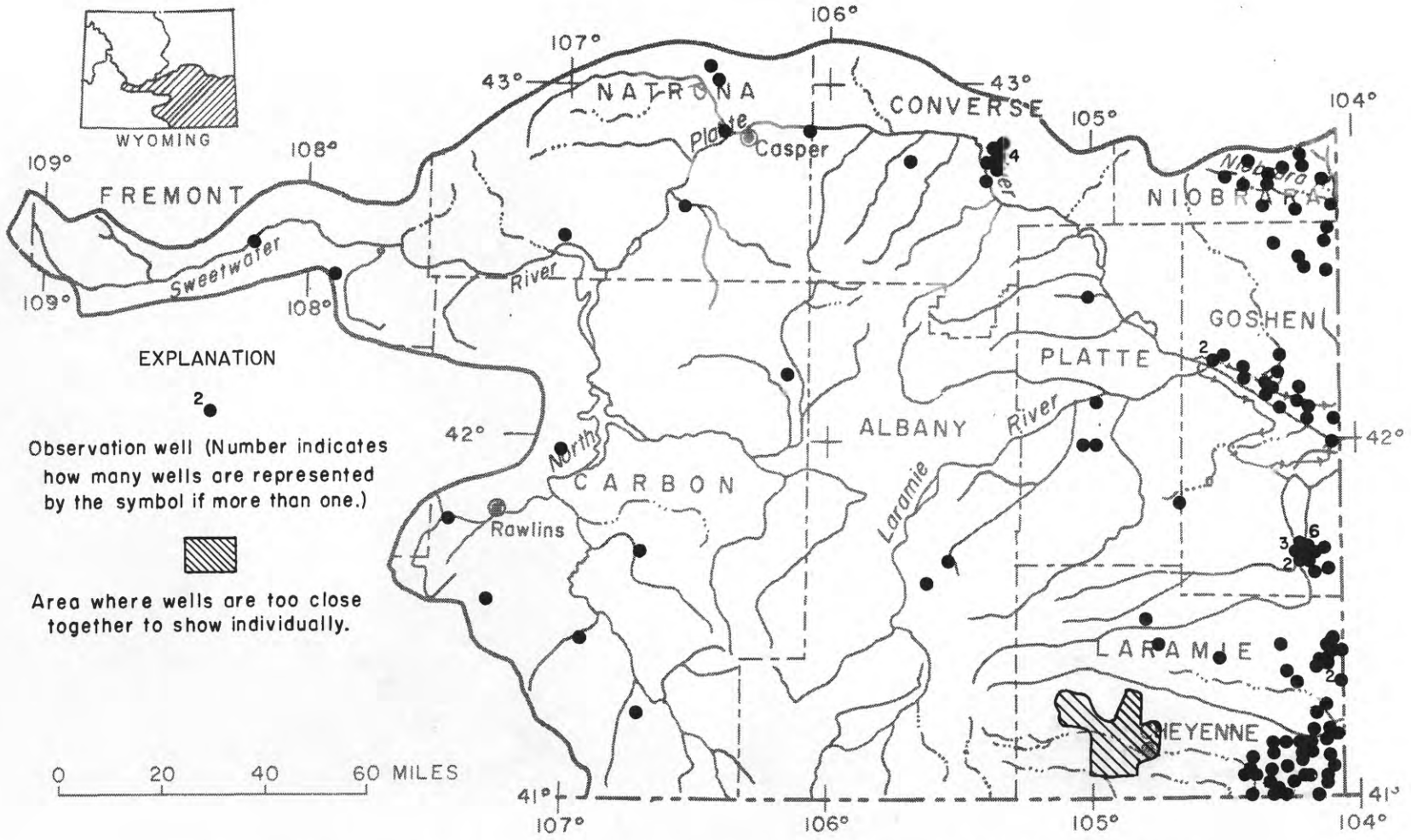


Figure 8.—Location of observation wells in the Niobrara River and Platte River basins.

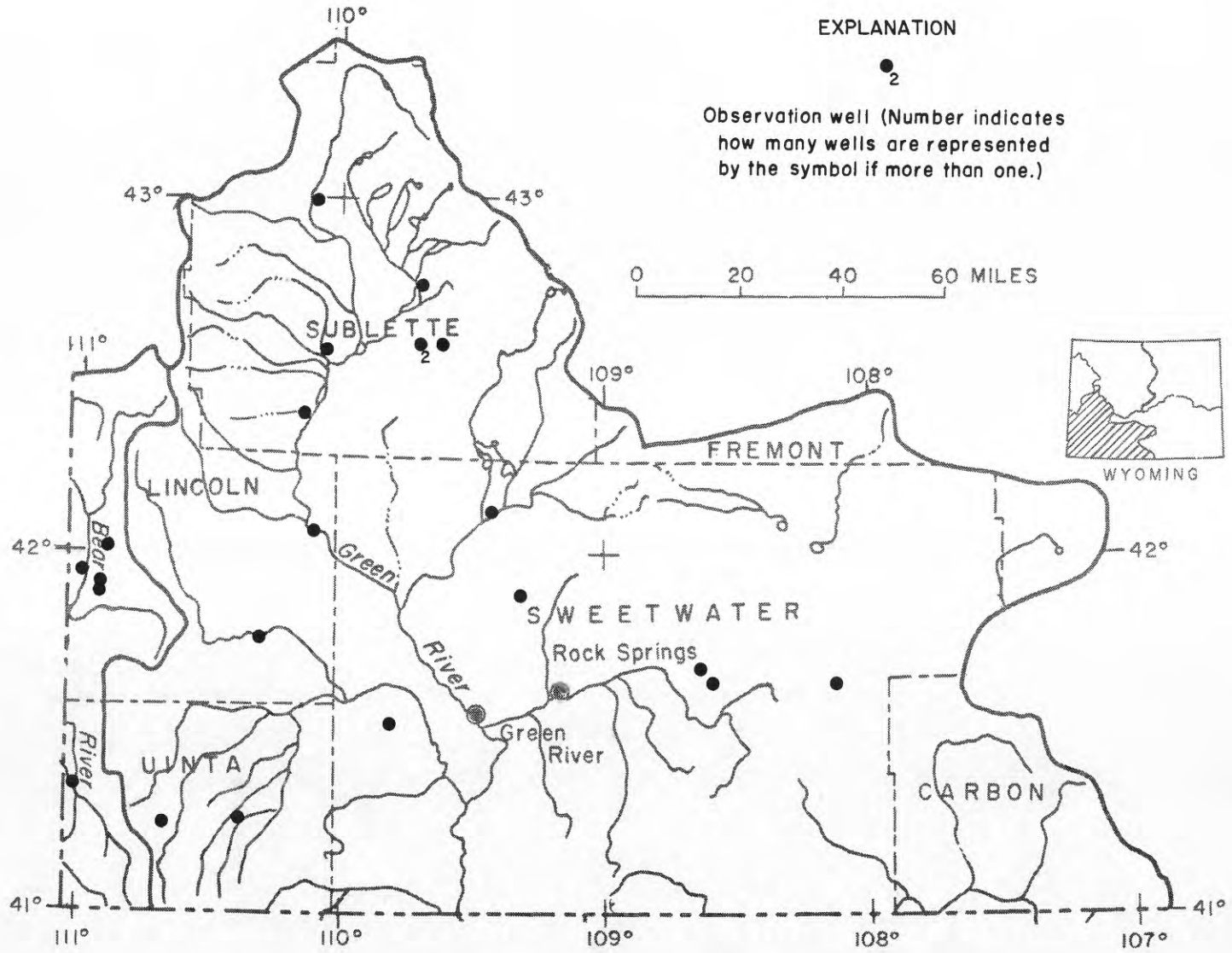


Figure 9.—Location of observation wells in the Green River and Bear River basins.

Observation Wells

Explanation of abbreviations and codes used in table 5.

Well number: The well-numbering procedure used is based on the U.S. Land Grant System. The first segment of the number is the township (north); the second number segment is the range (west); the third number segment is the section, which is followed by a first letter designating the quarter section, a second letter, if shown, designating the quarter-quarter section, etc., (A-NE¼, B-NW¼, C-SW¼, D-SE¼). Well 30-108-05BCD2, for example, is in the SE¼ of the SW¼ of the NW¼ of sec. 5, T. 30 N., R. 108 W. The number 2 indicates a second well in the quarter-quarter-quarter section. Wells shown in Fremont County have an additional uppercase letter that begins the number. This letter designates the quadrant of the Wind River Meridian and Base Line System. The quadrants are lettered A, B, C, and D in a counter-clockwise direction beginning with A in the northeast quadrant.

Lat-Long-Seq No.: The first six digits are the latitude in degrees, minutes, and seconds. The next seven digits are the longitude in degrees, minutes, and seconds. The last two digits indicate the sequence number of when the well was inventoried in the event more than one well has the same latitude and longitude.

Explanation of abbreviations and codes used in table 5--continued

Geologic Unit:

111	ALVM	Alluvium	211	MVRD	Mesaverde Formation or Group
111	TRRC	Terrace deposits	211	STEL	Steele Shale
121	NRPK	North Park Formation	217	CLVL	Cloverly Formation
121	OGLL	Ogallala Formation	217	LKOT	Lakota Formation
122	ARKR	Arikaree Formation	221	SNDC	Sundance Formation
123	BRUL	Brule Formation	237	SPRF	Spearfish Formation
123	WRVR	White River Formation or Group	317	FRLL	Forelle Limestone Member of Goose Egg Formation
124	LNEY	Laney Shale Member of Green River Formation	317	MNKT	Minnekahta Limestone
124	WDRV	Wind River Formation	331	MDSN	Madison Limestone
124	WSTC	Wasatch Formation	337	PHSP	Pahasapa Limestone
125	FRUN	Fort Union Formation	371	GRVR	Gros Ventre Formation
211	ALMD	Almond Formation	374	FLTD	Flathead Quartzite or Sandstone
211	FXHL	Fox Hills Sandstone			
211	LNCE	Lance Formation			

The seven-character geologic unit code given above consists of two parts. The first three characters are numeric and identify the Era, System, and Series of the rock unit. The next four characters are in alpha mnemonic code for the name of the rock-stratigraphic unit.

Numeric Codes for Geologic Age Identification

	Code		Code
Cenozoic	100	Paleozoic--continued	
Quaternary	110	Pennsylvanian	320
Holocene	111	Upper	321
Pleistocene	112	Middle	324
Tertiary	120	Lower	327
Pliocene	121	Mississippian	330
Miocene	122	Upper	331
Oligocene	123	Lower	337
Eocene	124	Devonian	340
Paleocene	125	Upper	341
Mesozoic	200	Middle	344
Cretaceous	210	Lower	347
Upper	211	Silurian	350
Lower	217	Upper	351
Jurassic	220	Middle	354
Upper	221	Lower	357
Middle	224	Ordovician	360
Lower	227	Upper	361
Triassic	230	Middle	364
Upper	231	Lower	367
Middle	234	Cambrian	370
Lower	237	Upper	371
Paleozoic	300	Middle	374
Permian	310	Lower	377
Upper	311	Precambrian	400
Lower	317		

Explanation of abbreviations and codes used in table 5--continued

Cooperator:
- CHEY, City of Cheyenne
- USGS, Geological Survey, Federal Program
- WSE, Wyoming State Engineer

Field Office:
- B, Buffalo
- C, Casper
- CF, Cheyenne Field Unit
- CH, Cheyenne Hydrologic Surveillance Section
- GR, Green River
- R, Riverton
- SD, South Dakota District

Frequency of Observation:
- C, continuous (graphic or digital recorder)
- M, monthly (12 visits per year)
- Q, quarterly (4 visits per year)
- SA, semiannual (2 visits per year)
- A, annual (1 visit per year)
- I, infrequent or as required

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.

Remarks: Recorder 77- indicates recorder continuous to present.

Table 5. Observation wells

WELL NUMBER	LAT-LONG-SEQ NO	GEOLOGIC UNIT	COOPERATOR	FIELD OFFICE	FREQUENCY OF OBSERVATION	PERIOD OF RECORD	NAME OF OWNER	REMARKS
ALBANY COUNTY	MISSOURI RIVER BASIN							
19-073-02CDD	413816105325601	317FRLL	WSE	CF	A	65-68,70-	GIL SMITH	
19-074-36CCA	413424105390301	211STEL	WSE	CF	A	68,70-	O. L. SCHMIDL	
CAMPBELL COUNTY	MISSOURI RIVER BASIN							
44-072-22CC	434611105295001	124WSTC	WSE	C	SA	66-	DURHAM MEAT CO.	
46-071-09ADA1	435904105231601	111ALVM	WSE	C	C	75-	USGS	RECORDER 77-
50-071-20BAD	441808105251201	124WSTC	WSE	C	Q	74-	WYODAK	
50-071-21BBB	441816105243101	125FRUN	WSE	C	Q	74-	USGS	
50-071-27AAC1	441749105221901	111ALVM	WSE	C	Q	74-	USGS	
50-071-27BAA1	441728105224801	125FRUN	WSE	C	Q	74-	USGS	
50-071-27BAC	441717105225501	125FRUN	WSE	C	Q	74-	USGS	RECORDER 74-
50-071-27BAD	441716105224901	111ALVM	WSE	C	Q	74-	USGS	
50-071-33BAC1	441628105240801	125FRUN	WSE	C	Q	74-	USGS	RECORDER 74-
50-071-33BAC2	441628105240802	125FRUN	WSE	C	Q	74-	USGS	
50-071-33BAC3	441628105240803	111ALVM	WSE	C	Q	74-	USGS	
57-071-13CCB1	445545105210601	111ALVM	WSE	C	C	75-	USGS	RECORDER 77-
CARBON COUNTY	MISSOURI RIVER BASIN							
15-083-32DDD	411307106442601	121NRPK	WSE	CF	SA	67-68,70-	HENRY FINCH	
17-085-23AAC1	412610106552401	121NRPK	WSE	CF	SA	77-	L.E.WALCK	
18-088-10BDA	413308107174401	217CLVL	WSE	CH	I	65-	CITY OF RAWLINS	
20-083-28BAB	414104106442701	121NRPK	WSE	CF	SA	50-	STATE OF WYOMING	
21-089-22ADA	414650107254501	125FRUN	WSE	CF	SA	63,65-	BLM	
23-085-19DBD	415652107014201	211MVRD	WSE	CF	SA	67-68,70-	MILLER ESTATE	
25-078-03CCC	420936106105001	111ALVM	WSE	CF	SA	68,70-		
CONVERSE COUNTY	MISSOURI RIVER BASIN							
32-071-31AAA	424229105242901	123WRVR	WSE	C	SA	50-56,59-	SALLIE EDWARDS	
32-071-02DAA1	424628105194201	125FRUN	WSE	C	SA	75-	ART SIMS	
32-071-04BDD1	424631105224301	125FRUN	WSE	C	SA	75-		
32-071-11BAB1	424558105204401	125FRUN	WSE	C	SA	75-		
32-074-03BCD	424620105424201	331MDSN	WSE	C	C	74-	WM BARBER	RECORDER 74-
33-071-24DBB1	424902105192301	125FRUN	WSE	C	SA	75-	RAYMOND BAKER	
33-071-26DAD1	424801105200901	125FRUN	WSE	C	SA	75-	ART SIMS	
33-071-34ACD1	424722105214301	125FRUN	WSE	C	SA	75-	D.W. FUNK	
33-071-34ACD2	424723105213602	125FRUN	WSE	C	SA	75-	ROY JARMON	
33-071-34ADC1	424723105213001	125FRUN	WSE	C	SA	75-	PHILLIPS PETROLEUM	
33-071-34BBC1	424734105222801	125FRUN	WSE	C	SA	75-	ROY JARMON	
CROOK COUNTY	MISSOURI RIVER BASIN							
50-068-36AD	441620104575001	211LNCE	WSE	C	SA	69-	STATE OF WYOMING	
51-063-23AAC	442340104225001	221SNDC	WSE	C	SA	68,75-	CITY OF SUNDANCE	
53-065-18BAC	443503104425101	317MNKT	WSE	C	SA	55,60,62-	NATIONAL PARK SERVICE	
53-065-18BBD1	443450104430001	237SPRF	WSE	C	SA	62-	NATIONAL PARK SERVICE	
53-065-18BBD2	443453104425602	337PHSP	WSE	C	SA	62-	NATIONAL PARK SERVICE	

Table 5. Observation wells (continued)

WELL NUMBER	LAT-LONG-SEQ NO	GEOLOGIC UNIT	COOPERATOR	FIELD OFFICE	FREQUENCY OF OBSERVATION	PERIOD OF RECORD	NAME OF OWNER	REMARKS
FREMONT COUNTY	MISSOURI RIVER BASIN							
29-093-36DB	422632107540501	122ARKR	WSE	R	C	74-	STATE OF WYOMING	RECORDER 74-
30-095-31AD	423127108132201	122ARKR	WSE	R	SA	65,73-		
A 1-4-33DDB	430051108240901	124WDRV	WSE	R	C	51,61-	TETON STUDS CORP.	RECORDER 66-
A 3-3-21ADA1	431326108311001	124WDRV	WSE	R	SA	49,65-	M. W. ROLAND	
A 3-3-21ADA2	431327108311101	124WDRV	WSE	R	SA	48-	M. W. ROLAND	
A 3-3-25BBB	431253108284401	124WDRV	WSE	R	SA	49-	USGR	
A 4-1-18DBC	431915108481501	124WDRV	WSE	R	SA	66-67,70-	USGS	
D 1-3-07DCD	425900108335401	124WDRV	WSE	R	SA	66-67,70-	USGS	
D 1-3-29CCC	425623108332401	124WDRV	WSE	R	SA	66-67,70-	USGS	
D 1-5-11BDD	425931108151301	111ALVM	WSE	R	SA	65-67,70-	USGS	
D 2-1-06DDD	425437108474101	111ALVM	WSE	R	SA	65-67,70-	I. W. SEAMANDS	
GOSHEN COUNTY	MISSOURI RIVER BASIN							
19-060-08ABB3	413809104060203	123BRUL	WSE	CH	SA	74-	JERRY CHAMBERLIN	
19-061-02CCD	413816104094901	111ALVM	WSE	CH	SA	43,49-69,72-	CITY OF LAGRANGE	
19-061-04ABC	413852104114901	111ALVM	WSE	CH	C	72-	FRANK SANDERS	RECORDER 73-
19-061-04CDD2	413813104115702	111ALVM	WSE	CH	SA	43,48-69,72-	HUGH STEMLER	
19-061-13BAA	413715104082701	123BRUL	WSE	CH	SA	72-	FLORA VANDENEL	
20-060-30CBB	414023104074501	123BRUL	WSE	CH	SA	72-	JOHN MEIER & SON, INC.	
20-061-21DDD	414051104112201	111ALVM	WSE	CH	SA	70-	CURTIS MEIER	
20-061-23CCC	414051104100701	111ALVM	WSE	CH	C	72-	USGS	RECORDER 73-
20-061-23DBB2	414104104091702	111ALVM	WSE	CH	SA	72-	CURTIS MEIER	
20-061-24CDD	414052104083001	123BRUL	WSE	CH	SA	76-	JOHN MEIER & SON, INC.	
20-061-25CBC2	414017104085702	111ALVM	WSE	CH	SA	72-	JOHN MEIER & SON, INC.	
20-061-25DCC	414002104081601	123BRUL	WSE	CH	SA	76-	CURTIS MEIER	
20-061-27DDA	414005104101701	111TRRC	WSE	CH	SA	43,49-70,72-	CURTIS TEMPLIN	
20-061-30BAC	414043104142301	123BRUL	WSE	CH	SA	72-	JAMES WARD	
20-061-31BCB	413944104144101	123BRUL	WSE	CH	SA	72-	LOVERCHECK LAND & CATTLE	
20-061-31DAD	413919104134101	123BRUL	WSE	CH	SA	72-	WARD HAY & CATTLE CO.	
20-061-33CCB	413917104122401	111ALVM	WSE	CH	SA	72-	FRANK SANDERS	
20-061-35AAB	413954104091101	123BRUL	WSE	CH	Q	70-	CURTIS MEIER	
23-060-10AAC	415902104031601	111ALVM	WSE	CH	SA	50-	FRENCH IRR. DIST.	
24-060-28CBD	420141104051501	111ALVM	WSE	CH	SA	62-		
24-061-05CBB2	420449104133402	111ALVM	WSE	CH	SA	51-	USGS	
24-061-11BBB	420426104100601	111TRRC	WSE	CH	SA	62-	BILL RING	
24-061-23CCB	420204104100601	111ALVM	WSE	CH	SA	62-	USGS	
24-062-11AAA	420429104155801	111ALVM	WSE	CH	SA	62-	USGS	
25-061-28DBC	420626104114501	111TRRC	WSE	CH	SA	43,48-52,54-	M. W. BERRY	
25-062-02BBB	421031104170001	111ALVM	WSE	CH	SA	62-	USGS	
25-062-19AAB	420753104204701	111ALVM	WSE	CH	SA	48-53,55-	LESTER STROUD	
25-062-27BDC2	420640104175402	111ALVM	WSE	CH	SA	62-	USGS	
25-062-31ADC	420548104204801	111ALVM	WSE	CH	SA	62-	USGS	
25-063-09CCB	420900104262201	111ALVM	WSE	CH	SA	43,48-	EMERY BRIGHT	
26-062-14BBA	421357104165001	111ALVM	WSE	CH	SA	48-	LESTER DUNTEN	
26-063-32DAC	421044104263201	111ALVM	USGS	CH	SA	48-	JOSEPH SPECKNER	
26-064-23CDA	421233104303401	111ALVM	USGS	CH	SA	62-	USGS	
26-064-28BBB	421216104332301	111ALVM	WSE	CH	M	48-	NPS-FED NO. 2	
26-064-29ADA	421205104333001	111ALVM	WSE	CH	M	42-43,46-	NPS	
29-060-29CAD	422713104060501	122ARKR	WSE	CH	A	49,72-	KEITH NEUMAN	
29-061-08CDC	422946104131001	122ARKR	WSE	CH	SA	49-51,70,75-	GERALD STURMAN	
29-061-26ACC	422734104092501	122ARKR	WSE	CH	C	74-		RECORDER 75
30-060-04DAA	423603104041001	122ARKR	WSE	CH	A	72-	WM IMMESOETA	
30-060-29BBC	423255104062301	122ARKR	WSE	CH	A	72-	OTTO YORK	
30-062-33DCA	423130104183401	122ARKR	WSE	CH	A	74-	RONALD PODALAK	

Table 5. Observation wells (continued)

WELL NUMBER	LAT-LONG-SEQ NO	GEOLOGIC UNIT	COOPERATOR	FIELD OFFICE	FREQUENCY OF OBSERVATION	PERIOD OF RECORD	NAME OF OWNER	REMARKS
HOT SPRINGS COUNTY	MISSOURI RIVER BASIN							
43-093-28CCC	433938108020301	374GRVR	WSE	CH	A	70-	USGS	
JOHNSON COUNTY	MISSOURI RIVER BASIN							
42-078-14DDB	433618106112901	211LNCE	WSE	C	SA	65-	W. B. LINCH	
49-083-05DCB	440912106512001	374FLTD	WSE	CH	C	74-	MOBIL OIL	RECORDER 75-
49-083-27DBA2	441112106493502	331MDSN	WSE	B	C	74-	MOBIL OIL	RECORDER 74-
51-083-10ACB	442427106494001	124WSTC	WSE	B	SA	60-	NIELS NIELSON	
LARAMIE COUNTY	MISSOURI RIVER BASIN							
12-060-06DDD2	410152104072502	123BRUL	WSE	CH	SA	72-	SAM ROTH	
12-061-06CBB	410218104152201	111TRRC	WSE	CH	SA	69-	KENNETH THOMPSON	
12-061-15DDD	410007104105301	123BRUL	WSE	CH	SA	70-	USGS	
12-062-05CBB	410205104210201	111TRRC	WSE	CH	SA	70-		
12-062-10BBC	410145104184101	111TRRC	WSE	CH	SA	70-		
12-062-13BAA	410100104160301	111TRRC	WSE	CH	C	75-	STATE ENGINEER	RECORDER 75-
12-062-22ABB	410008104181101	111TRRC	WSE	CH	SA	52,70-	FRANK DWINNELL	
12-063-15AAA2	410059104243202	123BRUL	WSE	CH	C	73-	USGS	RECORDER 72-
13-060-05CCB	410703104071201	123BRUL	WSE	CH	C	69-	ELMER GLANTZ	RECORDER 72-
13-060-20BBC	410458104071201	123BRUL	WSE	CH	SA	46,70-	BERNARD MORTIZ	
13-060-31AAA	410322104071701	123BRUL	WSE	CH	SA	40-	W. I. YOUNG	
13-061-04CBC	410710104125801	123BRUL	WSE	CH	SA	53,59,65,70-	CLAUS PLAMBECK	
13-061-33CCC	410234104125601	123BRUL	WSE	CH	SA	70-	TOM PORTER	
13-061-35CCC	410237104104101	111TRRC	WSE	CH	SA	70-	A. M. IDE	
13-062-04DDD	410654104184301	123BRUL	WSE	CH	SA	70-	USGS	
13-062-24BBB	410507104162301	111TRRC	WSE	CH	SA	70-		
13-062-28BCC	410356104195001	111TRRC	WSE	CH	SA	70-		
13-063-10AAA	410653104243001	111TRRC	WSE	CH	SA	42-47,64,71-	W. M. DITTMER	
13-063-27DDC	410330104244501	123BRUL	WSE	CH	SA	70-		
13-063-32DCC	410237104271801	123BRUL	WSE	CH	SA	72-		
13-063-35CCC	410235104242801	123BRUL	WSE	CH	SA	71-	USGS	
13-067-06BCB	410738104563501	1210GLL	CHEY	CH	A	67-	ART KING	
13-067-07DAD	410622104552801	1210GLL	CHEY	CH	A	63-64,67-	ART KING	
13-067-15BBA	410608104525201	1210GLL	CHEY	CH	A	41-43,49-50,64-65,67-68,71-	WARREN LIVESTOCK CO.	
13-067-16ABC	410557104534101	1210GLL	CHEY	CH	A	41-43,50,64-65,67-	WARREN LIVESTOCK CO.	
13-067-19ABA	410517104554601	1210GLL	CHEY	CH	A	64,67-	DAN REES	
13-067-19CAA	410446104560501	1210GLL	CHEY	CH	A	41-42,50,64,67-	DUCK CREEK GRAZING ASSN.	
13-067-27BBA	410420104525601	1210GLL	CHEY	CH	A	41-42,50,63,65,67-	DUCK CREEK GRAZING ASSN.	
13-067-28BCD	410401104540801	1210GLL	CHEY	CH	A	63,67,69-	DUCK CREEK GRAZING ASSN.	
13-067-34BBA	410330104525801	1210GLL	CHEY	CH	SA	63-	STATE OF WYOMING	
13-068-01BCD	410731104572901	1210GLL	CHEY	CH	A	63,67-	ART & JERRY KING	
13-068-03BBA	410747104594801	1210GLL	CHEY	CH	A	44-	CITY OF CHEYENNE	
13-068-04AAD	410742105000301	1210GLL	CHEY	CH	A	44-	CITY OF CHEYENNE	
13-068-04ADC	410729105001801	1210GLL	CHEY	CH	A	44-	CITY OF CHEYENNE	
13-068-04CBD	410717105010101	1210GLL	CHEY	CH	A	45-48,50-	CITY OF CHEYENNE	
13-068-04DCC	410707105002801	1210GLL	CHEY	CH	A	44-48,50-	CITY OF CHEYENNE	
13-068-09BAC	410640105004801	1210GLL	CHEY	CH	A	44,55,68-	ART KING	
13-068-10ADD	410637104590001	1210GLL	CHEY	CH	A	63,67-	ART & JERRY KING	
13-068-11ACC	410642104581201	1210GLL	CHEY	CH	A	69-	ART KING	

Table 5. Observation wells (continued)

WELL NUMBER	LAT-LONG-SEQ NO	GEOLOGIC UNIT	COOPERATOR	FIELD OFFICE	FREQUENCY OF OBSERVATION	PERIOD OF RECORD	NAME OF OWNER	REMARKS
LARAMIE COUNTY	MISSOURI RIVER BASIN	(Continued)						
13-068-12CCA	410622104573501	1210GLL	CHEY	CH	A	69-	CHEVRON OIL CO.	
13-068-12DCA	410623104565601	1210GLL	CHEY	CH	A	63-64,67-	ART & JERRY KING	
13-068-12DCC	410622104573201	1210GLL	CHEY	CH	A	70-	ART KING	
13-068-13CCC	410530104574001	1210GLL	CHEY	CH	C	42-50,69-	ART KING	RECORDER 72-
13-068-14BBB	410608104584901	1210GLL	CHEY	CH	A	45-50,69-	CITY OF CHEYENNE	
13-068-14CBD	410501104583901	1210GLL	CHEY	CH	A	45-	CITY OF CHEYENNE	
13-068-15CBD	410537104594701	1210GLL	CHEY	CH	A	63,68,70-70-	ART & JERRY KING	
13-068-16DBA	410542105002201	1210GLL	CHEY	CH	A	63,67,69-	ART & JERRY KING	
13-068-16DBD	410534105002401	1210GLL	CHEY	CH	A	49-	CITY OF CHEYENNE	
13-068-17CCB	410531105021601	1210GLL	CHEY	CH	A	65,67-69,71-	BELVOIR GRAZING ASSN.	
13-068-23BBC	410507104585201	1210GLL	CHEY	CH	A	67-	BELVOIR GRAZING ASSN.	
13-068-24AAD	410506104563701	1210GLL	CHEY	CH	SA	64,67-	CITY OF CHEYENNE	
13-068-26AAA	410424104575101	1210GLL	CHEY	CH	SA	73-	BELVOIR GRAZING ASSN.	
13-068-34ADD	410314104585801	1210GLL	CHEY	CH	A	61-69,71-	CITY OF CHEYENNE	
14-060-05BCB	410238104070801	123BRUL	WSE	CH	C	57-	C. C. GROSS	RECORDER 72-
14-060-10DBB	411131104041801	123BRUL	WSE	CH	C	73-	USGS	RECORDER 73-
14-060-19BDA	411001104075001	111TRRC	WSE	CH	SA	42,71-	DALE BOWERS	
14-061-02BCC	411230104103501	123BRUL	WSE	CH	SA	59,70-	R. M. FRANZEN	RECORDER 75-
14-061-20BCC	411000104135801	123BRUL	WSE	CH	SA	71-75		
14-061-22DCC	410900104110701	123BRUL	WSE	CH	C	75-	SHERIL BROWN	
14-061-23AAB	411019104094501	123BRUL	WSE	CH	SA	71-	WALTER BROWN	
14-061-25CCB	410847104093101	123BRUL	WSE	CH	SA	70-	JAY BROWN	
14-061-26BCB	410912104103801	123BRUL	WSE	CH	SA	73-	JAY BROWN	
14-062-20CCB	410940104205501	121ARKR	WSE	CH	SA	59,64,70-	JOHN BASTIAN	
14-062-24BAB	411019104160201	123BRUL	WSE	CH	SA	70-	MINNICK	
14-066-08BDC	411152104481201	1210GLL	WSE	CH	Q	77-	HUGH LOWHAM —	
14-066-18BBD	411110104492601	1210GLL	CHEY	CH	Q	75-	SAM WEST —	
14-066-21DDD	410938104462001	1210GLL	WSE	CH	Q	76-	FRED BONER —	
14-067-06DAD	411231104553401	1210GLL	CHEY	CH	A	64-65,67-	JOHN BELL	
14-067-07CCB	411130104562701	1210GLL	CHEY	CH	A	56-	CITY OF CHEYENNE	
14-067-07DCB	411131104555601	1210GLL	CHEY	CH	A	64-65,67-	CITY OF CHEYENNE	
14-067-18CBD	411050104562001	1210GLL	CHEY	CH	A	56-	CITY OF CHEYENNE	
14-067-18DDC	411034104554001	1210GLL	CHEY	CH	C	56-	CITY OF CHEYENNE	RECORDER 72-
14-067-19BBD	411020104562701	1210GLL	CHEY	CH	A	56-	CITY OF CHEYENNE	
14-067-31BBD	410834104562201	1210GLL	CHEY	CH	A	41-43,64,67-	MARK T. COX III	
14-068-02DDA	411224104574801	1210GLL	CHEY	CH	A	42,64,68-	FRED KOSTER	
14-068-10DCD	411124104591101	1210GLL	CHEY	CH	A	64-65,67-		
14-068-12DBC	411138104570501	1210GLL	CHEY	CH	A	65,67-	CITY OF CHEYENNE	
14-068-13ACB	411109104571001	1210GLL	CHEY	CH	A	56-	CITY OF CHEYENNE	
14-068-13CCD	411032104573001	1210GLL	CHEY	CH	A	56-	CITY OF CHEYENNE	
14-068-13DAD	411045104564201	1210GLL	CHEY	CH	A	56-	CITY OF CHEYENNE	
14-068-14ADA	411107104574901	1210GLL	CHEY	CH	A	56-	CITY OF CHEYENNE	
14-068-14CAD	411049104582301	1210GLL	CHEY	CH	A	56-	CITY OF CHEYENNE	
14-068-14CBB	411050104584701	111ALVM	CHEY	CH	A	41-48,50-	CITY OF CHEYENNE	
14-068-14DCD	411035104580501	1210GLL	CHEY	CH	A	56-	CITY OF CHEYENNE	
14-068-23DDC	410939104580101	1210GLL	CHEY	CH	A	40-47,49-	CITY OF CHEYENNE	
14-068-24BDD	411007104571801	1210GLL	CHEY	CH	A	56-	CITY OF CHEYENNE	
14-068-24DDD	410939104563601	1210GLL	CHEY	CH	A	50-53,55-62,64-	CITY OF CHEYENNE	
14-068-25ABB	410932104565801	1210GLL	CHEY	CH	A	41-42,50-51,64,70-	CITY OF CHEYENNE	
14-068-25DDA	410957104564401	1210GLL	CHEY	CH	A	41-	CITY OF CHEYENNE	
14-068-26BDD	410908104581801	1210GLL	CHEY	CH	A	42-43,45-47,68-69,71-	CITY OF CHEYENNE	
14-068-26CBC1	410901104585201	1210GLL	CHEY	CH	A	40-	CITY OF CHEYENNE	
14-068-27DCC	410848104592301	1210GLL	CHEY	CH	A	40,42-61,63-	CITY OF CHEYENNE	
14-068-28BC82	410922105010402	1210GLL	CHEY	CH	A	64,68-	FRANCIS LIVESTOCK CO.	

Table 5. Observation wells (continued)

WELL NUMBER	LAT-LONG-SEQ NO	GEOLOGIC UNIT	COOPERATOR	FIELD OFFICE	FREQUENCY OF OBSERVATION	PERIOD OF RECORD	NAME OF OWNER	REMARKS
LARAMIE COUNTY	MISSOURI RIVER BASIN		(Continued)					
14-068-28BDA	410921105004001	1210GLL	CHEY	CH	A	64-65,67-	FRANCIS LIVESTOCK CO.	
14-068-29CBB	410908105021601	1210GLL	CHEY	CH	A	64-	FRANCIS LIVESTOCK CO.	
14-068-32DDC	410759105012201	1210GLL	CHEY	CH	A	48-	CITY OF CHEYENNE	
14-068-33ABC	410836105002801	1210GLL	CHEY	CH	A	47-	CITY OF CHEYENNE	
14-068-33DCC	410758105003501	1210GLL	CHEY	CH	A	45-48,50-	CITY OF CHEYENNE	
14-068-34AAB	410844104590601	1210GLL	CHEY	CH	A	40,42-	CITY OF CHEYENNE	
14-068-34DBD	410809104591901	1210GLL	CHEY	CH	A	43-48,50,69-	CITY OF CHEYENNE	
14-068-34DDD	410755104590001	1210GLL	CHEY	CH	A	44-48,50-	CITY OF CHEYENNE	
14-068-35CAC	410811104583501	1210GLL	CHEY	CH	A	45-	CITY OF CHEYENNE	
14-068-35CDD2	410757104582302	1210GLL	CHEY	CH	C	69-	CITY OF CHEYENNE	RECORDER 72-
14-068-36ACC	410825104571001	1210GLL	CHEY	CH	A	41-	CITY OF CHEYENNE	
14-068-36ADB	410833104565101	1210GLL	CHEY	CH	A	41-61,63-	CITY OF CHEYENNE	
14-068-36BCA	410832104573501	1210GLL	CHEY	CH	A	41-61,63-	CITY OF CHEYENNE	
15-060-18DBB	411557104074001	123BRUL	WSE	CH	SA	71-	HENRY JESSEN	
15-061-25CCC	411348104092301	123BRUL	WSE	CH	SA	71-	USGS	
15-067-02DBA	411750104510901	1210GLL	WSE	CH	SA	61-	ERVIN M. MUELLER	
15-067-32DBA	411330104543701	1210GLL	CHEY	CH	A	42,50,53,64,67,69-	WARREN LIVESTOCK CO.	
15-069-06ACA	411808105094201	123BRUL	CHEY	CH	A	43-44,54-	CITY OF CHEYENNE	
15-069-09CAD	411655105073501	123BRUL	CHEY	CH	A	42-44,54-	CITY OF CHEYENNE	
15-069-16ACB	411621105072901	123BRUL	CHEY	CH	A	54-	CITY OF CHEYENNE	
15-069-21DCC	411452105072801	123BRUL	CHEY	CH	A	54-	CITY OF CHEYENNE	
15-069-27CDC	411406105063701	123BRUL	CHEY	CH	A	55-	CITY OF CHEYENNE	
15-069-28DBA	411425105071701	123BRUL	CHEY	CH	A	54-	CITY OF CHEYENNE	
15-069-33ABB	411359105072701	123BRUL	CHEY	CH	A	55-	CITY OF CHEYENNE	
15-069-34AAA	411355105055401	123BRUL	CHEY	CH	A	54-	CITY OF CHEYENNE	
16-060-07BBB	412227104081401	1210GLL	WSE	CH	C	75-	STATE ENGINEER	RECORDER 75-
16-060-10CBB	412156104045301	1210GLL	WSE	CH	SA	76-	MARION L. PETERS	
16-060-27ABC	411941104041401	1210GLL	WSE	CH	SA	72-	ANDERSON LIVESTOCK	
16-061-01CBA	412312104092001	1210GLL	WSE	CH	SA	72-	ORVILLE LEKURISH	
16-061-14BBC	412126104102909	1210GLL	WSE	CH	SA	64,74-	WARREN ANDERSON	
16-061-30BBB	411952104150501	122ARKR	WSE	CH	SA	64-69,72-	FAYE MARQUISS	
16-062-14AAA	412134104162001	1210GLL	WSE	CH	SA	72-	WARREN ANDERSON	
16-064-03CCB	412238104322001	1210GLL	WSE	CH	SA	53,64-70,72,74-	DAVID JOHNSON	
17-060-20ADA2	412542104053202	122ARKR	WSE	CH	SA	72-	JOHN W. FREEBURG	
17-060-30DAD	412429104064101	1210GLL	WSE	CH	SA	72-	RICHARD R. LARSON	
17-060-33BCC	412348104052501	1210GLL	WSE	CH	SA	72-	MALM RANCH CO.	
17-060-33CBB	412343104053101	1210GLL	WSE	CH	C	75-	STATE ENGINEER	RECORDER 75-
17-060-34CBB	412346104041801	1210GLL	WSE	CH	SA	72-	ED P. ANDERSON	
17-062-26AAA	412505104160301	1210GLL	WSE	CH	SA	53,64-70,72-	STOCKGROWERS BANK	
17-066-28BCC	412456104470901	1210GLL	WSE	CH	SA	72-		
18-066-31CCC	412853104493001	122ARKR	USGS	CH	SA	63-	HAROLD LEWIS	
LINCOLN COUNTY	GREEN RIVER BASIN							
21-114-26BCC1	414619110193301	124LNEY	WSE	GR	SA	65-	STATE OF WYOMING	
24-112-08CBB	420430110191901	124LNEY	WSE	GR	SA	66-70,72-	NATIONAL PARK SERVICE	
LINCOLN COUNTY	BEAR RIVER BASIN							
22-119-05CDA	415442110571801	111TRRC	WSE	GR	SA	59,62-	DOYLE KNOUSE	
23-119-32BDA2	415552110571502	111TRRC	WSE	GR	SA	62-	THORNOCK BROS.	
23-120-13AAC	415849110590801	111ALVM	WSE	GR	SA	55-	DOYLE KNOUSE	
24-119-28ACA	420202110555501	111TRRC	WSE	GR	SA	62-	HERMAN TEICHERT	

Table 5. Observation wells (continued)

WELL NUMBER	LAT-LONG-SEQ NO	GEOLOGIC UNIT	COOPERATOR	FIELD OFFICE	FREQUENCY OF OBSERVATION	PERIOD OF RECORD	NAME OF OWNER	REMARKS
NATRONA COUNTY	MISSOURI RIVER BASIN							
30-085-21BAB	423346107014201	122ARKR	WSE	C	SA	67-	USGS	
31-081-18AAB	423938106350301	111ALVM	WSE	C	SA	66-	J. H. RISSLER	
33-077-03BDC	425131106042801	111ALVM	WSE	C	SA	66-	JOHN PIERCE	
33-080-04ABB	425147106263701	111TRRC	WSE	C	SA	50,65-	USBR	
34-080-08CCC	425517106282501	111TRRC	WSE	C	SA	67-	USGS	
35-080-31DDD	425700106282801	111TRRC	WSE	C	SA	67-	USGS	
40-078-15AAB	432633106115201	211FXHL	WSE	C	SA	65-	TOWN OF EDGERTON	
NIOBRARA COUNTY	MISSOURI RIVER BASIN							
31-060-15DA	423940104031201	122ARKR	WSE	CH	A	62-	USGS	
31-061-29BB	423816104131501	122ARKR	WSE	CH	A	72-	ROBERT HOLMES	
31-062-18DC		122ARKR	WSE	CH	A	73,75-	GORDAN KAAN	
32-060-29BC	424323104060301	122ARKR	WSE	CH	A	56,72-	A. E. LARSON	
32-061-10AB	424610104101301	122ARKR	WSE	CH	A	72-		
32-062-12CCD	424532104153001	122ARKR	WSE	CH	A	72-	KEN FREEMAN	
32-062-20BDD	424410104195401	122ARKR	WSE	CH	A	58,68,70-	KOEL LARSEN	
32-062-32BBB	424244104202001	122ARKR	WSE	C	C	70-	RICHARD PFISTER	RECORDER 70-
32-063-02CCC	424623104234601	122ARKR	WSE	CH	A	52,59,68-	G. CHRISTIAN	
32-063-33BBB	424232104261001	122ARKR	WSE	CH	A	57,60-	EARL DUBLEY	
32-064-24DA2	424355104290202	122ARKR	WSE	CH	A	60-	IRA LAMB	
33-061-34BDC		122ARKR	WSE	CH	A	75-	STATE OF WYOMING	
33-062-29DBA	424801104203101	122ARKR	WSE	CH	A	67-74,76-	DALE FALLERTON	
36-062-28AB	430422104183201	331MDSN	WSE	C	C	74-	ENERGY TRANS. CO.	RECORDER 74-
36-062-28AB3	430422104183203	217LKOT	WSE	C	C	74-	ENERGY TRANS. CO.	RECORDER 75-
40-061-21BAB	432611104114801	111ALVM	WSE	C	SA	70-	USGS	
PLATTE COUNTY	MISSOURI RIVER BASIN							
21-065-16AAA	414755104391101	122ARKR	USGS	CH	Q	72-	HELLBAUM	
23-068-15DDD	415733104585601	122ARKR	WSE	CH	Q	58-70,72,74-	USBR	
23-068-18DAD	415749105022501	122ARKR	WSE	CH	Q	58-70,72-	USBR	
24-068-03DAD	420441104585801	122ARKR	WSE	CH	Q	58-70,72-	USBR	
26-068-17C8C	422355105023801	122ARKR	WSE	CH	Q	61-70,72-	W. H. JOHNSON	
SHERIDAN COUNTY	MISSOURI RIVER BASIN							
53-083-07ADC	443450106534801	124WSTC	WSE	B	SA	60-	MR. PRATHER	
54-081-14BC2	443915106352201	124WSTC	WSE	B	SA	60-	ULM SCHOOL	
SUBLETTE COUNTY	GREEN RIVER BASIN							
28-112-19AC1	422348110114501	124WSTC	WSE	GR	SA	65-70,72-	BLM	
30-107-06DD1	423540109382001	124WSTC	WSE	GR	SA	64-66,68-	BLM	
30-108-05BCD1	423555109445701	125FRUN	WSE	GR	SA	73-		
30-108-05BCD2	423555109445702	124WSTC	WSE	GR	SA	73-		
30-111-17ACA1	423504110053001	124WSTC	WSE	GR	SA	65-	SUBLETTE COUNTY	
32-108-05BA	424624109450201	111ALVM	WSE	GR	SA	65-	JAMES BARGER	
35-111-08ADB	430118110071001	111ALVM	WSE	GR	SA	65-	USGS	

Table 5. Observation wells (continued)

WELL NUMBER	LAT-LONG-SEQ NO	GEOLOGIC UNIT	COOPERATOR	FIELD OFFICE	FREQUENCY OF OBSERVATION	PERIOD OF RECORD	NAME OF OWNER	REMARKS
SWEETWATER COUNTY GREEN RIVER BASIN								
18-110-21DBA	413128109495801	111ALVM	WSE	GR	SA	64-	R. E. HOLDING	
19-095-05DD	413902108070601	124WSTC	WSE	GR	SA	72-	MR. JOLLEY	
19-099-06DCC	413850108362501	125FRUN	WSE	GR	SA	63-	ROCK SPGS GRAZING ASSOC.	
20-100-25DCD	414035108442001	211ALMD	WSE	GR	SA	63-	USGS	
22-105-07AAD	415402109203601	124LNEY	WSE	GR	SA	64-	SHEEP CO.	
25-106-27CCD	420615109265201	124LNEY	WSE	GR	SA	65-	TOWN OF FARSON	
UINTA COUNTY GREEN RIVER BASIN								
15-115-20CBA	411549110243501	111TRRC	WSE	GR	SA	57-	SCHOOL DISTRICT	
15-118-24BCB	411607110404201	124WSTC	WSE	GR	SA	64-		
UINTA COUNTY BEAR RIVER BASIN								
16-121-11ACC	412249111015801	111TRRC	WSE	GR	SA	55-	ELWIN SESSIONS	
WESTON COUNTY, MISSOURI RIVER BASIN								
45-061-33AB	435030104110001	337PHSP	WSE	CH	A	75-	CORONADO CO.	
46-061-29BAC	435628104123401	337PHSP	WSE	C	SA	69-	FARELLA BROS.	
46-063-09DB	435840104253001	217LKOT	WSE	C	SA	69-	BLACK HILLS POWER AND LIGHT	
46-066-25DBB	435610104433001	331MDSN	WSE	CH	A	62.75-	TERRA RESOURCES	
47-060-04ADA	440500104034001	337PHSP	WSE	SD	M	72.75-	WESTON COUNTY	
48-065-35CBC	440645104365601	337PHSP	WSE	CH	M	76-	TOWN OF UPTON	

WATER-RESOURCES APPRAISAL PROJECTS

The numerous water-resources appraisal projects being conducted in Wyoming are described in the following pages. The descriptions reflect project status as of October 1977. The project number is given following each title. All project leaders in the Wyoming district are located in the Cheyenne office.

The cooperating agency shown for each project is the one cooperating during the fiscal year 1978. The section "Progress and Significant Results" covers the period of fiscal year 1977. The area of each study is shown as either a shaded area or a large black dot on the index map near the title of each project.

Projects Conducted by Wyoming

PROJECT TITLE: Flood investigations in Wyoming (WY 59-010).

COOPERATING AGENCY: Wyoming Highway Department.

PROJECT LEADER: Gordon S. Craig, Jr.

FIELD LOCATION: Statewide.

PERIOD OF PROJECT: July 1958 to June 1983.

PROBLEM: The optimal design of highway drainage structures requires a knowledge of the magnitude and frequency of peak discharges expected at a given site. This knowledge may be derived either from data collected at the desired location or from regional analysis of peak-flow characteristics. The paucity of peak-flow data for small drainage basins in Wyoming, particularly for ephemeral streams restricts the use of presently available regionalization techniques. A network of peak-flow partial-record sites is needed to supplement the existing network of continuous-record streamflow stations.

OBJECTIVE: The main objective is to obtain sufficient basic hydrologic data to define the magnitude and frequency of floods on a regional basis for the entire state and to publish the interpretative analyses in easily usable form. On request from the cooperator, flood-flow characteristics of streams at specific sites will be determined by studying such factors as: History of past floods; distribution of flow across the flood-plain and main channel; and mean velocities in the main channel and overflow areas.

APPROACH: Available flood data will be analyzed, and sites for crest stage gages will be selected where they will supplement best the existing network of continuous-record stream-gaging stations. Stage-discharge relations will be defined for each crest-stage site by recording water stage and by making current-meter measurements, indirect measurements of peak flow, or by using the "step-backwater method." Basin characteristics that are pertinent in flood-frequency analysis will be determined. Frequency characteristics will be related to basin characteristics by regression analysis. Peak-flow measurements will be made at miscellaneous sites where unusual floods occur.

PROGRESS AND SIGNIFICANT RESULTS: The crest-stage gage network continued in operation without major change. The annual peak data files were updated to include data for the 1977 water year. Station-flow frequencies are being revised, based on the latest Water Resources Division guidelines. Indirect discharge measurements were made at two miscellaneous culvert sites where highway embankments created large runoff storage, but extensive scouring occurred at the culvert outlets. Colleague review of the Statewide flood-frequency report by Lowham was completed, and the report was approved and published in the Water-Resources Investigations Series.

PLANS FOR FISCAL YEAR 1978: Complete station-frequency analyses using Water Resources Division guidelines. Continue effort to relocate crest-stage gages to improve areal coverage. Special hydraulics and hydrologic studies at bridges and culverts will be made when requested by the Wyoming Highway Department. Miscellaneous measurements will be made where outstanding floods occur.

REPORTS PUBLISHED DURING FISCAL YEAR 1977:

Lowham, H.W., 1976, Techniques for estimating flow characteristics of Wyoming streams: U.S. Geol. Survey Water-Resources Inv. 76-112, 83 p.

PROJECT TITLE: Study of flood hydrographs for small drainage basins in Wyoming (WY 64-011).

COOPERATING AGENCY: Wyoming Highway Department.

PROJECT LEADER: Gordon S. Craig, Jr.

FIELD LOCATION: Statewide.

PERIOD OF PROJECT: April 1964 to June 1974 (final report completed September 1977).

PROBLEM: Optimum design of highway culverts requires knowledge of the magnitude and frequency of peak discharges and volumes expected at a given site. Knowledge of the characteristic shape of flood hydrographs is essential in culvert design if highway embankment storage is to be considered in reducing the peak discharge. Also there is little information available on the diverse climatic and physiographic conditions that govern floods on small drainage areas in Wyoming.

OBJECTIVES: The objectives are (1) to define the magnitude and frequency of flood volumes to be expected from small drainage areas in Wyoming; (2) to define the characteristic shape of flood hydrographs in relation to the physical characteristics of the basins; and (3) to develop a rational method of accounting for the effect of embankment storage which will be useful in culvert design.

APPROACH: Rainfall and runoff data are collected on 49 drainage basins (under 11 mi^2). Principal instrument on each basin is a stage-rainfall recorder with supplementary recording and nonrecording rain gages on basin perimeters. Stage-discharge relations will be determined; physical characteristics of the basins will be measured; and runoff characteristics will be determined from data collected by the gages. Rainfall-peak discharge-volume relations will be determined and discharge and volume frequencies will be developed. Computerized programs will be used for statistical analysis such as multiple regression and for synthesizing runoff by means of rainfall-runoff models.

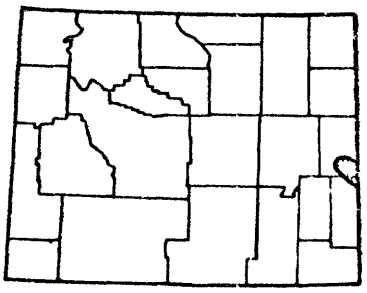
PROGRESS AND SIGNIFICANT RESULTS: During the year revisions were made and the final report was approved for release as Water-Supply Paper 2056, with interim release as an open-file report.

PLANS FOR FISCAL YEAR 1978: None.

REPORTS PUBLISHED DURING FISCAL YEAR 1977:

Craig, G. S., Jr., and Rankl, J. G., 1977, Analysis of runoff from small drainage basins in Wyoming: U.S. Geol. Survey Open-File Rept. 77-727, 88 p.

PROJECT TITLE: Hydrologic evaluation of the Arikaree Formation near Lusk, Wyoming (WY 74-024).



COOPERATING AGENCY: Wyoming Department of Planning and Development.

PROJECT LEADER: Marvin A. Crist.

FIELD LOCATION: East-central Wyoming.

PERIOD OF PROJECT: July 1973 to September 1979.

PROBLEM: The Arikaree Formation contains a large amount of good quality water suitable for domestic, industrial, and agricultural uses. Many irrigation wells have been developed near Lusk, Wyoming; yields greater than 500 gal/min are not uncommon. The number of irrigation wells in the Arikaree increases each year. Development of nearby energy resources will increase the need to use ground water for industrial purposes. State water planners have no guidelines for regulation of ground-water development in the area. A study is needed that will describe the ground-water system in detail and provide information on the cause-and-effect of ground-water development.

OBJECTIVE: The objectives are (1) to define the ground-water system in more detail than was done in previous studies; (2) to determine the cause-and-effect relationship of current ground-water development; and (3) to provide a means of predicting cause-and-effect relationship of future ground-water development.

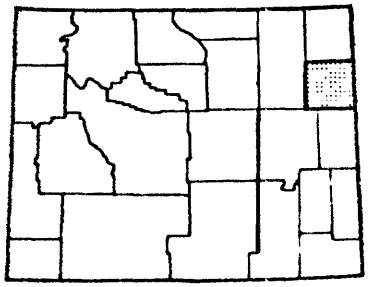
APPROACH: Inflow and outflow of all water will be inventoried and a water budget prepared. This will require inventories of all large-capacity wells, records of stream diversions for irrigation, pumpage, and acreage irrigated. Hydraulic properties will be determined primarily from aquifer tests. Surface geology and the configuration of the base of the Arikaree will be shown on maps. The water-level surface will be contoured and a saturated thickness map prepared. A digital model will be prepared to simulate hydrologic conditions in the Arikaree. The model will be used to determine cause-and-effect relationship of ground-water development in the aquifer.

PROGRESS AND SIGNIFICANT RESULTS: The principal report for the project was completed, colleague review completed, and the report submitted for approval for publication. The digital ground-water model developed can be used to indicate the general effect of applied stress. Pumpage from 1938 through 1972, estimated to be approximately 48,000 acre-ft, did not cause a noticeable decrease in natural discharge and is assumed to have caused no significant change in ground-water storage. Pumpage was estimated to total 39,500 acre-ft for the period 1973 through 1975.

PLANS FOR FISCAL YEAR 1978: The project has been extended for several years. The relatively small annual activity will consist of updating well-inventory and pumpage information, and to incorporate the new data into the digital model of the ground-water system.

REPORTS PUBLISHED DURING FISCAL YEAR 1977: None.

PROJECT TITLE: Water resources of Weston County, Wyoming (WY 74-026).



COOPERATING AGENCY: Wyoming State Engineer.

PROJECT LEADER: Marlin E. Lowry.

FIELD LOCATION: Northeastern Wyoming.

PERIOD OF PROJECT: March 1974 to June 1976 (incomplete).

PROBLEM: The demand for ground water will probably increase rapidly in Weston County because of its proximity to the coal deposits in the Powder River Basin and the fact that potential aquifers are at relatively shallow depths, compared to depths in the areas where coal will be mined. Industrial, municipal, and much of the agricultural supplies in the county are obtained from ground water. There are no major perennial streams in the area. The ground-water resources of the county have not been adequately evaluated for orderly development of these resources.

OBJECTIVE: The objectives are to determine (1) the distribution (areally and vertically) and thickness of each of the principal aquifers or aquifer systems; (2) the movement of water in each of the principal aquifers or aquifer systems; (3) the hydraulic characteristics for each principal aquifer or aquifer system; (4) the water-bearing properties of subordinate aquifers; (5) the volume of ground water in storage; (6) the quality of water in each aquifer; (7) the quantity of runoff from small watersheds; (8) the quality of runoff at gaged sites; (9) the effect of ground-water withdrawal on water levels; and (10) to evaluate the potential for artificial recharge.

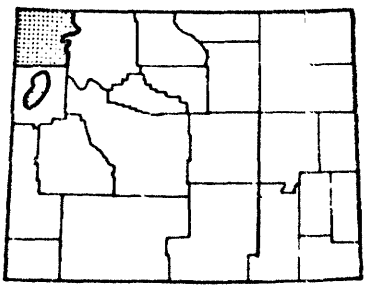
APPROACH: Make a well inventory and periodic water-level measurements; collect and analyze water samples; make pumping tests to determine aquifer characteristics; collect and analyze rock samples for water-bearing characteristics; auger cross sections of major drainages; and inventory ground-water use. Tabulate existing data; compile geologic map and cross sections; prepare structure-contour and isopach maps of principal aquifers; calculate volume of ground water in storage (by aquifer) and show on maps; construct potentiometric and depth-to-water maps for principal aquifers; analyze well-field histories; evaluate potential for artificial recharge; and describe runoff characteristics for small basins using channel-geometry techniques.

PROGRESS AND SIGNIFICANT RESULTS: Because of other assignments, the project staff was unable to complete the final report, although some progress was made. The report is nearly finished.

PLANS FOR FISCAL YEAR 1978: Finish the final report and publish it in the WRI series.

REPORTS PUBLISHED DURING FISCAL YEAR 1977: None.

PROJECT TITLE: Monitoring wastewater effluent in Yellowstone and Grand Teton National Parks, Wyoming (WY 74-027).



COOPERATING AGENCY: National Park Service.

PROJECT LEADER: Edward R. Cox.

FIELD LOCATION: Northwestern Wyoming.

PERIOD OF PROJECT: June 1974 to September 1979.

PROBLEM: The National Park Service is constructing new or rehabilitating existing evaporation-percolation ponds at several sewage wastewater treatment and disposal sites in Yellowstone and Grand Teton National Parks. The sites (four in Yellowstone and two in Grand Teton) are near streams or lakes. The National Park Service needs to determine the effects of the wastewater effluent on the ecosystem of the parks. In order to do this, they need to know the amount, direction, and velocity of movement of the effluent that percolates from the ponds. Additional sites may be added to the study.

OBJECTIVE: The objectives are to determine (1) the position of the water table and its relation to the ponds and nearby surface-water bodies; (2) the slope of the water table and thus the direction of movement of the effluent; (3) the ground-water velocities and thus the time-of-travel of effluent from pond to surface-water body; (4) the vertical zone of movement of the effluent; and (5) the baseline water quality in the shallow aquifers in the vicinity of the percolation ponds and in surface-water bodies.

APPROACH: Wells will be installed in unconsolidated material near the sewage ponds. About 30 wells in Yellowstone and about 9 wells in Grand Teton will be needed for the project. Aquifer tests will be made by pumping from selected wells. Tracer tests will be made in a few selected wells. Water samples will be collected from the wells and analyzed for chemical and bacteriological quality of the water. Water level in the wells will be measured periodically. A program of monitoring water quality will be established following preliminary sampling and calculations of ground-water velocity determined from the hydraulic and tracer tests.

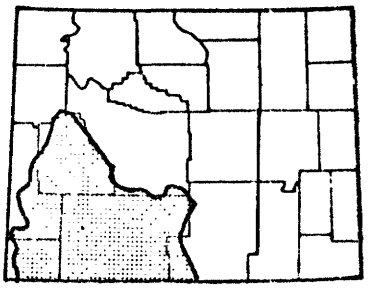
PROGRESS AND SIGNIFICANT RESULTS: Water levels were measured approximately monthly during spring and summer in about 40 wells near the four study sites in Yellowstone. About 36 water samples were collected from wells and nearby streams and were analyzed for dissolved carbon, nitrogen, phosphorus, and other constituents. In addition, about 50 samples were collected from wells and were analyzed for chloride, sulfate, and dissolved iron. A report containing basic data, water-level contours, hydrologic descriptions and most likely areas of wastewater movement in and near Grand Teton National Park was prepared, released to the open file, and transmitted to the National Park Service and the Teton County 208 Planning Agency. A similar report describing wastewater movement near the sites in Yellowstone and activities during the 15-month period ending September 1976 was prepared and is in review.

PLANS FOR FISCAL YEAR 1978: Measuring and sampling of wells near the four sites in Yellowstone will continue. An administrative report describing work in fiscal year 1977 will be prepared for the National Park Service. Preliminary work will begin on developing digital models to simulate ground-water flow and perhaps solute transport in the vicinity of the four sites in Yellowstone.

REPORTS PUBLISHED DURING FISCAL YEAR 1977:

Cox, E. R., 1977, Preliminary study of wastewater movement in and near Grand Teton National Park, Wyoming, through October 1976: U.S. Geol. Survey Open-File Rept. 77-275, 35 p.

PROJECT TITLE: Water and its relation to economic development in the Green River and Great Divide basins in Wyoming (WY 75-030).



COOPERATING AGENCY: Bureau of Land Management.

PROJECT LEADER: Hugh W. Lowham.

FIELD LOCATION: Southwestern Wyoming.

PERIOD OF PROJECT: November 1974 to September 1979.

PROBLEM: Development of extensive coal, oil, gas, trona, and oil-shale resources in the project area will require a projected increase in water consumption of 480,000 acre-ft per year by 1990. Development of energy resources in other parts of the State also will require large amounts of water; transbasin diversion of Green River water to other areas could total an additional 270,000 acre-ft per year. Water planners and managers need much more information about available ground and surface water, present quality of the waters, and the impacts on water supply and quality caused by development of energy resources.

OBJECTIVE: The study will be designed to gather information, and to make available to interested industrial, agricultural, and governmental people, interpretive reports that describe (1) the distribution and quality of surface water in space and time; (2) the relationships between surface water and ground water; (3) the distribution, quantity, and quality of ground water; and (4) the hydrology-related aspects of the environment. Efforts of the study will be directed towards (1) describing the water resources and hydrologic relationships that presently exist; (2) developing predictive methods that may be used to describe future conditions, including reactions to increased water development; and (3) establishing monitoring programs for detecting possible changes in water parameters.

APPROACH: Compile and evaluate existing water data. Conduct literature search for present hydrologic knowledge of the area. Prepare planning report during first year of project, outlining the specific techniques to be used in subsequent phases. Regarding water quality, particular attention will be given to trace metals, biological parameters, and trend analyses. Channel-geometry techniques, LANDSAT imagery, and detailed statistical analyses will be applied to surface-water studies. Aquifer tests and bore hole and surface geophysical surveys will be used in ground-water studies. Digital models will be developed for chemical-quality and surface-water systems.

PROGRESS AND SIGNIFICANT RESULTS: An expanded observation-well network was initiated by selecting locations for monitoring, updating well schedules and maps, and obtaining permission from owners to use wells. The ground-water data base was expanded by working with the Wyoming State Engineer office records. An intensive sampling program was conducted during the fall. With the aid of a helicopter several thousand samples were collected at more than 300 surface- and ground-water sites, mainly in known energy-rich areas where few previous data existed. Travel time and dispersion studies were made on the Little Snake River using fluorescent dyes, by personnel of the Green River Basin project in Wyoming and the Yampa Basin project in Colorado. An interpretive report using these data was completed and is in review. A report presenting an analysis of stream temperatures and a regional model for estimating temperatures of unmeasured sites in the Green River Basin was completed. A report presenting results of a salinity analysis was completed and approved for publication. A three-variable regression model was developed for estimating annual variability of dissolved solids. The three-variable model is much more accurate than existing two-variable models in describing dissolved solids. A contribution to an interagency effort on a coal-mine rehabilitation analysis was written by the project members. The section written by the project team involved hydrology and water resources of a potential mine site.

PLANS FOR FISCAL YEAR 1978: A helicopter will again be used to aid data collection of a large number of springs and streams. Two different sampling trips, once during base flow, and again during snowmelt runoff, are planned. Diurnal measurements of pH, conductivity, temperature, dissolved oxygen, and discharge will be conducted at about 15 streamflow stations. Emphasis will be placed on the completion of the interpretive reports. Models of stream-flow and water quality will be investigated and developed for small basins in oil-shale and coal areas.

REPORTS PUBLISHED DURING FISCAL YEAR 1977:

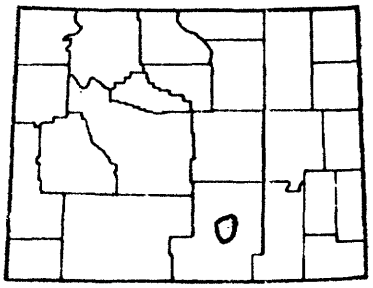
DeLong, L. L., 1977, An analysis of salinity in streams of the Green River Basin, Wyoming: U.S. Geol. Survey Water-Resources Inv. 77-103, 35 p.

Lowham, H. W., DeLong, L. L., Ringen, B. H., and Zimmerman, E. A., 1976, Hydrologic information on Sandy area (Big Sandy Grazing Unit): U.S. Geol. Survey contribution to U.S. Bureau of Land Management EIS on grazing practices, 62 p.

Lowham, H. W., DeLong, L. L., Zimmerman, E. A., Larson, L. R., Ringen, B. H., and Engelke, M. J., 1976, Hydrologic information on Seven Lakes--Ferris Mountain Grazing Unit: U.S. Geol. Survey contribution to U.S. Bureau of Land Management EIS on grazing practices, 45 p.

Lowham, H. W., Larson, L. R., Ringen, B. H., Wangsness, D. J., and Zimmerman, E. A., 1977, Hydrology and water supply of Red Rim area, Wyoming: U.S. Geol. Survey contribution to U.S. Bureau of Land Management mining reclamation rept., EMRIA Rept. No. 7, Red Rim study area, 56 p.

PROJECT TITLE: Impacts of economic development and water use on water resources in the Hanna Basin in Wyoming (WY 75-031).



COOPERATING AGENCY: Bureau of Land Management.

PROJECT LEADER: Samuel J. Rucker, IV.

FIELD LOCATION: South-central Wyoming.

PERIOD OF PROJECT: July 1974 to September 1978.

PROBLEM: The Hanna Basin has over 22,000 acres of land leased for coal mining. Oil and natural gas development is very likely to expand in the future. Mining, some of which will be in water-saturated coal beds, and oil and natural gas drilling will apply new stresses on the hydrologic environment and many new demands. The Bureau of Land Management is concerned about the effect mining will have on the water resources of the basin and the availability of water for reclamation. The Department of Energy needs information on how an in-situ coal gasification experiment it is conducting interacts with the ground water.

OBJECTIVE: The objectives of the project are to describe the present characteristics of the hydrologic environment, to monitor changes in it, and to evaluate the effects of those changes. On the surface, peak and annual flows, channel geometry, sedimentation rates, erosion rates, uses, and quality of water will be investigated. In the subsurface, aquifer characteristics, ground-water uses, and pumping amounts will be estimated.

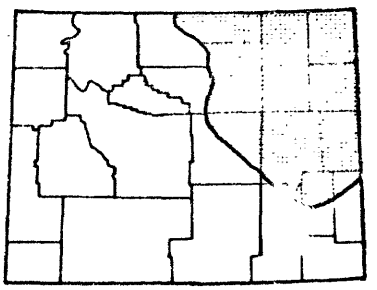
APPROACH: Describe streamflow conditions--evaluate past records, establish two new gaging sites for flow measurements, sediment sampling, and chemical quality; use channel geometry methods where necessary. Define aquifer characteristics--perform aquifer tests, draw potentiometric maps, analyze water quality, identify recharge and discharge areas.

PROGRESS AND SIGNIFICANT RESULTS: Monitoring of flow and chemical quality of water in Big Ditch and Hanna Draw continued. A new station was established on North Ditch. The observation-well network was expanded; water levels were measured periodically in about 50 wells. Conservation Division and Water Resources Division drilled, logged, and cased 10 new wells, which were added to the ground-water level program. These wells were finished in various coal seams at various depths. A few aquifer tests were made. Water samples were collected and analyzed for 40 wells. Water levels also were measured at 23 other wells at the Department of Energy in-situ coal gasification site near Hanna. Project personnel maintained close coordination with the coal companies in the area, as the companies are drilling numerous wells around their mines for monitoring programs. Most of the data from these wells have been made available to this project.

PLANS FOR FISCAL YEAR 1978: Complete the compilation of analyses and begin interpretation. Start a report on quality of ground water.

REPORTS PUBLISHED DURING FISCAL YEAR 1977: None.

PROJECT TITLE: Water resources of the Powder River structural basin in Wyoming in relation to energy development (WY 75-032).



COOPERATING AGENCY: Bureau of Land Management and Department of Energy.

PROJECT LEADER: Marlin E. Lowry.

FIELD LOCATION: Northeastern Wyoming.

PERIOD OF PROJECT: November 1974 to September 1979.

PROBLEM: The problems are those related to large water requirements for development of energy resources in the water-short Powder River Basin and the impacts resulting from such development. An average annual requirement of 250,000 acre-ft of water per year is projected by 1990. Part of the initial demand could be supplied by surface water and (or) ground water from aquifers of upper Cretaceous or Tertiary age. The impacts of mining, reclamation, transbasin diversions, off-channel and other reservoirs on the shallow aquifers, stream systems, and quality of water is not known.

OBJECTIVE: The objectives of the first phase will be to determine the adequacy of existing data to describe water availability and assess possible impact of the pending development, and to identify specific subjects that should be studied by the district. The findings of the first phase will be used to identify major thrusts for the second phase, which will constitute the district's program in the basin during the succeeding four years. A data-collection system will be designed, based on findings of the first phase, to meet data needs for thrusts and obtain benchmark information.

APPROACH: The existing data and data-collection program will be evaluated and a data-collection program, which is coordinated with other governmental and industrial programs, will be implemented. Various study techniques including those for determination of aquifer properties, streamflow analysis, channel geometry, isotope study, biological assay, water budgets, modeling, and geophysics will be explored and those that have merit will be pursued in the second phase of the study.

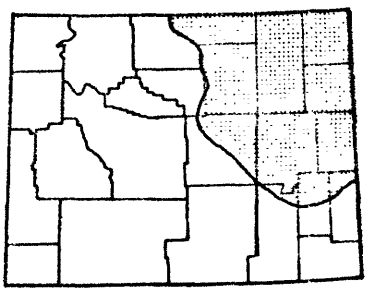
PROGRESS AND SIGNIFICANT RESULTS: A second project planning report was prepared. Data collection continued in reconnaissance studies and site-intensive studies. A random sampling of trace elements in ground water was completed. Intensive water-quality sampling of a section on the North Platte River below Casper was done. A draft of a report comparing erosion and deposition from the long-abandoned Hidden Water strip mine near Sheridan with a nearly undisturbed area was completed. A report on the aquatic biology of ponds in the same area was published and a similar report on Clear and Piney Creeks was started. Historical flows of streams were compiled, and records for 50 short-term stations were extended to a common base period. Progress was made in streamflow regional analysis and flow-storage analysis. Rainfall-runoff data from a previous study were compiled in a basic-data report and an analysis of the data started to determine infiltration characteristics of small drainage basins. Surface-water runoff was modeled for one of two drainage basins in the White Tail Butte study site for evaluation of the effects of strip mining on runoff. Ground-water discharge to streams from shallow aquifers in the basin was evaluated by downstream correlation of streamflow data. Surface electrical-resistivity data were analyzed to determine alluvial thickness in stream valleys and to delineate areas underlain by coal. An analysis of ground-water chemical data was started. Mass-balance calculations have given additional evidence of change in quality of water with depth by sulfate reduction; this will be useful in studying recharge-discharge relations.

PLANS FOR FISCAL YEAR 1978: Reports on five of ten intensive study areas will be completed or in process next year. The technique for analyses of surface-water storage is expected to be completed. The emphasis of the district's ground-water program will shift more toward study of impacts as the Central Region has initiated a program to model the aquifers in the basin. Because interpretation of the chemistry of ground water is nearly completed, emphasis will shift to interpretation of chemistry of surface-water quality. Visual network sites will be resurveyed to describe gully erosion.

REPORTS PUBLISHED DURING FISCAL YEAR 1977:

Wangsness, D. J., 1977, Physical, chemical, and biological relations of four ponds in the Hidden Water Creek strip-mine area, Powder River Basin, Wyoming: U.S. Geol. Survey Water-Resources Inv. 77-72, 48 p.

PROJECT TITLE: Hydrology of Paleozoic rocks in the Powder River basin and adjacent areas, northeastern Wyoming (WY 75-033).[1/]



COOPERATING AGENCY: None.

PROJECT LEADER: James R. Marie, Jr.

FIELD LOCATION: Northeastern Wyoming.

PERIOD OF PROJECT: November 1974 to September 1979.

PROBLEM: Development of energy resources, especially enormous coal deposits, in the Powder River Basin will require a projected increase of 250,000 acre-ft of water per year by 1990. Ground water is more readily available, and will be the principal source of water in the early years of development until large-scale multipurpose water projects are completed. Paleozoic-age carbonate rocks, largely undeveloped, could yield large quantities of water. Development of large water supplies from the Paleozoic rocks depends on the presence of secondary permeability and on the aquifer response to pumping from nearby wells developed in the same aquifer.

[1/] This project is subsidiary to project CR 76-192, described on page 98.

OBJECTIVE: The project is designed to derive a conceptual model of the aquifer system to better predict the quantity and quality of water available from the Paleozoic rocks and to predict some of the effects of its development. Principal objectives will be to determine (1) the distribution, thickness, and physical properties of the aquifer system; (2) the processes that developed the present distribution of aquifer parameters in order to extend point data to other parts of the aquifer system; (3) the potentiometric surface and chemical quality of the water in the aquifer system; and (4) the effects of increased development of water from the aquifer system.

APPROACH: Collect and compile all available data for the aquifer system including data for water wells, oil and gas tests that penetrated the aquifer, and tests, cores, and chemical analyses of water. Make borehole and surface geophysical surveys to evaluate and correlate the physical characteristics of the aquifer to the water-yielding properties. Use natural tracers to determine both the rate and direction of flow. Obtain temperature differences with depth to evaluate vertical movement of water. Make streamflow analysis to evaluate recharge and underground flow regime. Design digital simulation models to aid in interpreting the aquifer systems and to predict the response to future stresses.

PROGRESS AND SIGNIFICANT RESULTS: Preliminary data were gathered for the development of a digital ground-water flow model of the Madison aquifer in the vicinity of the Salt Creek oil field, Wyoming. A field examination of karstic features associated with the Paleozoic carbonate rocks in the Bighorn Mountains was completed. A considerable amount of logistic and scientific support was provided during construction and testing of the two U.S. Geological Survey Madison Limestone test wells in northeastern Wyoming and southeastern Montana. Fifteen of the original 30 gaging stations along Madison Limestone outcrops in Wyoming were selected for continuation and were operated during the year. Sampling of Madison and associated formation wells in Wyoming was completed, although there is a need for some resampling. A basic-data report on the water quality of the Pennsylvanian rocks was nearly completed. A preliminary interpretation indicates that waters in the Midwest area near the center of the basin are quite old and stagnant, and are of different origin from those in the recharge areas. Geophysical work included purchase of seismic data for an area in Niobrara County; measurement of vertical seismic profiles at Redbird, Wyoming, and each of the two Madison test wells; completion of interpretation of vertical seismic profiles made in 1976; processing data for several seismic lines; obtaining additional gravity data; completion of temperature studies and configuration maps; calculation of apparent water restivity from Madison geophysical logs for the Northern Great Plains; and completion of log suites in the two Madison test wells. Several geophysical reports were prepared.

PLANS FOR FISCAL YEAR 1978: A digital ground-water flow model for the Madison aquifer in the vicinity of the Salt Creek oil field, Wyoming, will be constructed. Logistical support for hydrologic and geophysical testing at the two U.S. Geological Survey Madison test wells will continue. The 15 gaging stations along Madison Limestone outcrops will continue in operation. Geochemical data will be interpreted and a variety of statistical tests applied. Geophysical work will include interpretation of seismic lines; compilation of a regional Bouguer gravity map and interpretation of gravity data; vertical seismic profile work will be completed; and (possibly) create a new seismic line between the two Madison test wells. A number of reports will be completed.

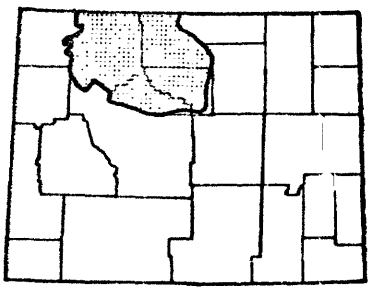
REPORTS PUBLISHED DURING FISCAL YEAR 1977:

Head, W. J., 1977, Exploration for ground water to develop energy resources in the semiarid West (extended abs.): U.S. Geol. Survey Open-File Rept. 77-690, 4 p.

Head, W. J., and Merkel, R. H., 1977, 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: U.S. Geol. Survey Jour. Research, v. 5, no. 4, p. 473-485.

Hoxie, D. T., 1976, Post-Laramide karst development in the Bighorn Mountains, Wyoming (abs.), in Program with abstracts: Geol. Soc. Amer. 1976 Ann. Mtg., p. 931.

PROJECT TITLE: Evaluation of Paleozoic and alluvial aquifers in the Bighorn Basin, Wyoming (WY 75-034).



COOPERATING AGENCY: Wyoming State Engineer.

PROJECT LEADER: Maurice E. Cooley.

FIELD LOCATION: North-central Wyoming.

PERIOD OF PROJECT: December 1974 to September 1977 (incomplete).

PROBLEM: In the Bighorn Basin there is a need for development of additional ground-water supplies for irrigation and industrial use. Lack of water for late-season irrigation is a problem now. The best potential sources include (1) the Artesian aquifer systems in the deeply buried Paleozoic rocks in the eastern part of the basin, and (2) the shallow water-table aquifers in generally thin flood-plain alluvium along tributaries to the Bighorn River throughout the basin. Additional information is needed about the amount and quality of water that could be developed from the Paleozoic and alluvial aquifers without causing significant decreases in the amount of water in storage, artesian pressures, or streamflow.

OBJECTIVE: For the Paleozoic (artesian) aquifers: (1) Evaluate effects of past withdrawals on storage, artesian pressures, and water quality; (2) delineate areas most favorable structurally for continued development of the aquifer system; and (3) provide additional water-quality data of wells, springs, and streams for comparisons with past and future data at the same sites. For the alluvial aquifers: (1) Delineate areas most favorable for ground-water development, particularly the Nowood River (Ten Sleep and Painted Rock Creeks), Greybull River, and Owl Creek; and (2) evaluate the suitability of ground water for irrigation, domestic, and industrial use.

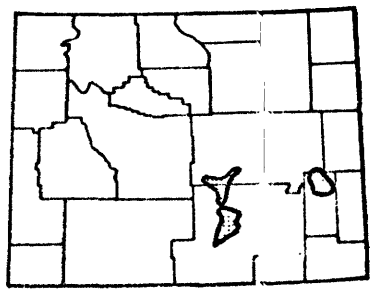
APPROACH: For the Paleozoic aquifers: (1) Make mass measurement of artesian pressures in wells; (2) prepare pressure map for the two artesian aquifers (Ten Sleep and Bighorn/Madison); (3) use aerial photographs and satellite imagery to determine folding and fracturing; (4) make conductivity measurements of streams; and (5) collect water samples of water from streams and wells. For the alluvial aquifers: (1) Determine lithologic characteristics of alluvium and prepare a geomorphic map; (2) use electrical resistivity and test drilling to prepare selected profiles; (3) make conductivity measurements of streams; (4) use color photography to determine wet areas and for geomorphologic information; (5) delineate on maps areas most favorable for ground-water development; and (6) analyze water samples from streams and wells.

PROGRESS AND SIGNIFICANT RESULTS: Sampling of wells and streams for chemical analyses (about 75 analyses) was completed. Conductivity measurements of streams was completed. Measurement of pressure in wells was continued (no recovery tests were made during the year). Most of the time was spent in completing four reports. At year's end, one report was in colleague review and three in final stages of preparation.

PLANS FOR FISCAL YEAR 1978: Complete and publish the four reports that are now in review or in final stages of preparation.

REPORTS PUBLISHED DURING FISCAL YEAR 1977: None.

PROJECT TITLE: Algal-growth potential of principal North Platte River reservoirs in Wyoming (WY 76-035).



COOPERATING AGENCY: None.

PROJECT LEADER: Samuel J. Rucker, IV.

FIELD LOCATION: Central Wyoming.

PERIOD OF PROJECT: July 1975 to September 1979.

PROBLEM: Eutrophic conditions may be developing in one or more of the four major reservoirs on the North Platte River (Seminoe, Pathfinder, Alcova, and Glendo). Oxygen depletion could have an adverse effect on recreational use of the reservoirs and on fish habitat. Development of mineral resources, particularly coal mining, is taking place at locations adjacent to one of the reservoirs. There is no information about the present state of algal growth with which to evaluate the seriousness of the problem, to evaluate changes caused by mining activities, or to predict future trends.

OBJECTIVE: The objectives of the study are to (1) determine the extent of algal growth in the four major reservoirs; (2) evaluate trends in algal-growth potential, including effects of effluent from coal mining activities adjacent to the reservoirs; and (3) determine the feasibility of developing a model for predicting algal growth (modeling would be a follow-up project).

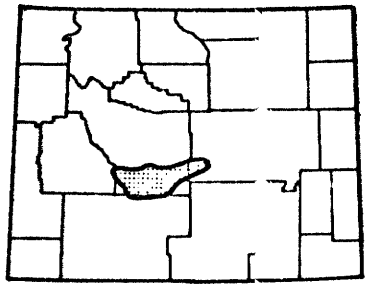
APPROACH: The first three years will be devoted exclusively to data collection, with analysis of data and preparation of a report scheduled for the fourth year. Vertical-profile water samples will be collected monthly (May-October) from a boat at sites above the dams and in the principal arms of each reservoir. Sampling will also be done twice each winter. Field parameters will include dissolved oxygen and temperature. Lab parameters will include nitrogen, ammonia (NH_4); nitrite + nitrate (NO_2+NO_3); phosphorus (P); residue, and algal-growth potential (AGP). A set of phytoplankton samples will be collected each year in early spring and in late summer for identification of genera. Graphical and statistical techniques, such as regression, will be used.

PROGRESS AND SIGNIFICANT RESULTS: The peak algal growth in the reservoirs occurs during the late summer and early fall. Aphanizomenon begins increasing in August and September until all other green and blue algae are excluded. When little or no circulation occurs the dead algae decays, causing depletion of dissolved oxygen. Coupled with thermal stratification, the quality of water in the reservoir is severely stressed. During the 1977 field season high winds occurred over the reservoirs during the period when degradation usually takes place; little adverse action has taken place thus far.

PLANS FOR FISCAL YEAR 1978: The spring sampling runs will be made on the reservoirs. The final report will be started.

REPORTS PUBLISHED DURING FISCAL YEAR 1977: None.

PROJECT TITLE: Hydrology of the Sweetwater River basin, central Wyoming (WY 76-037).



COOPERATING AGENCY: Wyoming State Engineer.

PROJECT LEADER: William B. Borchert.

FIELD LOCATION: Central Wyoming.

PERIOD OF PROJECT: August 1975 to September 1976. (Final report completed September 1977.)

PROBLEM: Increased demand for water supplies to be utilized for agricultural, industrial, municipal, and domestic purposes in Wyoming are foreseen in the immediate future. The Sweetwater River basin in central Wyoming is an area which appears to have potentially large supplies of ground water available. However, the Sweetwater River, a major tributary of the North Platte River, may be closely associated with the Arikaree Formation, the principal aquifer in the area. Before ground water is pumped from the Arikaree Formation, the relationship between the water in the Sweetwater River and the water in the Arikaree must be determined.

OBJECTIVE: The objectives are to define the existing surface- and ground-water inter-relationship, to develop a preliminary digital model of the hydrologic system for the Sweetwater River basin, and to evaluate the feasibility of a comprehensive digital model that could be verified for both steady-state and transient-state analyses. If it is found that the Sweetwater River is a gaining stream, the potentiometric surface of and the ground-water discharge from the Arikaree Formation will be used to determine average transmissivities for the Arikaree.

APPROACH: A hydrologic budget will be prepared using surface-water inflow and outflow estimates of ground-water underflow, estimates of recharge from precipitation, and estimates of evapotranspiration. Successive gain and loss studies will be made on the Sweetwater River during various seasons. Evapotranspiration will be estimated. Test holes will be augered and periodic water-level measurements made. Transmissivity will be estimated. Steady-state simulation of the stream-aquifer system will be made with a mathematical model. Approximately six ground-water samples will be taken and analyzed.

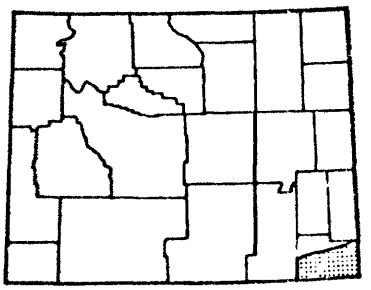
PROGRESS AND SIGNIFICANT RESULTS: Additional computer runs were made for parameter estimation and to achieve calibration of the model on the basis of reproduction of the potentiometric surface and the base flow of the Sweetwater River in November 1975. Calculated steady-state heads were within 50 feet of the observed heads in about 98 percent of the nodes. The calculated leakage from the aquifer to the river was within about 12 percent of the leakage determined by gain and loss studies. The final report was completed and submitted for colleague reviews, after which alterations were made. The report was approved for publication in the Water-Resources Investigations series.

PLANS FOR FISCAL YEAR 1978: None.

REPORTS PUBLISHED DURING FISCAL YEAR 1977:

Borchert, W. B., 1977, Preliminary digital model of the Arikaree aquifer in the Sweetwater River basin, central Wyoming: U.S. Geol. Survey Water-Resources Inv. 77-107, 19 p., 4 pl.

PROJECT TITLE: Quantitative study of the Tertiary aquifers in southern Laramie County, Wyoming (WY 77-038).



COOPERATING AGENCY: Wyoming State Engineer and Wyoming Department of Economic Planning and Development.

PROJECT LEADER: Marvin A. Crist.

FIELD LOCATION: Southeastern Wyoming.

PERIOD OF PROJECT: October 1976 to December 1978.

PROBLEM: Ground-water development for irrigation in Laramie County has increased significantly the past 3 years. Part of the development is upgradient of two areas that have been designated as Control Areas by the Wyoming State Board of Control. Development is regulated within the Control Areas, but generally is not restricted outside these areas. State water administrators need more information about the development and its effect on water levels and stream discharge, and a way to predict the result of decisions to regulate future development. A model of the ground-water system in the shallow aquifers is needed.

OBJECTIVE: The objectives are (1) to determine extent of ground-water development for irrigation, industry, and municipal use, and describe the effect of this development on water levels and stream discharge in the study area; and (2) to provide a means of predicting the effects of alternative ground-water management decisions.

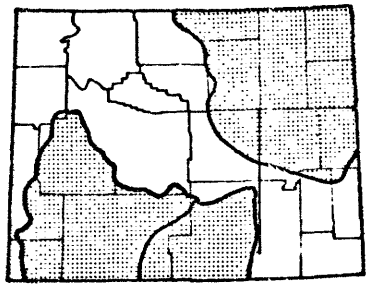
APPROACH: Collect and compile data to make a quantitative analysis of the hydrologic system in the Tertiary aquifers within the study area. Prepare a digital model with coarse grid utilizing available information. The model would be used to test and verify concepts of recharge and ground-water movement in southern Laramie County. Increase the grid density in areas of development where more information is available locally. The detailed model would be used to predict the effects of pumping.

PROGRESS AND SIGNIFICANT RESULTS: Mass water-level measurements were made and a potentiometric surface map prepared. An observation-well network has been established with water levels being measured monthly in about 70 wells by the Wyoming State Engineer's office as part of Direct Services activities. The Wyoming State Engineer's office drilled nine observation wells which will be equipped with digital water-level recorders. Terrace deposits adjacent to the study area in Colorado were mapped. Stream and spring discharges were measured during November (base-flow period). Inventory of large-capacity wells is about 90 percent complete. Satelite photos were surveyed for hydrologic information. Work has started on a preliminary digital model of the hydrologic system in the post-Cretaceous aquifers.

PLANS FOR FISCAL YEAR 1978: Complete a pumpage inventory for the period 1971 through 1977. Complete the final digital model of the ground-water system. Prepare a report of the investigation including estimated effects of future pumpage.

REPORTS PUBLISHED DURING FISCAL YEAR 1977: None.

PROJECT TITLE: Water-resources monitoring in the Powder River, south-central, and southwestern coal regions in Wyoming (WY 77-039).



COOPERATING AGENCY: None.

PROJECT LEADER: Stanley A. Druse.

FIELD LOCATION: Northeastern, south-central, and southwestern Wyoming.

PERIOD OF PROJECT: January 1977 to September 1980.

PROBLEM: Coal mining and associated developments of the scale and duration anticipated in major coal producing regions of the West may have adverse effects on the water resources of these regions. Mine dewatering, changes in land-use patterns, disposal of wastes, stream-channel realignment, and withdrawals of water for industrial and domestic use may significantly alter existing surface- and ground-water systems on a regional basis, limit available supplies, interfere with traditional water uses, and cause deterioration of the remaining water resources.

OBJECTIVE: The objective of the program is to determine the characteristics of the regional water-resources system and to detect and document changes in the system or in its components that may be associated with coal mining should changes occur.

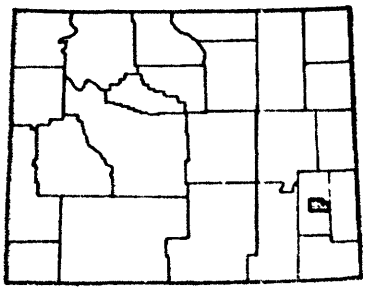
APPROACH: Evaluate the existing water-resources monitoring program for its regional surveillance value and add additional data sites or upgrade existing sites as needed. Evaluate data that continuously or periodically describe ground-water levels and quality, and streamflows and their quality, so that changes may be detected and documented.

PROGRESS AND SIGNIFICANT RESULTS: In the Powder River Coal Region, proposed surface-water monitoring sites were selected and field reconnaissance completed. Eleven sites were chosen for inclusion in the program, which included reactivation of an existing stream-gaging station. The remaining 10 sites required construction of a stream-gaging station. Construction of the shelter pad and placement of shelters was contracted by competitive bids; work was completed June 27. Construction of orifice lines, orifice anchorages, controls, and outside gages was performed by district personnel, and was completed July 11. Operation and maintenance of stream-gaging stations for the 1977 and 1978 fiscal years were contracted through formal solicitation procedures. Installation of gage equipment was completed by contractor and district personnel. All stations were in operation on September 2, 1977, for monitoring stream quality and quantity. Ground-water observation wells were selected for cleaning, sampling, and collection of aquifer-test data. Work for cleaning and sampling was contracted and will start early in fiscal year 1978. In the south-central and southwestern coal regions, ground-water observation wells were selected for cleaning, sampling, and collection of aquifer-test data. Work for cleaning and sampling was contracted. Processing of chemical-quality samples, obtaining well recovery data, and supervision of the cleaning and sampling was performed by district personnel. Scheduled work was about 50 percent complete at the close of fiscal year 1977. A contract for collection and processing the ground-water levels and quality-of-water data was solicited but not awarded because of excessive bids. The associated work reverted to existing in-house projects in the three coal regions.

PLANS FOR FISCAL YEAR 1978: Contractor operation of the eleven stream-gaging stations will be monitored for quality assurance. Installation of two cableways and rehabilitation of a third is planned. Indirect determinations of peak flow will be run as needed. Cleaning, sampling, and collection of aquifer-test data will proceed as contracted during fiscal year 1977. A similar contract will be solicited for different wells and selected repetitive wells. A status report on the coal-lease monitoring program in Wyoming will be prepared. All data will serve to augment the data base of current projects in the coal regions.

REPORTS PUBLISHED DURING FISCAL YEAR 1977: None.

PROJECT TITLE: Digital model to predict the effects of pumping from the Arikaree aquifer in Uva area, southeastern Wyoming (WY 77-042).



COOPERATING AGENCY: Wyoming State Engineer.

PROJECT LEADER: Dwight T. Hoxie.

FIELD LOCATION: Southeastern Wyoming.

PERIOD OF PROJECT: April to September 1977. (Final report completed September 1977.)

PROBLEM: The Wyoming State Engineer has requested that the U.S. Geological Survey provide information on the possible and probable effects of irrigation and industrial ground-water withdrawals from the Arikaree aquifer north of Wheatland, Wyoming. The industrial ground-water development will provide supplemental water to the 1,500-megawatt Laramie River Power Generation Station currently under construction. The power plant and wells are located near the Laramie River, which will provide the primary water supply.

OBJECTIVE: The objectives are to provide accurate predictions of the effects of projected irrigation and industrial ground-water withdrawals on the water levels in the Arikaree aquifer and on streamflow in streams near the pumping wells.

APPROACH: The U.S. Geological Survey two-dimensional ground-water flow model will be modified and utilized in this study. A streamflow accounting procedure for displaying any predicted streamflow depletions will be incorporated, and a provision to allow for constant gradient boundaries will be added to the flow model. Requisite input data for the flow model are available without further field collection. However, stream-discharge measurements will be made at selected sites on streams within the project area to define better the existing stream-aquifer relationships.

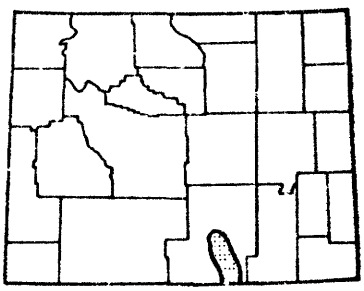
PROGRESS AND SIGNIFICANT RESULTS: A two-dimensional digital ground-water flow model was developed and calibrated. Three cases that represent projected maximum, mean, and minimum combined irrigation and industrial ground-water withdrawals at annual rates of 16,176, 11,168, and 6,749 acre-ft, respectively, were considered. Water-level declines of more than 5 feet over areas of 124, 120, and 98 mi^2 and depletions in streamflow of 14.4, 8.9, and 7.2 ft^3/s from the Laramie and North Laramie Rivers were predicted to occur at the end of a 40-year simulation period for these rates, respectively. A steady-state flow system was approximately established at the end of the 40-year simulation period only for the case representing the minimum withdrawal rate. Sensitivity tests with respect to hydraulic conductivity and specific yield indicated that the transient simulations were little affected by uniform variations of magnitudes equal to the assumed limits of uncertainty associated with these parameters. A tenfold increase in the vertical hydraulic conductivity that was assumed for the streambeds resulted in smaller predicted drawdowns near the Laramie and North Laramie Rivers and a 36 percent increase in the predicted depletion in streamflow for the North Laramie River. The final report was prepared, reviewed, and approved for release as an open-file report.

PLANS FOR FISCAL YEAR 1978: None.

REPORTS PUBLISHED DURING FISCAL YEAR 1977:

Hoxie, D. T., 1977, Digital model of the Arikaree aquifer near Wheatland, southeastern Wyoming: U.S. Geol. Survey Open-File Rept. 77-676, 54 p.

PROJECT TITLE: Effects of herbicide usage on water quality in the upper North Platte River, south-central Wyoming (WY 77-043).



COOPERATING AGENCY: Wyoming Department of Agriculture.

PROJECT LEADER: Joel R. Schuetz.

FIELD LOCATION: South-central Wyoming.

PERIOD OF PROJECT: June to September 1977 (incomplete).

PROBLEM: The Carbon County Weed and Pest Control District will be spraying the banks and islands of the North Platte River in south-central Wyoming with Tordon (4-amino-3, 5, 6-trichloropicolinic acid), Banvel (2-methoxy-3, 6-dichlorobenzoic acid), and 2,4-D. The Wyoming Department of Agriculture needs to know whether or not any of these herbicides appear in the water or bed material downstream from the spraying activity. This problem could be compounded by the extremely low flow expected in this reach of the river due to drought conditions in the area.

OBJECTIVE: The objectives are to determine the effects of herbicide spraying on water quality and on bed materials in the study reach.

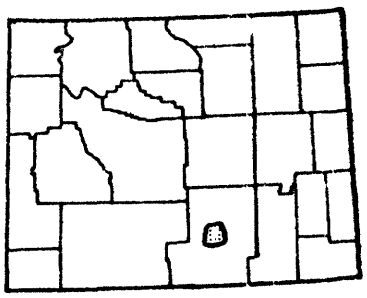
APPROACH: Sets of water- and bed-material samples will be collected upstream and downstream from the spray area before, during, and after the herbicide is applied. Application will last for about 8 weeks, during which sample sets will be collected twice a week immediately downstream. Samples will be analyzed in the Denver Central Laboratory. Results will be examined and the effects on water quality determined.

PROGRESS AND SIGNIFICANT RESULTS: Only part of the planned program of herbicide spraying was carried out by local authorities. Spraying was indefinitely delayed on areas controlled by BLM. Water-sample collection started in June and continued through the end of the fiscal year. Considerable time was spent by the project chief on training State employees in proper sampling techniques. All samples were sent to the Denver Central Laboratory for analysis for herbicides (particularly Dicamba, Picloram, and 2,4-D). Few results were available at the end of fiscal year 1977.

PLANS FOR FISCAL YEAR 1978: During the fall of 1977, a few more samples will be collected. A final report on results will be prepared for the cooperator.

REPORTS PUBLISHED DURING FISCAL YEAR 1977: None.

PROJECT TITLE: Evaluation of hydrologic impacts of in-situ coal-gasification experiment near Hanna, Wyoming (WY 78-044).



COOPERATING AGENCY: Environmental Protection Agency.

PROJECT LEADER: John F. Busby.

FIELD LOCATION: South-central Wyoming.

PERIOD OF PROJECT: October 1977 to February 1978 (suspended).

PROBLEM: The underground gasification of coal makes possible the recovery of coal from thin seams and from beds dipping too steeply to be mined by conventional techniques. To date all the effort has been directed toward the engineering of a successful burn with virtually no consideration of environmental issues. With underground coal gasification on the verge of commercialization, there is a need for more knowledge on the environmental impact of the process.

OBJECTIVES: The objectives of the study are (1) to determine the nature and concentrations of potential pollutants generated by the interaction between the residual coal char and coal tars with the ground waters moving back into the burned areas; (2) to determine the effects of contact time between the chars and the ground water on the quality of the backflood waters, and whether there is a net beneficiation or deterioration in the quality of water as a function of time; (3) to determine if a comparison of water samples collected a) from the site before the burn, b) in the surrounding area, and c) waters used in quenching Hanna II, phase I can be related to the burn process; (4) to develop and test a conceptual model of the solid, liquid, and gas phase interactions responsible for any changes observed in water samples collected before and after the burn; and (5) to determine the sorptive properties of the rocks in the area relative to pollutants produced by the burn.

APPROACH: Water samples will be collected from the burn site and the surrounding area. Samples from the surrounding area are required as background data representing conditions prior to the burn. Sampling will be performed quarterly in 1978, beginning when the burn site has refilled sufficiently for sampling.

Six wells including one blind split to test analytical reliability, and a sample from the immediate area surrounding the burn site, will be sampled on each trip.

The inorganic parameters to be analyzed were chosen by applying two sets of criteria: (1) Presence of the element in the coal; and (2) potential harmfulness to man or usefulness in making geochemical interpretations and testing the reliability of data.

The fractionation scheme for dissolved organic carbon developed by Jerry Leenheer will be used as a relatively inexpensive way to give insight into the type of organic material generated in the in-situ process.

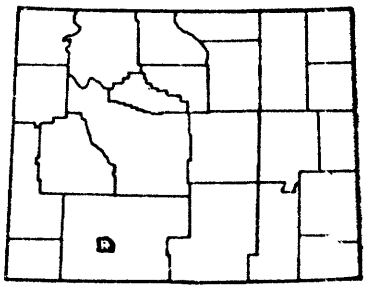
The data collected will be subjected to statistical analysis to determine the significance of each component compared to a baseline. The baseline will be computed using the geometric mean and variance of data collected during Hanna I and II by K. D. Peter, U.S. Geological Survey, and at Hanna III by the Department of Energy or their contractors.

Quality-of-water data will also be subjected to various forms of pattern analysis to determine the types of alterations occurring as a function of time.

PLANS FOR FISCAL YEAR 1978: Data collection and analysis are to be completed by July 1978. A report will be completed by October 1978 for publication in the U.S. Geological Survey Water-Resources Investigation Series. Information will be furnished to the Department of Energy quarterly for inclusion in their quarterly reports.

REPORTS PUBLISHED DURING FISCAL YEAR 1977: None.

PROJECT TITLE: A preliminary hydrologic investigation of an in-situ oil-shale retorting site near Rock Springs, Wyoming (WY 78-045).



COOPERATING AGENCY: Environmental Protection Agency.

PROJECT LEADER: John F. Busby.

FIELD LOCATION: Southwestern Wyoming.

PERIOD OF PROJECT: October 1977 to September 1978.

PROBLEM: The in-situ recovery of shale oil is a more economical means of recovery than strip mining, and it is much less harmful to the intrinsic beauty and to the air quality of an area than surface retorting. The effects of the in-situ process on the aquatic environment are still unknown, as most of the work to date has been directed toward engineering a successful burn. Laramie Energy Research Center of the Department of Energy, however, has done work on the quality of the water at the site. Although the Department of Energy has done, and is continuing to do, an excellent job of studying the composition of potential pollutants generated in the course of the experiments, no one has yet made an adequate study of the hydrology of the area and the possible transport of pollutants.

OBJECTIVES: The general objective of the study is to determine the hydrology at the site. Specific objectives are (1) to determine whether ground water at the site flows westward down the regional dip of the rocks or eastward locally toward nearby Bitter Creek; (2) to determine if there is enough hydraulic connection between the Tipton Shale Member and the overlying Wilkins Peak Member of the Green River Formation to permit movement of produced water from the Tipton into the Wilkins Peak; and (3) to determine if there is enough hydraulic connection between the Tipton Shale Member of the Green River Formation and the underlying Wasatch Formation to permit migration of water from the Tipton into the Wasatch.

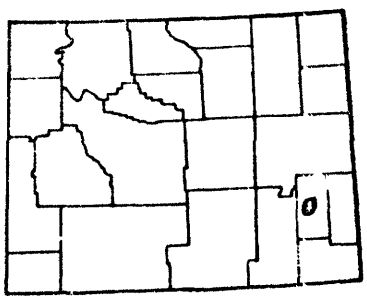
APPROACH: The study of the site hydrology will begin with the study of data available from the Department of Energy and their contractors. After these data have been analyzed and interpreted, a data-collection program will be recommended to the Department of Energy to develop potentiometric surfaces, hydraulic conductivities, transmissivities, storage coefficients, porosities, and leakages for the Wilkins Peak, Tipton, and Wasatch.

Data obtained in this manner will be used to plan a well inventory and a water-level program to prepare maps of the potentiometric surface to interpret the regional ground-water flow.

PLANS FOR FISCAL YEAR 1978: Data collection and analysis will be done during the year. Semiannual progress reports as required by the Environmental Protection Agency will be prepared. The final report will be completed by September 1978.

REPORTS PUBLISHED DURING FISCAL YEAR 1977: None.

PROJECT TITLE: Digital model of the Arikaree aquifer in Muleshoe Flat, southeastern Wyoming (WY 78-046).



COOPERATING AGENCY: Bureau of Land Management.

PROJECT LEADER: Dwight T. Hoxie.

FIELD LOCATION: Southeastern Wyoming.

PERIOD OF PROJECT: October 1977 to September 1978.

PROBLEM: A total of 75 high-yield wells are proposed to be installed in Muleshoe Flat for irrigation purposes. The Bureau of Land Management needs an evaluation of the effects of these withdrawals in order to make a final decision on whether or not to permit the development.

OBJECTIVE: The objective is to predict the effects of the proposed irrigation pumpage from 75 high-yield wells on ground-water levels within the study area and on stream-flow in the Laramie River and Sybille Creek, which border the area.

APPROACH: Plans are to (1) conduct a hydrogeologic reconnaissance of the Arikaree aquifer, including a) compilation of surface geologic map, b) map a configuration of base of aquifer, c) measurement of water levels and compilation of water-table map, and d) make seepage runs on principal streams; (2) develop and calibrate a digital two-dimensional flow model; and (3) simulate the proposed pumpage under transient conditions to predict effects on water levels and streamflow.

PLANS FOR FISCAL YEAR 1978: A geohydrologic evaluation of the Arikaree aquifer in the study area will be made. Water levels will be measured in existing wells and a seepage run made on the Laramie River and Sybille Creek. Surface geologic map, map of base of the aquifer, and water-table map will be prepared. A digital model will be developed and calibrated and then used to simulate the proposed pumpage. A final report will be prepared.

REPORTS PUBLISHED DURING FISCAL YEAR 1977: None.

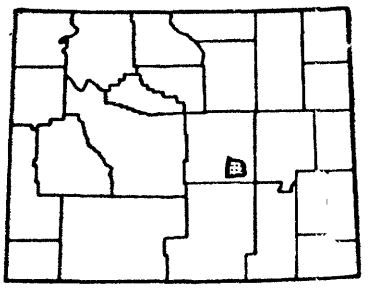
PROJECT TITLE: Digital model of the alluvial aquifer in Bates Hole, central Wyoming (WY 78-047).

COOPERATING AGENCY: Wyoming State Engineer.

PROJECT LEADER: Kent C. Glover.

FIELD LOCATION: Central Wyoming.

PERIOD OF PROJECT: October 1977 to September 1979.



PROBLEM: A total of 10 high-yield irrigation wells are proposed for installation in Bates Hole. Existing surface-water diversions virtually depleted the flow of Bates Creek during the irrigation season. The Wyoming State Engineer needs an evaluation of the effects of these withdrawals on streamflow in order to make a final decision on whether or not to permit the development.

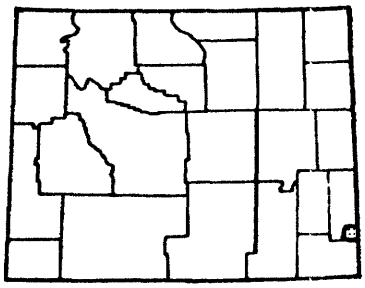
OBJECTIVE: The objectives of this study are to define the relationship between Bates Creek and its associated alluvial aquifer and to predict the effects of the proposed pumpage on streamflow and water levels within the area.

APPROACH: The approach to be taken in this study is (1) to conduct a hydrogeologic reconnaissance at the alluvial aquifer, including a) collection of lithologic and water-table data at 30 wells [this will require drilling 20 observation wells], b) installation of three stream gages, c) compilation of surface geology map, map of base of the aquifer, and water-table maps for irrigation and non-irrigation seasons, d) aquifer tests of stream depletion, e) seepage runs on Bates Creek, and f) monitor pumpage and diversions; (2) to develop a digital two-dimensional ground-water flow model for the area; and (3) to simulate the proposed pumpage to predict the effects on streamflow and water levels.

PLANS FOR FISCAL YEAR 1978: A geohydrologic evaluation of the alluvial aquifer in the study area will be made. Three stream gages will be installed and operated. Fifteen observation wells will be drilled. To monitor the effects of irrigation, mass water-level measurements and seepage runs along Bates Creek will be made throughout the irrigation season. Pumpage and stream diversions will be measured. Aquifer tests of stream depletion will be made. Surface geology map, map showing the base of the aquifer and water-table maps for each mass water-level run will be prepared. Work will begin on developing and calibrating a digital model.

REPORTS PUBLISHED DURING FISCAL YEAR 1977: None.

PROJECT TITLE: Digital model of the hydrologic system in the La Grange area, southeastern Wyoming (WY 78-048).



COOPERATING AGENCY: Wyoming State Engineer.

PROJECT LEADER: William B. Borchert.

FIELD LOCATION: Southeastern Wyoming.

PERIOD OF PROJECT: October 1977 to September 1979.

PROBLEM: Surface water and ground water are used for irrigation in the La Grange area. Surface water stored in a water district reservoir is supplemented by ground water pumped from district wells adjacent to the reservoir and by springs at the reservoir. The reservoir is down gradient of 27 irrigation wells in a 7 mi^2 area where water-level declines have occurred in the last 3 years. Because of concern about possible additional water-level declines, the Wyoming State Engineer needs to know the effect of current stresses on the system, as well as a means of predicting future stresses, for water administration.

OBJECTIVE: The objectives are to determine the interrelationship between water in the reservoir and water in the aquifer or aquifers adjacent to the reservoir, to determine the effects of ground-water pumpage on water levels throughout the area, and to determine the effects of ground-water pumpage on the flow of the springs at the reservoir. The ground-water flow system and the surface- and ground-water relationships will be simulated using a digital model with possible future stresses imposed on the model.

APPROACH: Observation wells will be drilled in and near the reservoir and where needed in other parts of the area. Water-level measurements will be made as needed. Preparation of a hydrologic budget will include surface-water inflow and outflow data for two creeks, a pumpage inventory, and estimates of ground-water inflow and outflow, evapotranspiration, and recharge from precipitation. Seepage runs on the creeks and measurements of surface-water diversions will be made. The reservoir will be simulated by a pond model used in conjunction with an appropriate digital model that simulates the ground-water flow system.

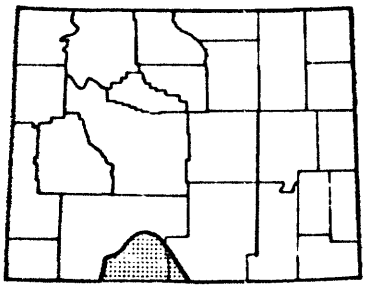
PROGRESS AND SIGNIFICANT RESULTS: None.

PLANS FOR FISCAL YEAR 1978: Observation wells will be drilled, an observation-well network will be established, and mass water-level measurements made during spring and fall. Stream-gaging stations will be installed and seepage runs made. Most of the ground-water and surface-water data collection will be done this fiscal year. A steady-state digital model will be started.

REPORTS PUBLISHED DURING FISCAL YEAR 1977: None.

Projects Conducted by Other Districts

PROJECT TITLE: Yampa River Basin assessment, northwestern Colorado and south-central Wyoming (CO 75-075).



COOPERATING AGENCY: Routt County Department of Environmental Health.

PROJECT LEADER: Timothy Doak Steele. (Lakewood, Colorado)

FIELD LOCATION: South-central Wyoming and northwestern Colorado.

PERIOD OF PROJECT: April 1975 to December 1977.

PROBLEM: Energy resources in the Yampa River basin in Colorado and Wyoming are being developed. Coal is the dominant energy resource being developed, with annual production in northwestern Colorado expected to increase from 6.0 million tons in 1976 to more than 20 million tons by 1990. A substantial part of this mined coal will be converted in the basin to electric power or possibly synthetic gases. Other energy resources in the basin include oil and gas, oil shale, uranium, and geothermal springs.

Decisions affecting policy of energy-resource development need to consider the environmental and economic impact of this development. Energy-resource development leads to increased discharge of residuals to water, air, and land. Residuals are the noneconomic byproducts of energy-development activities. Discharged residuals will modify environmental quality, and attempts to modify or reduce residual discharges will affect both the quantity and quality of the basin's water resources. The availability of water may be a limiting factor to future development of the energy resources in the basin.

OBJECTIVES: The project is designed to assess the availability and quality of the basin's water resources and evaluate the potential environmental and selected socioeconomic impacts of various coal-resource development plans proposed by mining and power companies. The possible constraints on water availability and current uses as a consequence of existing water rights and compact arrangements will be considered. The basin-assessment program is designed to provide Federal, State, and local decision makers with basic environmental information for formulating and evaluating policies for the development of the basin's energy and water resources.

APPROACH: Ambient hydrologic conditions in the Yampa River basin will be evaluated through interpretation of historic data and collection of additional data where deficiencies have been identified. Other basin-assessment evaluations include analyses of surface- and groundwater availability, multireservoir modeling of proposed surface-water development alternatives, remote-sensing applications, travel time and wasteload assimilative capacity analyses, socioeconomic impacts, review of water rights, and investigation of institutional constraints and basin compacts which may limit the availability of water for energy-resource development. Existing hydrologic models as well as coal-mining and coal-conversion models will be used to simulate the impact of various coal-development plans on the water-resource systems.

PROGRESS AND SIGNIFICANT RESULTS: Two reports describing the phase I and phase II project work activities have been published. All study work elements outlined in these work-plan reports were carried out, and most have been completed. Several reports documenting results of special topic areas, including contractual studies, are completed or are in process. Summary reports highlighting results for each project phase are in preparation.

PLANS FOR FISCAL YEAR 1978: Complete all reports.

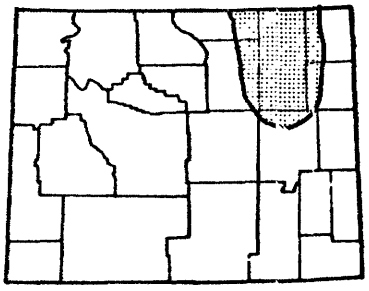
REPORTS PUBLISHED DURING FISCAL YEAR 1977:

Wentz, D. A., and Steele, T. D., 1976, Surface-water quality in the Yampa River Basin, Colorado and Wyoming--an area of accelerated coal development: Proc., Engineering Foundation Conference on water for energy development, Asilomar Conference Center, Pacific Grove, Calif., December 5-10, 1976 (reprint 28 p.).

Udis, Bernard, and Hess, R. C., 1976, Input-output structure of the economy of Routt and Moffat counties of the Yampa River Basin in Colorado, 1975: Completion report for U.S. Geol. Survey contract P. O. 12166, December 1976, 146 p.

Udis, Bernard, Adams, T. H., Hess, R. C., and Orr, D. V., 1977, Coal energy development in Moffat and Routt counties of the Yampa River Basin in Colorado--Projected primary and secondary economic impacts resulting from several coal-development futures: Completion report for U.S. Geol. Survey Contract P. O. 12185, June 1977, 342 p.

PROJECT TITLE: Effects of mining and related activities on the shallow ground-water system (MT 75-048).



COOPERATING AGENCY: None.

PROJECT LEADER: Steven E. Slagle.
(Billings, Montana)

FIELD LOCATION: Eastern Montana and northeastern Wyoming.

PERIOD OF PROJECT: July 1974 to June 1979.

PROBLEM: Strip mining and the related aspects of coal development can be expected to cause ground-water levels and ground-water quality to change. The public, industry, and government need to know the extent of change in order to take and enforce mitigating measures. Water availability and water quality need to be known in order for other agencies to evaluate alternate sources of water.

OBJECTIVE: Define and understand the regional and local flow systems in aquifers above the Pierre Shale. Develop a semi-quantitative conceptual model as a basis for predictive models. Develop predictive models to assess the effects of mining on water levels and the yield of wells and springs. Develop "first estimate" water-quality models to predict rate and direction of movement of poor quality water from spoil banks and other sources. Utilize all of the models to evaluate and revise the data-collection program. Assure that the data-collection and interpretation (modeling) programs meet the needs of other federal and state agencies.

APPROACH: Combine the accumulated geologic and hydrologic information to develop conceptual models of the hydrologic system on both large and small scales. Collect additional data needed for more complete understanding of the hydrologic system. Develop digital models, first, to test and modify the concepts and evaluate the data-collection network, then to predict the effects of mining and related activities on ground-water levels and the discharge of springs. Using the hydraulic models, try to develop water-quality models to determine or predict leachate migration and the movement of other poor quality water.

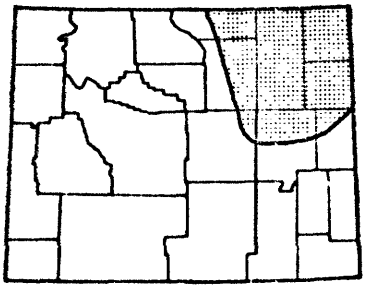
PROGRESS AND SIGNIFICANT RESULTS: Completed well inventory and entered majority of data into System 2000. Conducted low-flow investigation of major streams in study area. Cased test holes for aquifer testing, water-level monitoring, and water-quality sampling. Implemented regional observation well network to obtain long-term information. Designed and implemented a ground-water monitoring network at four specific sites to obtain both short- and long-term information. Completed structure contour, sand thickness, sand percentage, and transmissivity factor maps of all units included in the Powder River Basin hydrologic model. Completed potentiometric surface maps for the Tongue River and Lebo Shale Members of the Fort Union Formation. Collected and analyzed about 50 water samples. Completed data analysis required to initiate water-quality reports on intensive areas. Submitted report for Otter Creek near Ashland for review. Geologic map and text released as open-file reports.

PLANS FOR FISCAL YEAR 1978: Collect data necessary for refinement of hydrologic model. Continue monitoring of water levels and chemical quality. Continue casing of test holes drilled by government or industry in areas of government-owned minerals. Conduct aquifer tests. Begin development of site study for geochemical concepts verification and modeling. Trace element sampling in intensive areas and complete interpretive report. Finalize hydrologic maps and write text for a map report. Complete geochemical reports on four intensive areas. Refine and verify data entered in System 2000 and compile well-location map for publication of basic data report. Initiate compilation of final report.

REPORTS PUPLISHED DURING FISCAL YEAR 1977:

Lewis, B. D., and Roberts, R. S., 1977, Geology and water-yielding characteristics of rocks in the northern Powder River Basin, southeastern Montana: U.S. Geol. Survey Open-File Rept. 77-75, 22 p.

PROJECT TITLE: Availability of ground water from aquifers in the Cretaceous and Tertiary systems in the Fort Union Coal Region (ND 75-071).



COOPERATING AGENCY: None.

PROJECT LEADER: Mack G. Croft.
(Bismark, North Dakota)

FIELD LOCATION: Northeastern Wyoming, southeastern Montana, and western North Dakota and South Dakota (Northern Great Plains).

PERIOD OF PROJECT: July 1974 to June 1977.

PROBLEM: Proposed coal developments in the Fort Union Coal Region of the Northern Plains will be attended by substantial increases in water usage. In much of the region, the only practical source of water for domestic, stock, municipal, and small-scale industrial requirements is ground water from relatively shallow aquifers in rocks of Cretaceous and Tertiary age. However, knowledge of these aquifers is fragmental and limited to scattered localities. A systematic and regional appraisal is required for planning, development, and management purposes.

OBJECTIVE: The major objectives are (1) to determine the location, extent, and nature of the major aquifers and confining beds in the Cretaceous and Tertiary systems in the Fort Union Coal Region; (2) to evaluate the occurence, movement, and availability of ground water, including sources of recharge and discharge; and (3) to determine the chemical quality of the ground water.

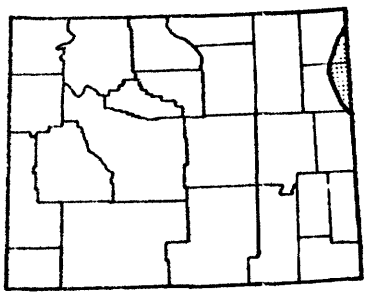
APPROACH: The investigation will be concerned mainly with the compilation, analysis, and interpretations of existing pertinent data from available sources in the states of North Dakota, South Dakota, Wyoming, and Montana. Major aquifers in the Cretaceous and Tertiary systems will be identified, described, and correlated mainly through the use of geophysical and lithologic logs. Three regional hydrogeologic sections will be prepared that will illustrate the structural and stratigraphic relationships of the major aquifers. A structural map will be prepared, using the top of the Pierre Shale which, for much of the region, also will represent the lower limit of potable ground water. The final report will be prepared in the professional paper or Water-Resources Investigation Series.

PROGRESS AND SIGNIFICANT RESULTS: The project is mainly a compilation of existing published and unpublished data from reports in the Fort Union Coal Region. Water-level and transmissivity maps of the Fox Hills and Tullock (lower Ludlow) aquifer have been compiled. Also a geologic map of the Fort Union Coal Region and cross sections have been made. All field work and data compilation completed. First draft of report submitted for review.

PLANS FOR FISCAL YEAR 1978: Finish processing of report and obtain Director's approval for publication.

REPORTS PUBLISHED DURING FISCAL YEAR 1977: None.

PROJECT TITLE: Hydrology of the aquifer(s) in the Madison Group (SD 76-043).[1/]



COOPERATING AGENCY: None.

PROJECT LEADER: Lewis W. Howells.
(Huron, South Dakota)

FIELD LOCATION: Northeastern Wyoming and western South Dakota.

PERIOD OF PROJECT: July 1975 to June 1980.

PROBLEM: New withdrawals of water from the aquifer(s) in the Madison Group for existing and proposed mining and industrial facilities could greatly exceed 100,000 acre-ft per year within five years. Some concerned persons, including public officials, fear that the aquifer is incapable of supporting a sustained yield of that magnitude and that severe damage may result to other water users in the region.

The problem, therefore, is to delineate the magnitude and distribution (both in space and time) of the water resources in the Madison, and to determine the response of the aquifer to proposed withdrawals of water.

[1/] This project is subsidiary to project CR 76-192, described on page 98.

OBJECTIVE: The objectives of the study are (1) to delineate the water resource(s) contained in or integrally related to the Madison Group in South Dakota; (2) to determine the hydrologic regimen of the aquifer(s), with special emphasis on the surface- and ground-water relationship in areas of outcrop, of the aquifer(s) in the Madison Group and to those in underlying limestone rocks of Paleozoic age and of the overlying Minnelusa Formation; and (3) to predict the probable results of removal of large amounts of water from the Madison.

APPROACH: Collect, evaluate, and interpret records, data, and other information available from public and private sources, including analysis of drill-stem test data by a professional analyst. Establish and operate a data-collection network to meet the objectives of the project. Conduct test drilling, dye tracer tests, aquifer tests, geophysical studies, and other tests and studies as needed and feasible. Interpret information and prepare reports that include structure, isopach, potentiometric, and geochemical maps, and predictions of probable effects of various patterns and magnitude of water resources development. Refine predictions from new information available from the data-collection network.

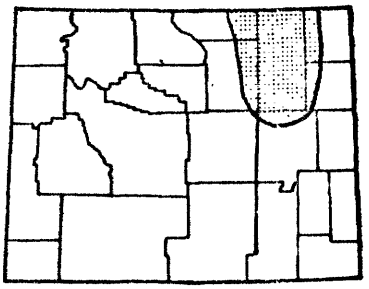
PROGRESS AND SIGNIFICANT RESULTS: The canvass of wells in the western half of South Dakota is essentially complete. The gaging stations on streams in the Black Hills have been installed. Plotting of data for stratigraphic maps is nearly complete.

PLANS FOR FISCAL YEAR 1978: Continue compilation and evaluation of data. Operate gaging stations and continue water-level monitoring program. Collect and analyze additional ground-water samples.

REPORTS PUBLISHED DURING FISCAL YEAR 1977: None.

Projects Conducted by Central Region Staff

PROJECT TITLE: Geochemical survey of waters of the western coal regions (CR 74-095).



COOPERATING AGENCY: None.

PROJECT LEADER: Gerald L. Feder. (Lakewood, Colorado)

FIELD LOCATION: Northeastern Wyoming, southeastern Montana, western North Dakota, and parts of Arizona, Colorado, New Mexico, and Utah.

PERIOD OF PROJECT: July 1973 to September 1979.

PROBLEM: The anticipated large scale exploitation of coal or other energy producing natural materials in the western United States is expected to result in marked changes in the geochemical environment including the quality of waters in the region, and especially the trace element content of waters. Such changes will result predominantly from effects of strip mining and power production. These changes can be best monitored only if realistic estimates of the predevelopment water quality are known.

OBJECTIVE: It is the goal of this project to efficiently provide data on the "natural" or pre-development geochemistry of the waters of the area, with particular emphasis on trace elements that may have a relationship to health and disease in humans or animals. If time and interest permit, attention may also be given to quantifying changes already produced by existing developments in the area. In addition, the relationships between soils, plants, rocks, and waters, within the study area, will be quantified.

APPROACH: During the 1974-75 field season, a hydrogeochemical sampling program will be carried out in the major coal basins in the Rocky Mountain and Northern Great Plains Coal Provinces. Rigorous statistical techniques will be used throughout the study. The data collected will include major chemical constituents, trace elements, and gross alpha and beta activity. If high alpha or beta activities are obtained, additional analysis will be made for specific radiochemical elements. All chemical analyses will be done in Water Resources Division laboratories.

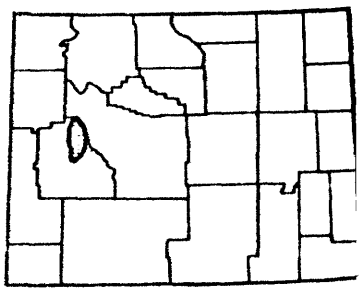
PROGRESS AND SIGNIFICANT RESULTS: Completed sampling of ground-water in the Powder River coal region, and analyzed and interpreted data. Published progress report on comparison of data from Fort Union and Powder River coal regions. Analysis of variance shows no significant difference between the water quality of both basins. However, there are similar large differences within the basins indicating similar geochemical processes operate in both basins.

PLANS FOR FISCAL YEAR 1978: Selectively sample other western coal regions and see if the same geochemical principals which operate in the Fort Union and Powder River coal regions operate in them. Do coal overburden leaching experiments in cooperation with Todd Hinkley, Geologic Division, and use results to help explain natural water geochemistry in the western coal regions. Start writing final professional paper.

REPORTS PUBLISHED DURING FISCAL YEAR 1977:

Feder, G. L., Lee, R. W., Busby, J. F., and Saindon, L. G., 1977, Geochemistry of ground waters in the Powder River Coal Region, in (U.S. Geol. Survey) Geochemical Survey of the Western Energy Regions, Fourth Annual Progress Report, July 1977: U.S. Geol. Survey Open-File Rept. 77-872, p. 173-179.

PROJECT TITLE: Bedload transport research (CR 74-187).



COOPERATING AGENCY: None.

PROJECT LEADER: William W. Emmett. (Lakewood, Colorado)

FIELD LOCATION: West-central Wyoming.

PERIOD OF PROJECT: April 1973 to September 1980.

PROBLEM: Of all processes operating in river channels, and especially of those of practical concern to engineers and others interested in river channel behavior, perhaps the least knowledge is available regarding the hydraulics and mechanics of bedload transport. Before continuing advances in river channel behavior can be made, some understanding of the behavior of bedload sediment must be made.

OBJECTIVE: The objectives are (1) to define spatial and temporal variations in bedload transport rate for a single stage of flow; (2) to define change in average magnitude of transport rate over a range in hydraulics of flow; (3) to define change in average magnitude of transport rate over a range in channel geometry; and (4) to analyze the data to evaluate the applicability of available bedload equations, suggest new coefficients for the existing equations, or propose new relations for predicting rates of bedload transport.

APPROACH: To use the conveyor-belt bedload-transport facility on the East Fork River near Pinedale, Wyoming, as a control to evaluate variability factors in bedload transport and to field calibrate the Helley-Smith bedload sampler; to use the calibrated Helley-Smith sampler in the systematic collection of bedload samples, along with the concurrent measurements of streamflow hydraulics, from a variety of sand- and gravel-bed streams; and, within the laws of general physics, stochastically develop empirical relations of bedload transport and interpret the physical significance of the developed relations.

PROGRESS AND SIGNIFICANT RESULTS: Field calibration of the sediment-trapping characteristics of the Helley-Smith bedload sampler have been completed. Principal data collection at the conveyor-belt bedload-trap facility have been completed. Analysis of these data are ongoing and draft reports underway. Preliminary field studies undertaken to facilitate transfer of information from site-specific field areas to areal application with emphasis to energy-resource areas and with application to watershed and channel flow/sediment modeling concepts.

PLANS FOR FISCAL YEAR 1978: Use Helley-Smith bedload sampler (1) to aid in site selection for construction of conveyor-belt bedload-trap facility on gravel-bed river; and (2) to collect bedload data in upper Salmon River area to complete sediment-transport studies on these rivers. In collaboration with L.B. Leopold, propose continuation of studies to show interaction of lithology, discharge, and base level on stream gradient and sediment-transport processes.

REPORTS PUBLISHED DURING FISCAL YEAR 1977:

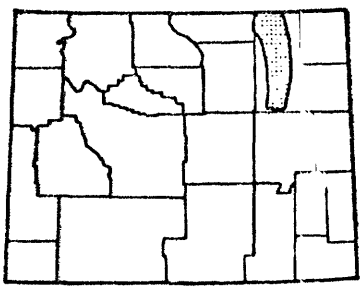
Druffel, Leroy, Emmett, W. W.,Schneider, V. R., and Skinner, J. V., 1976, Laboratory hydrualic calibration of the Helley-Smith bedload sediment sampler: U.S. Geol. Survey Open-File Rept. 76-752, 63 p.

Emmett, W. W., and Leopold, L. B., 1977, A comparison of observed sediment-transport rates with rates computed using existing formulas: in Geomorphology in Arid Regions (D. O. Doehring, ed.), Proc., 8th Ann. Geomorphology Symposium, State Univ. of NY, Binghamton, NY, Sept. 23-24, 1977, p. 187-188.

Leopold, L. B., and Emmett, W. W., 1977, 1976 bedload measurements, East Fork River, Wyoming: Proc., Nat. Acad. of Sciences, v.74, no.7, p. 2644-2648.

Mahoney, H. A., Andrews, E. D., Emmett, W. W., Leopold, L. B., Meade, R. H., Myrick, R. M., and Nordin, C. F., 1976, Data for calibrating unsteady-flow sediment-transport models, East Fork River, Wyoming, 1975: U.S. Geol. Survey Open-File Rept. 76-22, 293 p.

PROJECT TITLE: Reconnaissance techniques for evaluation of rehabilitation potential of energy resource lands (CR 75-104).



COOPERATING AGENCY: Bureau of Land Management.

PROJECT LEADER: Lynn M. Shown. (Lakewood, Colorado)

FIELD LOCATION: White Tail Butte EMRIA site, northeastern Wyoming.

PERIOD OF PROJECT: July 1974 to June 1979.

PROBLEM: Hydrologic information with respect to rehabilitation potential is needed by local, state and federal governments, private landowners, energy companies, and others prior to decisions on the leasing, mining plans, and mining of publicly-owned coal and oil shale. The information is needed over the next 1 to 5 years, so reconnaissance techniques must be used to obtain much of the necessary data. The two facets of the problem are: (1) To define the baseline conditions as they exist prior to mining, mostly in areas having sparse hydrologic data; and (2) to assess the potential for rehabilitation of the land-water system after mining.

OBJECTIVES: The purpose of this project will be to refine and apply reconnaissance techniques that will provide mappable and other easily assimilated information to be used as baseline data and in evaluating the rehabilitation potential of lands where energy resource mining is proposed. Data will be collected and interpreted for the following subjects: Mean annual runoff, 2-, 5-, and 10-year peak flows, soil erodibility, annual sediment yields, soil-vegetation-water associations, evapotranspiration, slope and exposure effects on vegetation and hydrology, reconstruction of topography after assumed mining, and channel and hillslope erosion.

APPROACH: The techniques to be used to characterize watersheds of various sizes are (1) soil-moisture storage associated with vegetation types; (2) estimates of annual runoff by subtracting soil-moisture storage from annual precipitation; (3) the relation of percent bare soil to runoff and sediment yields; (4) index of erodibility by water dispersion; (5) estimates of annual runoff and peak discharges using channel measurements; (6) estimates of sediment yield using climate, drainage basin characteristics, and reservoir sediment surveys; (7) erosion monitoring by resurveying monumented transects; and (8) hillslope, channel, and geologic cross-section analysis with respect to reconstruction of the topography of potential mine areas. Soils, vegetation and runoff and erosion of nearby mine spoils in various states of rehabilitation will be investigated.

PROGRESS AND SIGNIFICANT RESULTS: Map preparation and preliminary interpretations were begun for the White Tail Butte study area. A draft map of source-area sediment yields for areas upstream from surface-mineable coal deposits was completed for Campbell County. Sediment yields from much of the area are low; higher yields occur on steeper, eroded areas where bedrock composed chiefly of claystone is exposed. Another investigation shows that sediment yield is about 11 times greater from a small basin where an unrehabilitated surface mine is located than from an adjacent unmined basin near Sheridan. Amounts of chemical constituents adsorbed to the sediment were similar in both basins. Chemical concentrations in the water were an order of magnitude greater for the mined basin, probably derived from ground water.

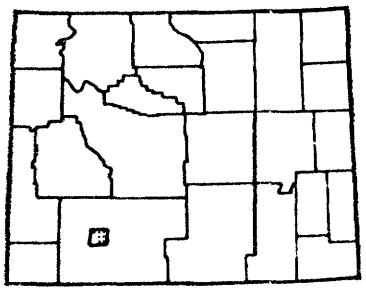
PLANS FOR FISCAL YEAR 1978: Maps and report for the White Tail Butte study area will be completed. The source-area sediment yield map for the coal region in Campbell County will be completed.

REPORTS PUBLISHED DURING FISCAL YEAR 1977:

Keefer, W. R., and Hadley, R. F., 1976, Land and natural resource information and some potential environmental effects of surface mining in the Gillette area, Wyoming: U.S. Geol. Survey Circ. 743, 27 p.

Shown, L. M., 1977, Hydrologic aspects of the rehabilitation potential of surface-mineable coal lands in the West (abs.), in Meissner et al., 1977, Coal Geology and the Future--Symposium Abstracts and Selected References: U.S. Geol. Survey Circ. 757, 20 p.

PROJECT TITLE: Sorption of residual organic substances in retort waters by spent oil-shale residues (CR 75-181).



COOPERATING AGENCY: Department of Energy, Laramie Energy Research Center.

PROJECT LEADER: Jerry A. Leenheer (Lakewood, Colorado)

FIELD LOCATION: Southwestern Wyoming (Rock Springs LERC oil-shale retorting site).

PERIOD OF PROJECT: 1975 to September 1980.

PROBLEM: In-situ oil-shale retorting produces 1 to 5 barrels of wastewater per barrel of oil. This wastewater is the result of free water contained in the oil shale, the dehydration and dehydroxylation of oil shale minerals at the high temperatures of the retorting process, and the partial combustion of the kerogen which produces retort water. The water-oil mixture is an emulsion which is physically separated after pumping from the in-situ retort, and the wastewater is a brown solution containing 500 to 1,000 milligrams per liter dissolved organic carbon.

Because the wastewater must be handled at land surface during oil production, there is some potential for wastewater contact with the soils present at the retort site. Because of concern about the nutrient and toxilogical aspects of the constituents dissolved in the wastewaters, it is important to understand and measure the chemical and physical interactions between the soil and the wastewater.

The wastewater may be disposed at land surface by using various waste treatment processes, or it may be disposed in the subsurface via injection wells. Because of the concern about the toxilogical aspects of these waste organic solutes, the waste treatment process selected for use is partially contingent upon the rate of transport of these organic solutes in surface and ground waters after their disposal. Organic solute transport is governed by the rate of water movement, and by solute sorption upon soils, sediments, and aquifer material.

OBJECTIVE: The objective of the proposed research is to determine the chemical and physical effects of soil upon the wastewater composition and wastewater upon soil composition, and to determine the type and magnitude of the organic solute sorption processes which occur upon soil and sediment sorbents associated with the disposal of in-situ-produced wastewater.

APPROACH: This investigation will be conducted using the wastewaters, natural waters, soils, and sediments associated with the experimental in-situ oil-shale retorting site of the Laramie Energy Research Center, Department of Energy, located near Rock Springs, Wyoming. All waters, soils, and sediments will be supplied by personnel of the Laramie Energy Research Center.

The proposed investigation will directly study only the chemical and physical aspects of soil-wastewater interactions. Also, the sorptive properties of unconsolidated soils and sediment sampled at land surface will be characterized by running adsorption isotherms by the batch process of both fractionated and unfractionated wastewater using dissolved organic carbon to quantify the organic solute concentration. The fractionation procedure (Leenheer and Huffman, 1976) typifies the sorptive interactions of the organic solutes into six characteristic fractions.

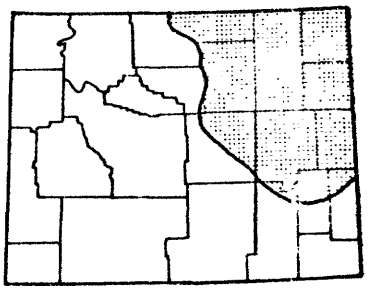
PROGRESS AND SIGNIFICANT RESULTS: Processed oil shale has been found to be a basic sorbent which sorbed organic acids in retort water preferentially to organic bases. Total organic solute concentrations in retort waters studied ranged from 1,000 to 5,000 milligrams per liter dissolved organic carbon with organic acid concentrations greater than organic neutral greater than or equal to organic base concentrations. Significant concentrations of thiosulfate and thiocyanate were found in retort waters. Thiosulfate and tetrathionate were unstable in ground waters associated with an in-situ retort, but thiocyanate persisted. A diverse range of processed shale materials were found in a sampling trench dug into an in-situ retort. Retort water was found to dissolve the calcium carbonate and organic matter coatings from soil colloids.

PLANS FOR FISCAL YEAR 1978: Work to be accomplished will be (1) survey and classify the soils at Site 9 and adjacent areas; (2) characterize the soil selected for the field plot study as to chemical properties, physical properties, and numlerlogic analysis by X-ray diffraction; (3) determine organic carbon breakthrough curves for wastewater passed through consolidated cores contained in the Hassler sleeve coreholder; and (4) investigate the solute-solute interactions between natural organic solutes and waste organic solutes, and the effect of these interactions upon sorption.

REPORTS PUBLISHED DURING FISCAL YEAR 1977:

Leenheer, J. A., Malcolm, R. L., and White, W. R., 1977, Physical, chemical, and biological aspects of subsurface organic waste injection near Wilmington, North Carolina: U.S. Geol. Survey Prof. Paper 987, 51 p.

PROJECT TITLE: Hydrology of the Madison Limestone and associated rocks in parts of Montana, North Dakota, South Dakota, and Wyoming (CR 76-192).



COOPERATING AGENCY: None.

PROJECT LEADER: Elliot M. Cushing. (Lakewood, Colorado)

FIELD LOCATION: Northeastern Wyoming, southeastern Montana, southwestern North Dakota, and northwestern South Dakota.

PERIOD OF PROJECT: December 1975 to September 1980.

PROBLEM: Major development of coal within the area will place a heavy demand on the area's limited water resources. Surface water is poorly distributed in time and space. It is fully appropriated in part of the area, and in the rest its use will require storage reservoirs and distribution systems. Preliminary studies indicate that the Madison Limestone and associated rocks might provide a significant percentage of the total water requirements for coal development. However, the effects of large sustained withdrawals of water from these rocks on the hydrologic system are not known.

OBJECTIVE: Evaluate quantity of water that may be available from the Madison, define chemical and physical properties of the water, determine effects of existing developments on potentiometric head, storage, recharge and discharge, spring flow and streamflow, and pattern of ground-water flow, predict possible hydrologic effects of proposed withdrawals of water for large-scale developments at selected rates and locations, determine the better locations for wells and the type of construction and development of deep wells to obtain optimum yields, and design a network of observation wells and streamflow gages to monitor effects of additional developments on the hydrologic system.

APPROACH: Assemble, review, and assess available geologic and hydrologic data, prior studies, and oil company information. Purchase borehole and surface geophysical information and other pertinent data from oil companies. Define structure and stratigraphy; determine aquifer boundaries and geologic parameters that control permeability. Translate these parameters into hydrologic terms. Design test-drilling program; drill and test aquifer. Refine preliminary digital simulation model of system, and design monitoring network. Predict effects of various patterns of water-supply development on potentiometric surface, recharge, discharge, springs, streamflow, and water quality that could result from these developments. Operate monitoring network and refine predictions.

PROGRESS AND SIGNIFICANT RESULTS: Madison Limestone test well 1 was drilled to a depth of 4,341 ft below land surface, had a free-flowing yield at land surface estimated at 650 to 700 gallons per minute, and a shut-in pressure at land surface of about 110 ft. Madison test well 2 was drilled to a depth of 9,378 ft below land surface, had a free-flowing yield at land surface of 44 gallons per minute, and a shut-in pressure of about 770 ft. Began tectonic and structural analysis of Madison Group and associated rocks with respect to environment of deposition and post-depositional movement. Began prepreparation of preliminary struture and lithofacies maps. Geochemical and subsurface geophysical studies, including temperature, aeromagnetics, gravity mapping, seismic lines, and vertical seismic profiles, were continued.

PLANS FOR FISCAL YEAR 1978: Continue tectonic and structural analysis, preparation of preliminary structure and lithofacies maps, and geochemical and subsurface geophysical studies. Prepare specifications, select drilling site, drill, core, and perform preliminary tests in Madison Limestone test well 3.

REPORTS PUBLISHED DURING FISCAL YEAR 1977:

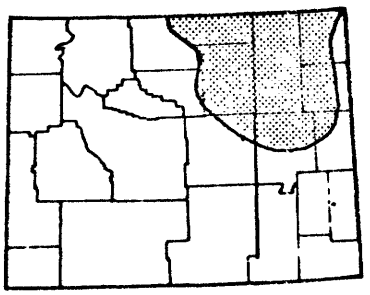
Blankennagel, R. K., Miller, W. R., Brown, D. L., and Cushing, E. M., 1977, Report on preliminary data for Madison Limestone test well 1, NE¼SE¼ sec. 15, T. 57 N., R. 65 W., Crook County, Wyoming: U.S. Geol. Survey Open-File Rept. 77-164, 97 p.

Cushing, E. M., 1977, Description of the Madison aquifer study, Montana, North Dakota, South Dakota, and Wyoming: U.S. Geol. Survey Open-File Rept. 77-514, 8 p.

Cushing, E. M., 1977, The Madison Aquifer Study--Current Status: U.S. Geol. Survey Open-File Rept. 77-692, 12 p.

The following two projects are scheduled to begin during fiscal year 1978 but complete information is not yet available.

PROJECT TITLE: Northern Great Plains regional aquifer assessment (project number not available).



COOPERATING AGENCY: None.

PROJECT LEADER: (Vacant).

FIELD LOCATION: Northeastern Wyoming, eastern Montana, western North Dakota, and northwestern South Dakota.

PERIOD OF PROJECT: Fiscal years 1978 through 1980.

OBJECTIVE: Objectives of the program to assess the availability of water in the Northern Great Plains are those recommended by the National Water Commission in 1973 in its final report sponsored by the United States Congress, with priorities given to those with falling water tables and deteriorating water quality, are to determine: (1) Aquifer boundaries, thickness, saturation, and transmissivity; (2) the suitability of overlying land and wells for artificial recharge programs; (3) depth of water, quality and temperature of water; (4) the storage capacity at various ground-water levels; (5) the source of pollutants found in the aquifer; (6) natural discharge from the aquifer, principal withdrawals, sources and amounts of recharge, anticipated yields, and the effect of pumping on surface supplies; (7) the extent of past ground-water mining and the estimated economic life of the aquifer under various assumptions as to rates of withdrawal; and (8) the susceptibility of the aquifer to operation and management on a "sustained yield" basis.

APPROACH: The first 9 months of the study is designated for collection of existing geologic, hydrologic, and geochemical data. Report outlines will be prepared also the first year, after data compilation is underway.

Drilling, geophysical logging, and testing in test holes is scheduled for late fiscal year 1978, all of fiscal year 1979, and early fiscal year 1980. This phase of the study is delayed to allow adequate time to select drilling sites and to prepare contracts for bid. The large expenditures for drilling, logging, and testing are distributed over all 3 fiscal years of the project in order to effectively utilize the funds budgeted for each fiscal year. Testing includes hydraulic testing in zones isolated by packers, and coring for lab tests; including hydraulic and elastic measurements. Water-quality sampling and analysis from each aquifer penetrated by the test holes is also part of testing.

Preliminary design of simulation models is scheduled to begin the second half of fiscal year 1978, in order to design the framework of the models, to ascertain needed data for models, and to conduct preliminary simulation of hydrologic systems.

Additional data collection beginning in late fiscal year 1978 includes well and spring inventory, aquifer testing, and gain-and-loss studies. Well and spring inventory are needed in the remote parts of the area to provide data on the potentiometric surface, water quality, water use and discharge, and to identify wells suitable for further testing. Aquifer testing of existing wells will continue for a large part of the project duration in order to obtain data needed for modeling and analytical calculations. Gain-and-loss studies in selected streams are needed in order to identify areas of natural recharge by streams, and discharge to streams for exposed aquifers. Repetitive measurements through a 21-month period permit calculation of rates of recharge and discharge.

Preparation of geologic, hydrologic, and geochemical maps begins in late fiscal year 1978 and continues to the middle of fiscal year 1980. Resulting maps will be published in technical reports and provide input data for hydrologic models, geochemical models, and water-management analyses. Geologic maps include structure-contour maps, tectonic maps, and lithofacies maps. Hydrologic maps include saturated thickness, potentiometric surface, transmissivity, and storage. Geochemical maps include water type as related to flow systems, pollution, and special studies, as needed.

A series of professional papers is proposed to describe results of each project. Chapters of each professional paper would cover the geology, configuration, tectonics, hydrology, and geochemistry of each project. A combined report on modeling of the Madison and Northern Great Plains projects is planned in order to describe multilayered system analysis. The modeling report would describe hydrologic and geochemical modeling, including analysis of water-management alternatives.

A preliminary coarse-mesh simulation model will be prepared beginning in fiscal year 1979. The model is proposed to include the following areas: Williston Basin; Power River Basin; Hogeland Basin and north-central Montana; and Bull Mountains Basin. The model will integrate all data and simulate the flow systems, including water quality as related to the flow systems. Carefully prepared and calibrated models will be prepared during fiscal year 1979 and fiscal year 1980. The models form the basis for later water-management studies.

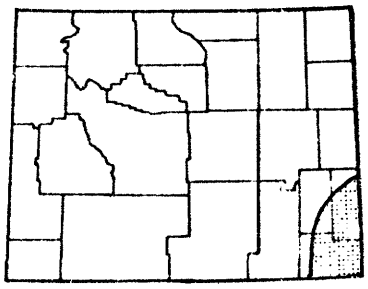
Water-management alternatives will be appraised late in fiscal year 1979 and during most of fiscal year 1980. The effects of normal use, drouth, and coal mining on the aquifers, water quality, and land surface will be simulated. Schemes to improve water use will be designed and tested using the simulation models and techniques of systems analysis.

PROJECT TITLE: High Plains regional aquifer-system analysis (project number not available).

COOPERATING AGENCY: None.

PROJECT LEADER: John B. Weeks. (Lakewood, Colorado)

FIELD LOCATION: Southeastern Wyoming, south-central South Dakota, Nebraska, eastern Colorado, western Kansas, western Oklahoma, western Texas, and eastern New Mexico.



PERIOD OF PROJECT: Fiscal years 1978 through 1982.

PROBLEM: The High Plains is a discontinuous upland area of about 150,000 mi^2 extending from southern South Dakota to western Texas and eastern New Mexico. The Ogallala Formation is the principal aquifer underlying the High Plains, which includes about 23 percent of the irrigated land in the United States. The aquifer contains on the order of 2 billion acre-ft of water in storage; but, water is being withdrawn for irrigation in excess of the rate of natural replenishment. The economic future of the High Plains and the surrounding region in eight states (Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming) is heavily dependent upon the capacity of the aquifer to sustain withdrawals.

Several water-management options have been proposed, including those (1) to extend the life of the aquifer by artificial recharge, more efficient soil and water-management practices, and limiting annual withdrawal; (2) to supplement the water in the region by weather modification and water importation; and (3) to allow unrestricted water use. Local, regional, and National interests are vitally concerned about the future of the ground-water supply and its impact on the economy of the region. A comprehensive knowledge of the hydrologic system of the High Plains is required so that water-management alternatives can be evaluated and the economic life of the aquifer can be projected.

OBJECTIVE: The objectives of the study of the High Plains aquifer system are (1) to describe the water resource and the operation of the hydrologic system; (2) to develop a regional water-resources (and related) data storage and retrieval system; (3) to design and develop a digital computer model (or models) of the High Plains aquifer system; and (4) to evaluate selected ground-water management alternatives to demonstrate the applicability of the model (or models) and provide a hydrologic basis for the economic evaluation of management alternatives.

APPROACH: The objectives of the study will be accomplished through (1) the assembly, compilation, and analysis of existing data; (2) the collection and analysis of data designed to provide information on parameters for which data are lacking; and (3) the development of computer models. Data collection networks will be initiated in those areas where existing networks are inadequate to quantitatively describe the hydrology of the High Plains. The data compiled and collected will become part of a computerized data-management system which will provide a hydrologic (and related) data file for the entire High Plains region.

The purpose of the computerized data file is twofold. First, the data file will provide all input data necessary for the development of a regional model of ground-water flow in the High Plains aquifer system. Second, the data file will provide all users with hydrologic and related data on a scale suitable for local interpretation and modeling. The data-management file will be maintained on the U.S. Geological Survey computer at National Headquarters (possibly within System 2000) to provide maximum accessibility to the file. It is intended that the data file will be periodically updated and maintained for water-resource management purposes beyond the life of this High Plains aquifer study.

Information for several of the hydrologic parameters needed for modeling is not available in adequate detail to provide regional and (or) historical variations in the value of the parameter. This is particularly true of recharge, pumpage, and specific yield data. For these and other parameters where data are sparse or nonexistent, special investigations will be planned and executed to develop the necessary data or estimation techniques to regionalize the data.

Water-level, pumpage, and recharge records are the primary data sets for which historical data must be developed. It is anticipated that water-level records are generally adequate to describe the historical water-level changes in the Ogallala aquifer. However, it is expected that adequate data are not available to describe historical pumpage or recharge for the aquifer. Existing data collection networks for both water levels and pumpage will be reviewed, revised, and expanded as necessary to provide an accurate and extensive data base for the future. Particular emphasis will be placed on developing a monitoring network for determining annual pumpage and consumptive use.

Data on the regional variation of specific yield are not available and will have to be developed during this study. It is anticipated that several methods for estimating specific yield will be funded and studied by this project. The methods will include both field and computer model studies.

The primary product of this project is a computer model of the High Plains aquifer system capable of predicting the future state of the aquifer system given knowledge of the future stress. It is intended that this model will become a ground-water management tool to aid regional, state, and local planners in assessing the impact of management alternatives on the hydrologic and economic future of the aquifer system. The model (or models) will be developed and tested during this study and used to evaluate selected ground-water management alternatives to demonstrate the applicability of the model.

PROGRESS AND SIGNIFICANT RESULTS: None.

PLANS FOR FISCAL YEAR 1978: Work will be started on (1) compilation and review of all existing reports and data; (2) design of a computerized data-management system; (3) evaluate adequacy of existing data; (4) review, revise, and design data-collection networks; and (5) design and initiate special investigations to obtain data where needed.

REPORTS PUBLISHED DURING FISCAL YEAR 1977: None.

SELECTED REFERENCES

A listing of selected references of publications by the U.S. Geological Survey is given in the folder, "Water-Resources Investigations in Wyoming, 1976". A more complete State list of reports is given in a pamphlet, "Geologic and Water-Supply Reports and Maps--Wyoming". Both pamphlets may be obtained free on application to the Wyoming District Office of the U.S. Geological Survey. (See p. II for addresses.)

Listed below are additional selected references of recent publications not given in the pamphlets previously mentioned.

Hadley, R. F., and Keefer, W. R., 1975, Some potential effects of surface mining of the Wyodak-Anderson coal in the Gillette area, Campbell County, Wyoming: U.S. Geol. Survey Misc. Geol. Inv. Map I-848-F.

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Steele, T. D., 1976, Coal-resource development alternatives, residuals management, and impacts on the water resources of the Yampa River basin, Colorado and Wyoming: Proc., IWRA symposium on water resources and fossil fuel production, Dusseldorf, Germany, September 7-8, 1976, Article 28, 17 p. (reprint 14 p.).

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