UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PRELIMINARY STUDY OF WASTEWATER MOVEMENT IN AND NEAR GRAND TETON NATIONAL PARK, WYOMING, THROUGH OCTOBER 1976.

Open-File Report 77-275

Prepared in cooperation with

Teton County, Wyoming,

and the

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PRELIMINARY STUDY OF WASTEWATER MOVEMENT IN AND NEAR GRAND TETON NATIONAL PARK, WYOMING, THROUGH OCTOBER 1976.

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ABSTRACT

This report contains basic hydrologic data and describes the investigation by the U.S. Geological Survey in cooperation with Teton County, Wyoming and the National Park Service to determine the effects on nearby lakes and streams of percolating wastewater effluent at three sites in and near Grand Teton National Park. Observation wells were drilled at two of the sites, and water samples were collected from the wells. Sites were established on selected streams to collect water samples and to measure streamflow.

Sufficient data have not been collected at this time to determine in detail the baseline quality of water in the selected streams or the rate, direction, and velocity of movement of percolating effluents. However, theoretical concepts and data collected to date suggest that effluent percolating near Colter Bay Village is most likely moving westward and southwestward toward Swan Lake and Colter Bay. Effluent percolating near Moose is most likely moving southeastward and southward toward the Snake River. Effluents near Flagg Ranch and Huckleberry Hot Springs probably discharge into the Snake River and Polecat Creek, but the amounts are small.

INTRODUCTION

A study was begun in 1974 by the U.S. Geological Survey in cooperation with the National Park Service to determine the effects on nearby lakes and streams of wastewater effluents that percolate from evaporation-percolation lagoons at four sites in Yellowstone National Park and at one site (Colter Bay Village) in Grand Teton National Park. In 1975, the study was expanded to include another site in Grand Teton National Park (Moose) and the collection of hydrologic data at selected sites in cooperation with the Teton County, Wyoming, 208 Planning Agency[1/]. This report is a summary of work and data collected near Colter Bay Village, Moose, Flagg Ranch, and other selected sites in and near Grand Teton National Park (fig. 1).

For use of those readers who may prefer to use metric units rather than English units, the conversion factors for the terms used in this report are listed below:

Inches (in)	X	$2.54 \times 10^{+1}$	= Millimeters
Feet (ft)	X	3.048×10^{-1}	= Meters
Mile (mi)	X	1.609	= Kilometers
Cubic feet per second (ft^3/s)	X	2.832×10^{-2}	= Cubic meters per second

1/ An agency formed as a result of a grant from the U.S. Environmental Protection Agency under Section 208 of the Water Polution Control Act Amendments of 1972 (PL 92-500).

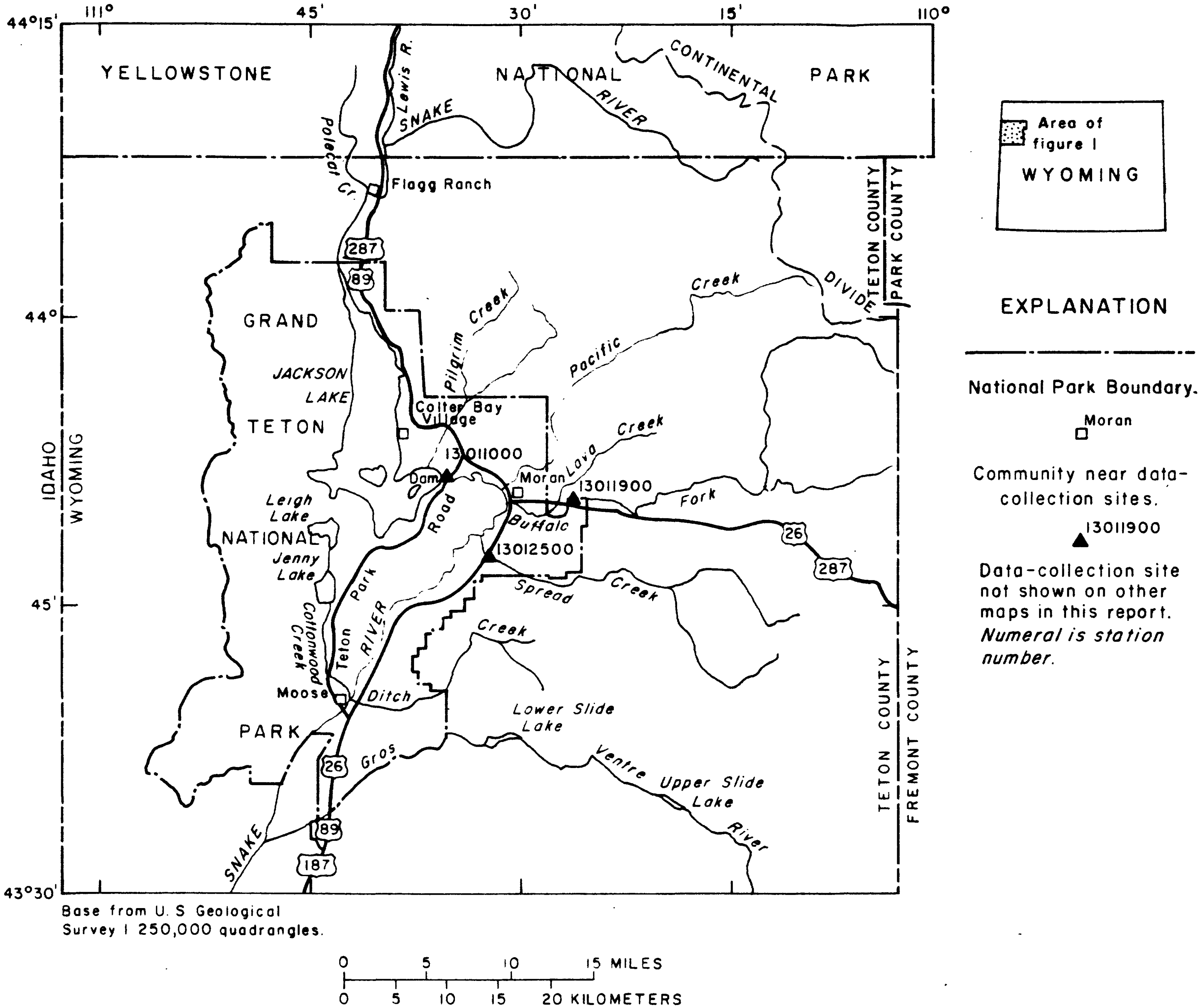

Figure 1.—Selected communities and data-collection sites in and near Grand Teton National Park.

Test holes were made with a cable-tool drill near the Colter Bay Village and Moose sites to study the occurrence of ground water and the nature of the water-bearing materials. The test holes were completed as observation wells by installing 6-in diameter steel casing. Selected intervals of the casing were perforated. The wells were developed by surging and by pumping. Water samples for chemical and bacteriological analyses were collected from the wells by pumping with a portable centrifugal pump and by bailing.

Water levels in the wells were measured periodically. Altitudes of the wells were established by spirit leveling near Colter Bay Village and by interpretation of a topographic map near Moose. Water-level-contour maps were drawn at each site to show the configuration of the water level.

Sites were established on selected streams to collect water samples for chemical and bacteriological analyses and to measure streamflow. Wire-weight gages were installed on railings of highway bridges over the Snake River near Flagg Ranch and near Moose. A staff gage was installed on a pier supporting a bridge over Polecat Creek near Flagg Ranch. A reference mark was established on the highway bridge over Spread Creek near Moran. Staff gages were available for use at gaging stations on Buffalo Fork and the Snake River near Moran.

Water samples were collected during periods of relatively high and of relatively low streamflow and during two periods of intermediate streamflow. Discharge measurements were made at as widely ranging streamflows as possible to establish stage-discharge relationships.

Abbreviations to identify the wells established for this study are used in the text, illustrations, and tables of this report. The first two letters are abbreviations of place names near the sites studied--CB, Colter Bay Village, and MV, Moose (also called Moose Village). The number is a sequential number of the wells near each site. For example, well CB 4 is the fourth well near Colter Bay Village.

As a means of identification, the Geological Survey assigns an eight-digit station number (such as 13010070) to most sites where surface-water data are collected. Where assigned, station numbers are used in this report. The station numbers increase in downstream order. Stations on tributaries are assigned numbers between upstream and downstream stations on main stems. Gaps are left in the numbering system to allow for new stations that may be established. The first two digits of the station number denote the drainage basin. Station numbers beginning with "13" are in Snake River drainage.

The Geological Survey also uses a 15-digit number to identify the location of hydrologic data collection sites. Such numbers have been assigned to sites in this report. The number is based on the universal system of latitude and longitude and a sequential number. The first six digits represent degrees, minutes, and seconds of north latitude; the next seven digits are degrees, minutes, and seconds of west longitude; the last two digits are a sequential number of sites having the same latitude and longitude.

Basic data for this study are tabulated at the back of this report. Records of the observation wells are shown in table 1; logs of the wells are shown in table 2. Chemical and bacteriological analyses of water from wells and a spring are shown in table 3; water levels in wells are shown in table 4. Discharge measurements of streams are shown in table 5; additional gage heights are shown in table 6; chemical and bacteriological analyses of water from streams are shown in table 7.

SITES STUDIED

Data were not collected before wastewater effluents began percolating into ground water near Colter Bay Village, Moose, and Flagg Ranch; therefore, natural conditions are not entirely known. Moreover, sufficient data have not been collected at this time to determine in detail the rate, direction, and velocity of movement of the percolating effluents. However, some generalized interpretations can be made based on theoretical concepts and on data collected to date.

Ground-water mounds probably have built up under the lagoons as percolation of effluents occur, and ground water may move short distances in all directions from the lagoons. The movement of effluents percolating from the lagoons probably is chiefly vertical in the unsaturated zone, and little lateral dispersion commonly takes place above the water table. In the saturated zone below the water table, however, lateral movement and dispersion predominates, and the effluents move toward areas of ground-water discharge (LeGrand, 1965, p. 87-88). The effluents mix with ground water and form plumes containing chemical constituents from the effluents. Each plume tends to move down the hydraulic gradient of the aquifer in a direction perpendicular to the water-level contours. The plume may either spread out as it moves through the aquifer owing to dispersion and diffusion, or it may converge owing to dilution by water outside the plume.

Following are brief descriptions of the sites and summaries and interpretations of data collected at each site:

Colter Bay Village

Wastewater effluent from Colter Bay Village is disposed of in evaporation-percolation lagoons about half a mile east of the village in a valley underlain by alluvial and glacial-outwash deposits (fig. 2). The water-level contours shown in figure 2 indicate the configuration of the water level in the vicinity of the lagoons. Control for the contours are not only the altitude of water level in the wells near the lagoons but also the altitude of water level in a well near Pilgrim Creek and one near Colter Bay and the altitude of the water surface in Pilgrim, Second, and Third Creeks and Jackson Lake. The most likely direction of movement of percolating effluent is westward and southwestward in the area within the heavy dashed lines in figure 2. Based on this interpretation, the plume of ground water containing effluent may eventually reach Swan Lake and Colter Bay.

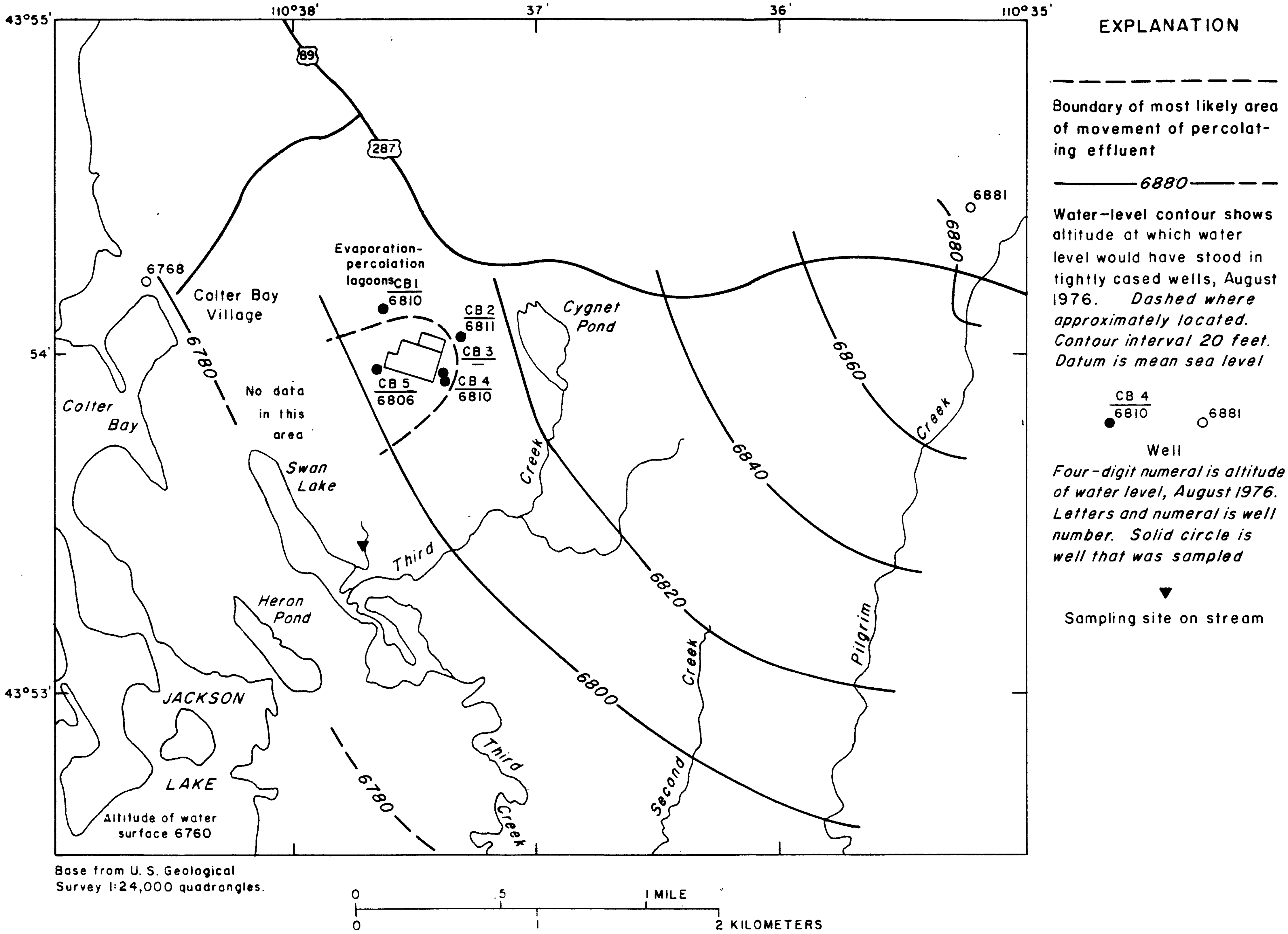

Figure 2.—Data-collection sites and water-level contours near Colter Bay Village.

Moose

Wastewater effluent from Moose is disposed of in an underground percolation area about a quarter of a mile north of the village (fig. 3). The percolation area and the village are on a terrace underlain by alluvial and glacial-outwash deposits about 30 feet above the Snake River. The water-level contours shown in figure 3 indicate the configuration of the water level in the vicinity of the percolation area. Controls for the contours are the altitude of the water level in wells and the altitude of the water surface in springs, the Snake River, Cottonwood and Ditch Creeks, and smaller unnamed streams. The most likely direction of movement of percolating effluent is southeastward and southward in the area within the heavy dashed lines in figure 3. The plume of ground water containing effluent may reach the Snake River.

The discharge of the Snake River at the highway bridge at Moose (station 13013650) was determined from a graph showing the stage-discharge relationship (fig. 4) prepared from discharge measurements and gage heights (table 5).

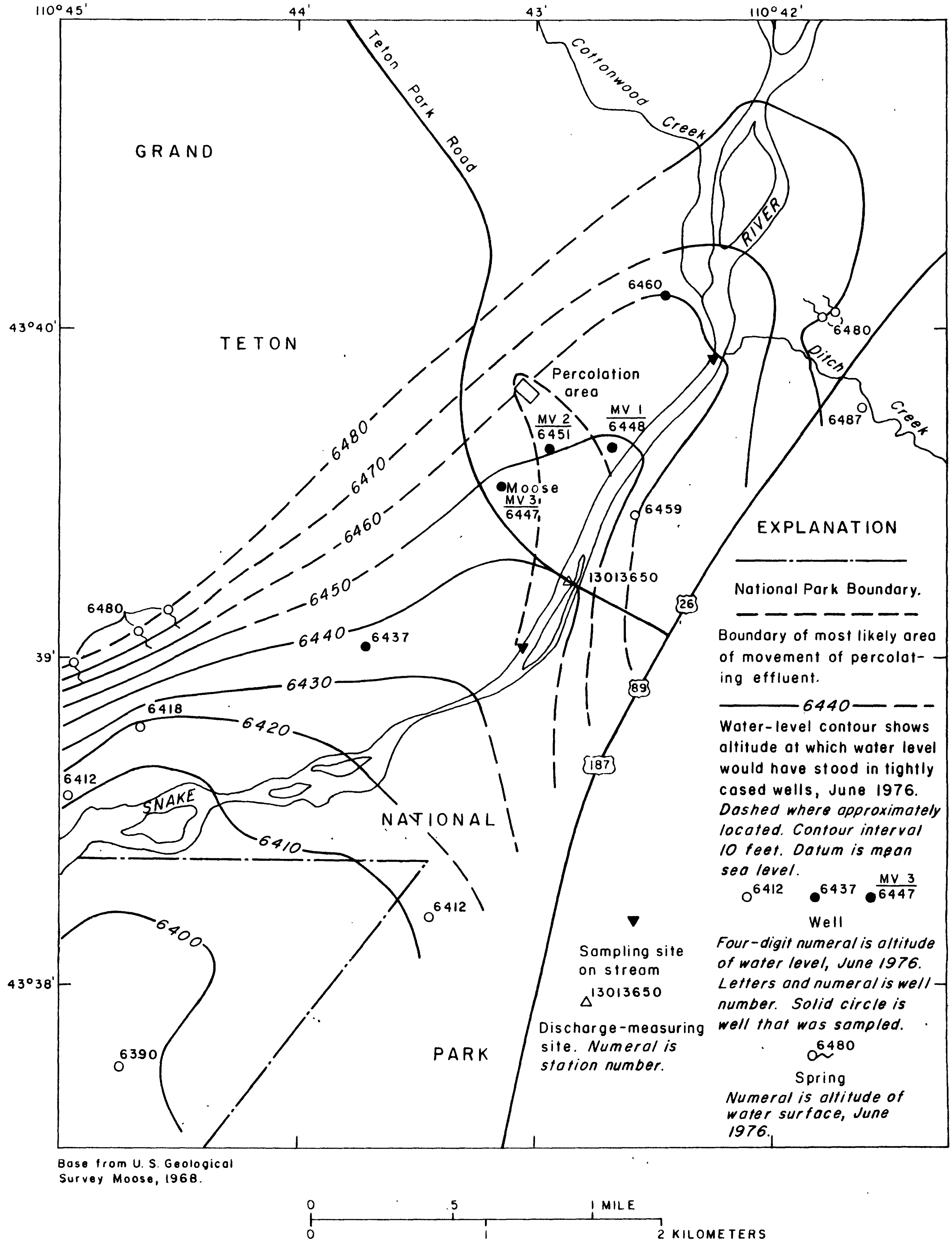

Figure 3.—Data-collection sites and water-level contours near Moose.

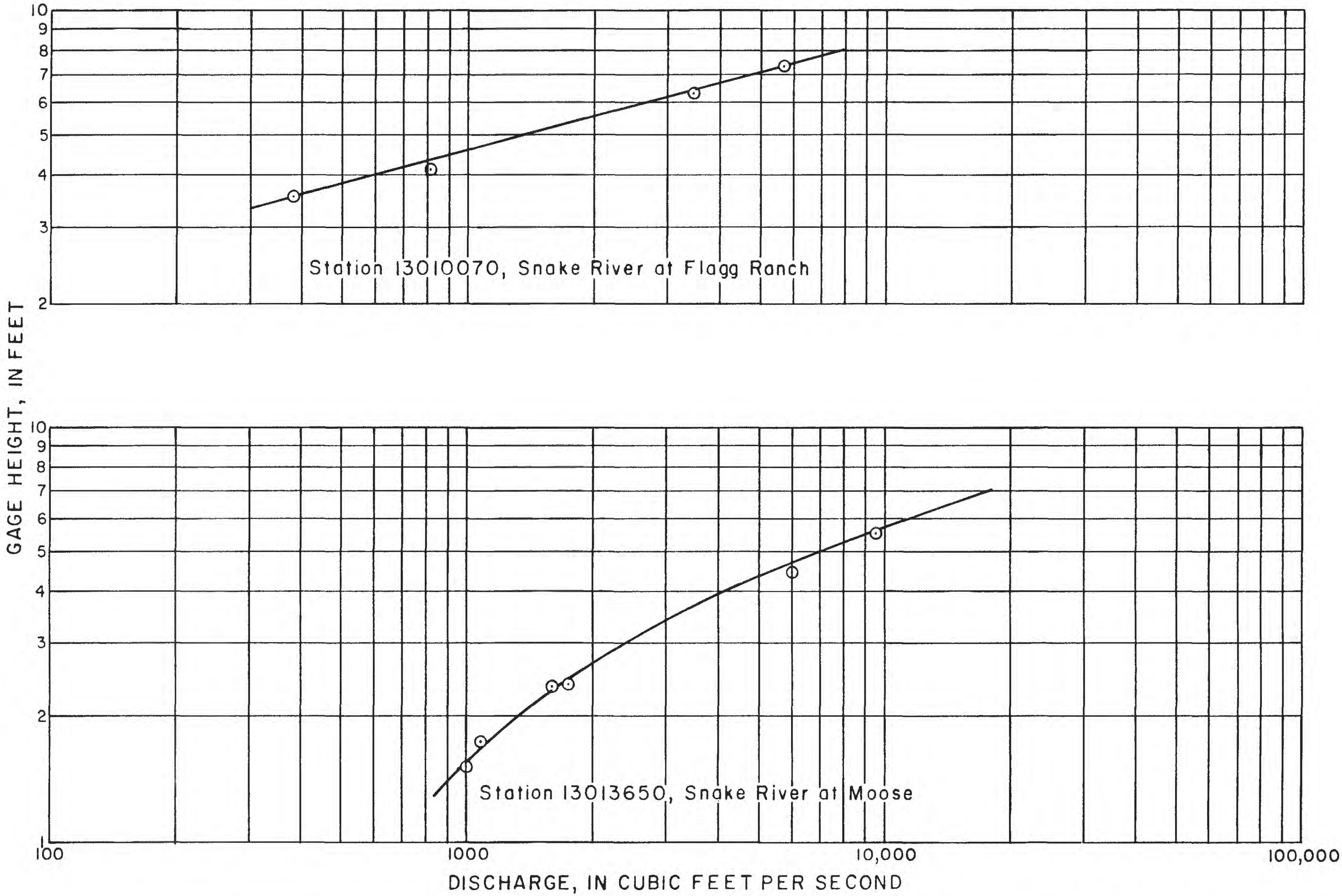

Figure 4.—Stage-discharge relationships of the Snake River at Flagg Ranch

The discharges of the Snake River at the sampling sites above and below Moose were estimated from the discharge at the bridge and previously estimated ground-water inflow. A ground-water inflow of 290 ft^3/s was estimated for the 6-mile reach of the river above the bridge at Moose (Cox, 1976, sheet 3). Assuming the inflow is uniform throughout the 6-mile reach, the inflow between the sampling site above Moose and the bridge (a 1-mile reach) would be about 1/6 of 290, or about 48 ft^3/s. The sampling site below Moose is about a quarter of a mile below the bridge, and the ground-water inflow is estimated to be about 12 ft^3/s in this reach. The discharge of the river at the sampling sites, therefore, was not only estimated from the discharge at the bridge but also was rounded to show a 60 ft^3/s difference in discharge between the sampling sites.

The concentrations of some chemical constituents were greater at the sampling site below Moose than at similar times at the sampling site above Moose (table 7). The greater values of dissolved solids in tons per day at the sampling site below Moose seem to indicate the discharge of ground water into the river between the sampling sites.

Ground water west of the Snake River near Moose generally contains 50 to 100 mg/L dissolved solids (table 3). The quality of water east of the river is not known. A discharge of 60 ft^3/s of ground water with dissolved solids of 100 mg/L would yield only 16 tons per day dissolved solids. This is much less than the apparent gain of from 29 to 443 tons per day of dissolved solids in the reach of the river between the sampling sites as indicated in table 7.

The samples at both sites were collected near the west bank of the river, and they may not represent the concentrations in the entire river. Moreover, Cottonwood and Ditch Creeks flow into the Snake River just above the site above Moose (fig. 3), and waters from the three streams are not well mixed at the sampling site. The flows of Cottonwood and Ditch Creeks, however, are small compared to the flow of the Snake River. Samples that represent conditions in the entire river are needed to determine changes near Moose.

Flagg Ranch

Wastewater effluent from Flagg Ranch is disposed of in a small evaporation-percolation lagoon about half a mile west of the main building of the community and about a quarter of a mile north of the Snake River (fig. 5). Another small lagoon is located near the west bank of Polecat Creek and is used for disposal of effluent from tourist facilities at Huckleberry Hot Springs (fig. 5). Both lagoons are underlain by alluvial deposits of sand and gravel. Additional disposal of effluent is by septic tanks in the vicinity of Flagg Ranch. Effluents from Flagg Ranch and Huckleberry Hot Springs facilities probably discharge into the Snake River and Polecat Creek, respectively, because the lagoons and septic tanks are near the streams.

The discharge of the Snake River at the highway bridge at Flagg Ranch (station 13010070) was determined from a graph showing the stage-discharge relationship (fig. 4) prepared from discharge measurements and gage heights (table 5). The discharge of Polecat Creek near Flagg Ranch (station 13010170) was determined by measurements as much as possible because the stage-discharge relationship is unreliable owing to plant growth in the stream. The discharge of the Snake River above Jackson Lake near Flagg Ranch (station 13010200) was determined by adding the discharge of the river at Flagg Ranch and the discharge of Polecat Creek near Flagg Ranch. The discharge of Polecat Creek near Huckleberry Hot Springs was estimated based on the discharge of Polecat Creek near Flagg Ranch and an unnamed tributary to the creek between the stations (fig. 5).

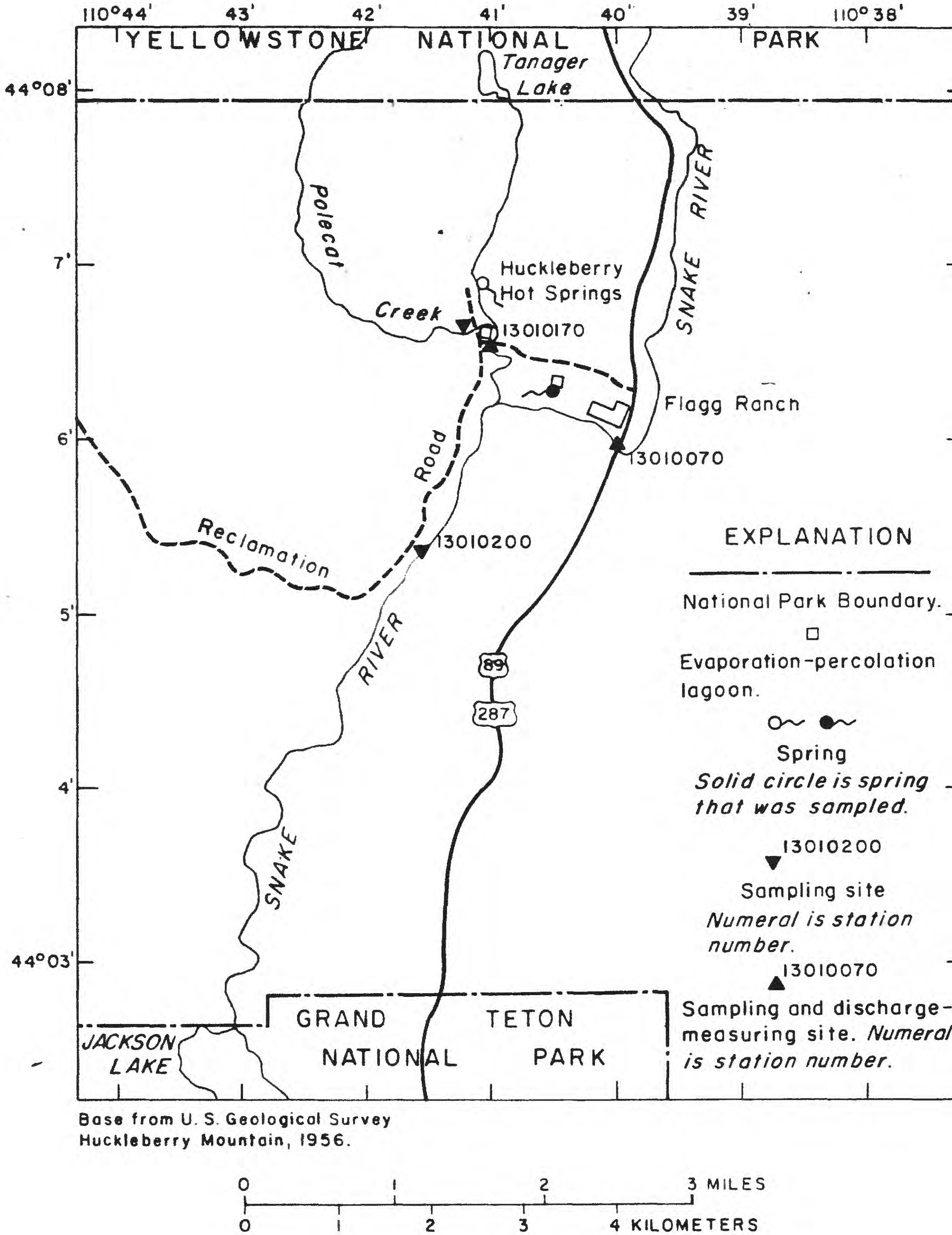

Figure 5.—Data-collection sites near Flagg Ranch.

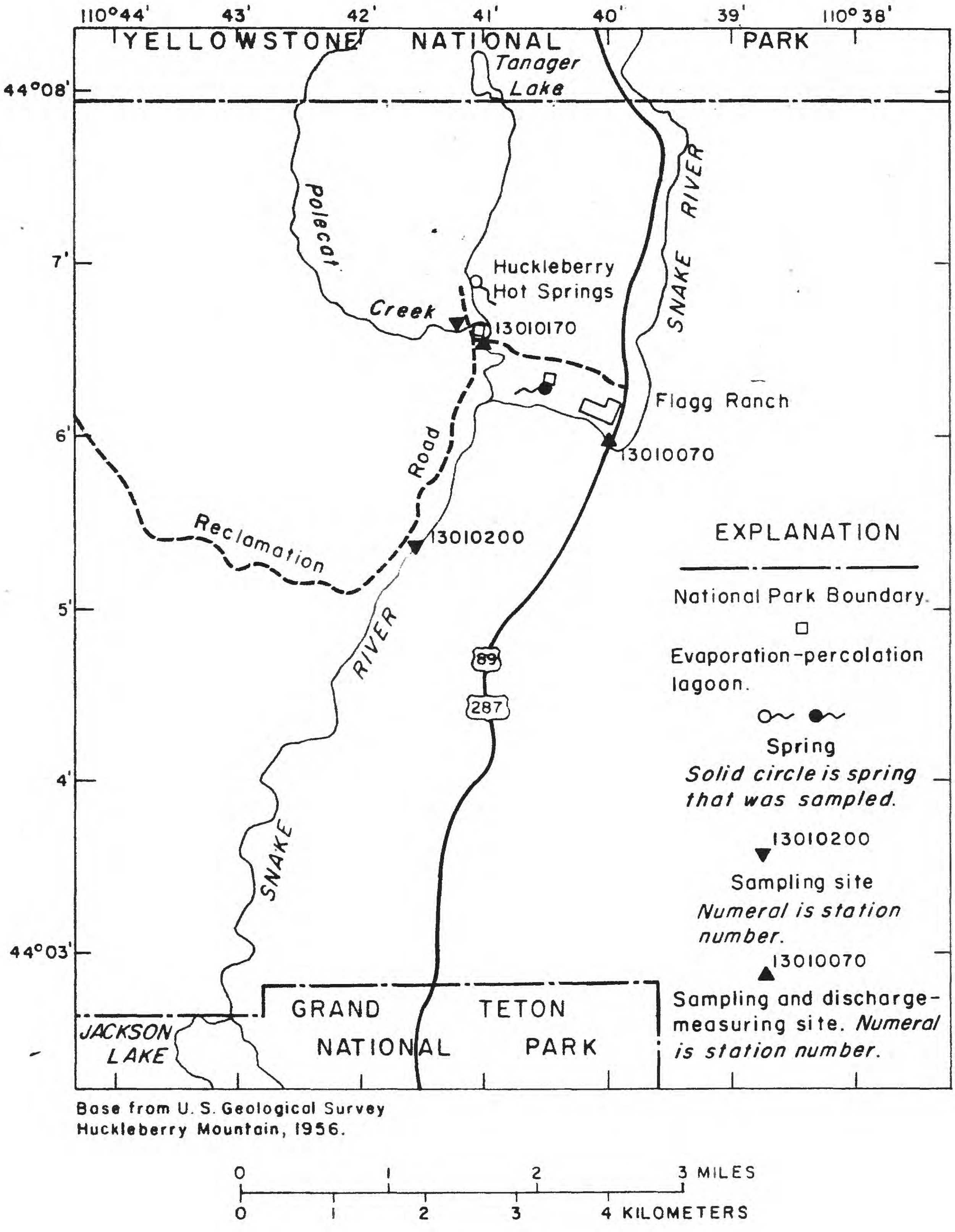

Figure 5.—Data-collection sites near Flagg Ranch.

Ground water containing wastewater effluent probably discharges into the Snake River and Polecat Creek near Flagg Ranch and Huckleberry Hot Springs, but the amount is probably small. The values of dissolved solids in tons per day of the Snake River at Flagg Ranch plus those of Polecat Creek near Flagg Ranch are within 3 percent of those of the Snake River above Jackson Lake near Flagg Ranch (table 7). This is within the expected margin of error for most determinations of discharge and loads of chemical constituents.

Miscellaneous Sites

Data were collected at three miscellaneous sites on streams near Moran (fig. 1) to determine the baseline quality of water in the streams. Originally, the miscellaneous data-collection sites selected were Snake River near Moran (station 13011000) and Buffalo Fork above Lava Creek near Moran (station 13011900), both of which are Geological Survey gaging stations. In 1976, the Teton County 208 Planning Agency requested that the Snake River near Moran site be discontinued for this study and that a site on Spread Creek (station 13012500) be established.

The discharges of the Snake River and Buffalo Fork near Moran were determined from stage-discharge relationships established at the gaging stations. The discharge of Spread Creek was determined by measurements as much as possible, or by stage-discharge relationship. The establishment of a good stage-discharge relationship for Spread Creek was not possible because channelization work under the highway bridge sometimes diverted the stream away from the reference mark on the bridge.

FUTURE WORK

The data collected to date are not sufficient to define the hydrologic conditions underground or in the streams or to determine the effects on lakes and streams of the percolating effluents.

Chemical and bacteriological analyses of water samples from the streams, collected three or four times a year at high, intermediate, and low flows for another year or two, should indicate the baseline quality of water in the streams. Additional streamflow measurements are needed to determine discharge or to refine the stage-discharge relationships.

Additional sampling of the Snake River is needed to establish conditions at the sites above and below Moose. Samples that represent the entire stream during low flow may yield data that would indicate the effects on the stream of percolating effluent.

Additional samples from the observation wells near Colter Bay Village and Moose are needed. Additional wells in the Moose area should be sampled to determine the quality of ground water that discharges into the Snake River near Moose.

Additional observation wells are needed in the area between the Colter Bay Village lagoons and Swan Lake to define subsurface hydrologic conditions. The area is not accessible with truck-mounted well-drilling machines without extensive road building. However, shallow monitoring wells might be established by driving well points and pipe by hand.

CONCLUSIONS

Sufficient data have not been collected at this time to determine in detail the baseline quality of water in the selected streams or the rate, direction, and velocity of movement of percolating effluents.

Ground-water mounds probably have built up under areas of percolating effluent. The percolating effluents mix with ground water and form plumes containing chemical constituents from the effluents. Each plume tends to move down the hydraulic gradient of the aquifer in a direction perpendicular to the water-level contours.

Data collected to date suggests that effluent percolating from lagoons near Colter Bay Village is most likely moving westward and southwestward toward Swan Lake and Colter Bay. Effluent percolating near Moose is most likely moving southeastward and southward toward the Snake River. Effluents near Flagg Ranch and Huckleberry Hot Springs probably discharge into the Snake River and Polecat Creek, but the amounts are small.

REFERENCES CITED

Cox, E. R., 1976, Water resources of northwestern Wyoming: U.S. Geol. Survey Hydrol. Inv. Atlas HA-558, 3 sheets.

LeGrand, H. E., 1965, Patterns of contaminated zones of water in the ground: Water Resources Research, v. 1, no. 1, p. 83-95.

BASIC DATA

Table 1.--Records of observation wells near percolating wastewater effluents in Grand Teton National Park

Well	Identification number	Well depth (ft)	Well cased (ft)	Interval perforated (ft)	Date completed	Altitude of land surface (ft above mean sea level)
CB 1	435407110374001	37	36	29-30	6- 2-75	6,820.0
CB 2	435403110372001	36	35	21-23	6- 5-75	6,820.4
CB 3	435355110372401	34	34	20-21	6-10-75	6,815.1
CB 4	435354110372401	44	44	21-22 31-32	8-11-75	6,814.9
CB 5	435357110374101	39	39	17-18 32-33	8-14-75	6,810.2
MV 1	433939110424001	49	48	35-36	1-16-76	6,460
MV 2	433939110425601	49	49	15-16 34-35	6- 1-76	6,462
MV 3	433932110430801	49	49	38-39 42-43 45-46	1-22-76	6,455

Table 2.--Logs of observation wells near percolating wastewater effluents in Grand Teton National Park

Lithology and hydrology	Thickness (ft)	Depth (ft)
CB 1, 435407110374001		
Silt, clay, and gravel, brown	1	1
Sand, gravel, and cobbles; contains many large cobbles and boulders from 4 to 14 feet	13	14
Sand and gravel, dry, poorly sorted; contains small cobbles; contains silt	14.5	28.5
Sand and gravel, fairly well sorted; sand is mostly coarse and very coarse grained; gravel is fine; water at 28.5 feet	2.5	31
Silt, sand, and gravel, poorly sorted; dry from 31 to 36 feet	6	37

Table 2.--Logs of observation wells near percolating wastewater effluents--continued

Lithology and hydrology	Thickness (ft)	Depth (ft)
CB 2, 435403110372001		
Clay, silt, and gravel------------------------------------	1	1
Sand, gravel, cobbles, and boulders, dry, poorly sorted---	13	14
Sand and gravel, moist------------------------------------	6.5	20.5
Sand and gravel, fairly well sorted; sand is mostly coarse and very coarse grained; gravel is fine; water at 20.5 feet---	3	23.5
Silt, sand, and gravel, dry, poorly sorted----------------	6	29.5
Sand, coarse-grained and very coarse grained, fairly well sorted; contains some fine gravel; contains small amount of water---	1.5	31
Silt, sand, and gravel, poorly sorted; contains very small amount of water-----------------------------------	5	36
CB 3, 435355110372401		
Silt, clay, and gravel------------------------------------	1	1
Gravel and cobbles, dry, poorly sorted--------------------	11	12
Sand, coarse-grained; contains a small amount of water----	2	14
Sand, gravel, and silt, poorly sorted, dry----------------	6	20
Sand and gravel; contains water---------------------------	2	22
Silt, sand, and gravel, poorly sorted; contains very small amount of water-----------------------------------	12	34

Table 2.--Logs of observation wells near percolating wastewater effluents--continued

Lithology and hydrology	Thickness (ft)	Depth (ft)
CB 4, 435354110372401		
Clay, gravel, and cobbles; clay is brown	14	14
Silt and gravel; silt is reddish brown; water at 14 feet	7	21
Silt and gravel; gravel is fine; silt is reddish brown	4	25
Silt and gravel; silt is reddish brown	7	32
Clay, gravel, and cobbles; clay is silty	12	44
CB 5, 435357110374101		
Silt and sand	1	1
Gravel and cobbles	9	10
Gravel; water at 10 feet	7	17
Gravel and clay; clay is gray	4	21
Gravel and silt; silt is brown	3	24
Sand, coarse-grained	7	31
Gravel	8	39
MV 1, 433939110424001		
Silt and sand	1	1
Gravel, cobbles, and boulders	11	12
Silt, sand, and gravel	23	35
Sand; contains gravel; water at 35 feet	12	47
Gravel and cobbles	2	49

Table 2.--Logs of observation wells near percolating wastewater effluents--continued

Lithology and hydrology	Thickness (ft)	Depth (ft)
MV 2, 433939110425601		
Silt and sand	1	1
Gravel, cobbles, and boulders	12	13
Sand, gravel, and cobbles; sand is coarse below 34 feet; water at 14 feet; more water at 34 feet	24	37
Sand; contains fine gravel	12	49
MV 3, 433932110430801		
Silt and sand	2	2
Silt, sand, gravel, and cobbles; water at 16 feet	19	21
Gravel and cobbles; contains sand	17	38
Sand and gravel	11	49

Table 3.--Chemical and bacteriological analyses of water from selected wastewater effluents, wells, and a spring in and near Grand Teton National Park

[Analytical results in milligrams per liter (mg/L) or micrograms per liter (μg/L), except as indicated.

Analyses by U.S. Geological Survey, except total coliform bacteria by National Park Service.]

Well	Identification no.	Date of collection	Well depth (ft)	Temperature (°C)	Dissolved Silica (SiO_2) (mg/L)	Dissolved Iron (Fe) (μg/L)	Dissolved Calcium (Ca) (mg/L)	Dissolved Magnesium (Mg) (mg/L)	Dissolved Sodium (Na) (mg/L)	Dissolved Potassium (K)[1] (mg/L)	Bicarbonate (HCO_3) (mg/L)	Carbonate (CO_3) (mg/L)	Dissolved Sulfate (SO_4) (mg/L)	Dissolved Chloride (Cl) (mg/L)	Dissolved Fluoride (F) (mg/L)	Dissolved Nitrite plus Nitrate (N) (mg/L)	Total Kjeldahl Nitrogen (N) (mg/L)	Total Phosphate (PO_4) (mg/L)	Total Ortho Phosphorus (P) (mg/L)	Total Phosphorus (P) (mg/L)	Dissolved Organic Carbon (C) (mg/L)	Dissolved solids (Sum of constituents) (mg/L)	Hardness (Ca, Mg) (mg/L)	Specific conductance (micromhos)	pH (units)	Dissolved Oxygen (mg/L)	Biochemical Oxygen demand (5 day) (mg/L)	Turbidity (Jackson turbidity units)	Fecal Coliform bacteria (colonies per 100 milliliters)	Total Coliform bacteria (colonies per 100 milliliters)	Suspended solids (mg/L)
CB Effluent	435400110373501	9-10-75	--	16.0	20	100	31	5.8	64	16	111	0	19	36	0.1	24	8.8	-----	----	9.0	24	353	100	580	7.6	---	---	--	--	-	--
CB 1	435407110374001	7-15-75	37	5.5	17	510	8.5	1.7	2.2	.7	33	0	2.8	.5	.1	.11	.30	-----	----	.13	1.6	51	28	70	5.3	---	---	--	--	-	--
		9-15-76	37	6.5	16	130	7.3	2.0	2.4	.7	32	0	5.7	.8	.1	.17	.00	-----	----	.06	1.3	52	26	70	5.8	---	---	--	--	-	--
CB 2	435403110372001	7-17-75	36	6.0	16	700	13	1.8	2.1	.9	58	0	2.3	.5	.1	.15	.12	-----	----	----	.7	67	40	110	---	---	---	--	--	-	--
		9-15-76	36	9.0	17	40	12	2.6	2.3	.8	47	0	4.7	.8	.1	.27	.00	-----	----	.04	.8	65	41	90	6.3	---	---	--	--	-	--
CB 3	435355110372401	7-15-75	34	5.0	8.8	3,600	8.6	1.3	1.8	.9	40	0	2.4	.7	.1	.04	.34	-----	----	----	.8	48	27	90	---	---	---	--	--	-	--
CB 4	435354110372401	8-13-75	44	8.5	16	510	13	2.3	2.2	.9	53	0	2.6	.5	.1	.15	.04	-----	----	.20	1.4	65	42	110	8.0	---	---	--	--	-	--
		9-16-76	44	7.5	17	90	12	2.9	2.0	.8	55	0	5.1	.5	.1	.13	.00	-----	----	.19	10	68	42	95	6.3	---	---	--	--	-	--
CB 5	435357110374101	9-10-75	39	11.5	12	220	14	3.2	12	1.5	79	0	3.0	5.9	.1	.08	.81	-----	----	.15	6.3	91	48	155	5.5	---	---	--	--	-	--
		9-16-76	39	10.5	12	890	27	6.2	19	2.1	78	0	7.7	48	.1	.01	.63	-----	----	.03	3.8	161	93	320	6.1	---	---	--	--	-	--
MV Effluent	433949110430201	8- 6-76	--	16.5	2.7	100	9.1	1.6	18	8.8	20	0	11	19	.0	6.9	2.4	16	4.3	5.3	7.9	111	29	220	6.4	---	---	--	--	-	45
MV 1	433939110424001	6-28-76	49	10.0	7.8	10	32	5.7	1.1	1.1	130	0	3.9	1.2	.1	-----	.05	-----	----	.03	.7	117	100	220	7.7	2.7	3.6	--	<1	-	--
		8-22-76	49	10.0	7.3	30	30	5.0	1.4	1.3	110	0	2.0	.6	.2	.16	.40	.00	.00	.00	2.1	103	96	200	7.8	1.4	1.0	10	<1	-	--
MV 2	433939110425601	6-28-76	49	8.0	8.0	10	19	3.8	1.1	.7	84	0	6.3	2.3	.1	-----	.25	-----	----	.05	.9	83	63	140	7.6	---	1.7	--	<1	-	--
		8-22-76	49	9.0	7.2	30	20	3.8	1.5	1.1	74	0	4.1	.8	.1	.15	.15	.00	.01	.00	1.3	76	66	150	7.6	4.8	2.2	2	<1	-	--
MV 3	433932110430801	6-28-76	49	7.0	2.1	50	11	2.2	1.5	1.1	50	0	4.6	1.3	.1	-----	.35	-----	----	.06	1.2	49	37	90	8.4	---	1.9	--	<1	-	--
		8-22-76	49	9.0	6.3	20	15	2.7	1.4	.9	53	0	4.1	.8	.1	.29	.35	.00	.01	.00	1.4	59	49	110	8.2	1.6	1.4	2	<1	-	--
4 Lazy F	434007110422701	10-13-76	55	10.0	6.9	0	13	2.6	1.0	.7	49	0	2.6	.3	.0	.09	.27	.03	.02	.01	1.5	52	43	90	8.5	---	.1	--	--	0	--
Murie	433902110434301	10-13-76	35	7.0	8.4	0	17	3.6	1.1	.8	64	0	2.6	.5	.1	.15	.00	.03	.02	.01	.3	66	57	115	7.6	---	.4	--	--	1	--
Spring near Flagg Ranch	440613110402801	8- 4-76	--	7.0	27	20	27	5.3	18	3.4	120	0	21	9.3	1.4	.09	.10	-----	----	.02	15	172	89	270	7.1	---	---	--	--	-	--

< Less than value shown.

Table 4.--Water levels in observation wells near percolating wastewater effluents in Grand Teton National Park

Date	Water level (ft below land surface)	Date	Water level (ft below land surface)	Date	Water level (ft below land surface)	Date	Water level (ft below land surface)
CB 1, 435407110374001							
6- 3-75	0.93	6- 5-76	5.49				
6-16	5.20	7-13	9.19				
7-15	8.65	8- 2	9.79				
8- 4	9.50	8-31	10.24				
8-13	9.97	9-15	10.38				
9- 3	10.32	10-14	10.65				
10- 2	10.64						
10-16	10.76						
CB 2, 435403110372001							
6- 5-75	4.16	6- 5-76	6.25				
6-16	5.92	7-13	8.90				
7-15	8.67	8- 2	9.17				
8- 4	9.01	8-31	9.65				
8-13	9.76	9-15	9.71				
9- 3	9.83	10-14	10.00				
10- 2	10.23						
10-16	10.39						
CB 3, 435355110372401							
6-16-75	2.81						
7-15	4.31						
8- 4	4.57						
8-13	5.19						
CB 4, 435354110372401							
8-13-75	4.85	6- 5-76	2.70				
9- 3	4.91	7-13	4.18				
10- 2	5.21	8- 2	4.25				
10-16	5.28	8-31	4.72				
		9-16	4.75				
		10-14	5.02				

Table 4.--Water levels in observation wells near percolating wastewater effluents--continued

Date	Water level (ft below land surface)	Date	Water level (ft below land surface)	Date	Water level (ft below land surface)	Date	Water level (ft below land surface)
CB 5, 435357110374101							
9- 3-75	3.61	6- 5-76	3.07				
9-10	3.64	7-13	3.56				
10- 2	3.94	8- 2	3.60				
10-16	3.91	8-13	3.82				
		9-16	3.85				
		10-14	3.88				
MV 1, 433939110424001							
		6- 3-76	10.97				
		6-23	11.99				
		6-28	12.58				
		7-17	13.05				
		8- 6	13.26				
		8-22	13.31				
		9-17	15.36				
		10.13	16.08				
MV 2, 433939110425601							
		6- 6-76	10.21				
		6-23	11.10				
		6-28	11.43				
		7-17	12.08				
		8- 6	12.32				
		8-22	12.53				
		9-17	13.78				
		10-13	14.88				
MV 3, 433932110430801							
		6- 3-76	6.95				
		6-23	7.81				
		6-28	8.10				
		7-17	8.72				
		8- 6	8.83				
		8-22	8.99				
		9-17	10.12				
		10-13	11.16				

Table 5.--Discharge measurements at selected sites on streams in and near Grand Teton National Park

Station no.	Stream	Date	Gage height (ft)	Discharge (ft^3/s)
13010070	Snake River at Flagg Ranch	11- 4-75	3.55	383
		6- 8-76	7.28	5,630
		6-18-76	6.34	3,490
		7-25-76	4.16	818
13010170	Polecat Creek near Flagg Ranch	9-27-73	-----	59.4
		11- 4-75	.67	55.6
		6- 9-76	1.84	193
		6-18-76	1.47	174
		6-27-76	1.20	133
		7-25-76	1.36	109
		10-12-76	.98	79.5
13012500	Spread Creek near Moran	6- 5-71	-----	469
		8-18-71	-----	11.4
		10-18-72	-----	57.0
		6-12-76	1/ 12.90	335
		6-20-76	1/ 13.30	218
		7-25-76	1/ 14.25	34.6
		10-11-76	-----	49.6
13013650	Snake River at Moose	10-14-71	2.38	1,570
		10-16-72	2.40	1,720
		10-25-73	1.76	1,060
		11- 5-75	1.51	981
		6- 9-76	5.54	9,500
		7-25-76	4.45	5,950

1/ Reference point on bridge to water surface.

Table 6.--Gage heights at selected sites on streams in and near Grand Teton National Park

Station no.	Stream	Date	Time (24 hrs)	Gage height (ft)
13010070	Snake River at Flagg Ranch	11- 4-75	1330	3.55
		11- 6-75	1420	3.52
		5- 5-76	1650	4.32
		5-18-76	1930	7.07
		6- 3-76	0950	7.65
			1935	7.71
		6- 4-76	0915	7.57
			1705	7.42
		6- 7-76	1050	7.47
		6- 8-76	1055	7.30
			1250	7.25
		6-18-76	1100	6.34
		6-23-76	1415	6.29
		6-27-76	0750	5.76
		7-13-76	1920	4.73
		7-17-76	1330	4.42
		7-25-76	0920	4.16
		8- 4-76	1550	4.01
		8-21-76	1700	3.68
		8-31-76	0945	3.62
		9-15-76	1605	3.55
		9-30-76	1735	3.50
		10-14-76	1315	3.45
		10-20-76	1610	3.37

Table 6.--Gage heights at selected sites on streams--continued

Station no.	Stream	Date	Time (24 hrs)	Gage height (ft)
13010170	Polecat Creek near Flagg Ranch	11- 4-75	1500	0.67
		6- 3-76	0900	1.78
			1925	1.70
		6- 4-76	0930	1.83
			1655	1.69
		6- 9-76	1020	1.84
		6-18-76	1350	1.47
		6-23-76	1400	1.40
		6-27-76	0905	1.20
		7-17-76	1315	1.27
		7-25-76	0945	1.36
		8- 4-76	1345	1.40
		8-21-76	1810	1.33
		8-31-76	0935	1.28
		9-15-76	1615	1.24
		10-12-76	1110	.98
		10-14-76	1325	.96
		10-20-76	1605	.95

Table 6.--Gage heights at selected sites on streams--continued

Station no.	Stream	Date	Time (24 hrs)	Gage height (ft)
13013650	Snake River at Moose	11- 5-75	1450	1.51
		11- 6-75	0935	1.57
		5-18-76	1840	5.66
		6- 3-76	1030	6.35
			1635	6.18
		6- 6-76	1225	5.66
		6- 9-76	1430	5.56
			1635	5.52
		6-16-76	1540	4.55
		6-23-76	1630	5.17
		6-26-76	1520	4.52
		7-17-76	1430	4.33
		7-24-76	1330	4.45
		7-25-76	1340	4.48
			1500	4.42
		8- 6-76	1635	4.07
		8-21-76	1245	4.29
		8-31-76	1345	3.97
		9-17-76	1105	1.74
		10-13-76	1635	1.55

Table 7.--Chemical and bacteriological analyses of water from selected streams in and near Grand Teton National Park

[Analytical results in milligrams per liter (mg/L) or micrograms per liter (µg/L), except as indicated. Analyses by U.S. Geological Survey.]

Station no.	Stream	Identification no.	Date of collection	Discharge (ft^3/s)	Temperature (°C)	Dissolved Silica (SiO_2) (mg/L)	Dissolved Iron (Fe) (µg/L)	Dissolved Calcium (Ca) (mg/L)	Dissolved Magnesium (Mg) (mg/L)	Dissolved Sodium (Na) (mg/L)	Dissolved Potassium (K) (mg/L)	Bicarbonate (HCO_3) (mg/L)	Carbonate (CO_3) (mg/L)	Dissolved Sulfate (SO_4) (mg/L)	Dissolved Chloride (Cl) (mg/L)	Dissolved Fluoride (F) (mg/L)	Dissolved Nitrite plus Nitrate (N) (mg/L)	Total Kjeldahl Nitrogen (N) (mg/L)	Total Phosphate (PO_4) (mg/L)	Total Ortho Phosphorus (P) (mg/L)	Total Phosphorus (P) (mg/L)	Dissolved Organic Carbon (C) (mg/L)	Dissolved solids (Sum of constituents) (mg/L)	Dissolved solids (Tons per day)	Hardness (Ca, Mg) (mg/L)	Specific conductance (micromhos)	pH (units)	Dissolved Oxygen (mg/L)	Biochemical Oxygen demand (5 day) (mg/L)	Turbidity (Jackson turbidity units)	Fecal Coliform bacteria (colonies per 100 milliliters)	Suspended solids (mg/L)
13010070	Snake River at Flagg Ranch	440557110400001	11- 4-75	383	6.0	33	0	17	2.8	29	4.3	83	0	24	17	2.3	0.00	0.05	----	----	0.00	7.1	170	176	54	260	7.2	----	---	-	---	--
			6-27-76	2,300	6.5	18	60	11	2.1	9.8	1.7	48	0	9.1	4.2	.8	----	.08	0.09	0.01	.03	2.3	80	497	36	120	7.3	9.4	3.7	-	B8	1
			7-24-76	680	21.0	26	70	15	2.5	17	3.5	67	0	18	10	1.4	.06	.57	.03	.02	.01	1.8	127	233	48	200	7.6	7.1	2.2	1	B4	0
			8-21-76	430	17.5	30	20	19	3.2	22	3.9	79	0	24	13	1.9	.08	.62	.00	.00	.00	1.6	156	181	61	250	8.0	8.3	2.1	1	<1	2
			10-12-76	350	8.0	33	20	17	3.1	28	4.3	72	0	27	18	2.1	.01	.45	.00	.03	.00	1.3	168	159	55	260	7.7	10.0	2.0	1	<1	8
--------	Polecat Creek near Huckleberry Hot Springs	440637110410801	8-22-76	100	13.0	53	20	4.5	.8	20	4.1	43	0	4.8	13	2.9	.08	.34	.00	.01	.00	1.0	125	34	15	150	7.5	7.8	---	1	48	1
			10-12-76	75	11.0	58	20	4.5	.6	29	4.5	51	0	4.9	19	3.2	.00	.09	.00	.05	.00	.6	149	30	14	200	7.5	9.5	1.4	1	B6	11
13010170	Polecat Creek near Flagg Ranch	440631110410001	11- 4-75	55.6	15.0	58	20	7.9	1.1	40	4.7	83	0	4.8	21	3.2	.00	.04	----	----	.02	1.7	182	27	24	230	7.7	----	---	-	---	--
			6-27-76	133	13.0	5.0	20	3.5	.6	21	3.0	46	0	4.2	9.3	2.2	----	.20	.09	.01	.03	1.3	72	26	11	125	7.3	9.1	2.3	3	20	1
			7-25-76	109	17.0	49	40	4.6	.5	21	4.3	50	0	5.2	12	2.7	.06	.14	.06	.04	.02	1.9	124	36	14	150	7.5	8.0	2.0	2	B14	3
			8-21-76	105	22.0	54	30	4.9	.7	23	4.0	48	0	5.1	14	2.9	.06	.32	.03	.01	.01	1.2	133	38	15	165	7.9	7.5	2.8	1	B15	0
			10-12-76	79.5	11.5	60	20	4.7	.6	33	4.5	67	0	5.3	19	3.3	.00	.05	.00	.05	.00	.7	163	35	14	220	7.7	10.1	2.0	1	B8	12
13010200	Snake River above Jackson Lake near Flagg Ranch	440521110413801	11- 4-75	440	8.0	36	10	15	2.8	31	4.3	80	0	21	18	2.3	.00	.12	----	----	.01	1.8	170	202	49	250	7.5	----	---	-	---	--
			6-27-76	2,430	6.5	20	40	9.3	1.8	12	1.9	48	0	9.4	4.8	.9	----	.25	.06	.01	.02	2.3	84	551	31	125	7.4	9.4	2.7	5	B4	4
			7-24-76	789	21.5	----	--	----	---	--	---	--	-	----	----	---	----	----	----	----	----	---	---	---	--	190	7.8	7.3	3.8	1	B2	--
			8-21-76	535	18.5	34	30	16	2.5	23	3.9	63	0	22	13	2.0	.07	.50	.00	.02	.00	11	148	214	50	240	8.0	8.1	5.8	1	B1	3
			10-12-76	430	7.0	36	40	15	2.8	29	4.5	74	0	24	19	2.3	.09	.10	.00	.03	.00	4.9	170	197	49	280	7.4	9.4	1.9	1	B16	6
--------	Tributary to Swan Lake near Colter Bay Village	435325110374501	10-16-75	2	6.0	7.3	250	11	2.5	4.9	.9	50	0	1.4	3.8	.1	.04	.49	----	----	.03	7.5	57	.3	38	100	7.5	----	---	-	---	--
13011000	Snake River near Moran	435131110350901	11- 6-75	409	7.5	14	0	14	2.7	10	1.9	62	0	11	5.7	.9	.01	.14	----	----	.00	3.0	91	100	46	145	7.3	----	---	-	---	--

Table 7.--Chemical and bacteriological analyses--continued

Station no.	Stream	Identification no.	Date of collection	Discharge (ft^3/s)	Temperature (°C)	Dissolved Silica (SiO_2) (mg/L)	Dissolved Iron (Fe) (μg/L)	Dissolved Calcium (Ca) (mg/L)	Dissolved Magnesium (Mg) (mg/L)	Dissolved Sodium (Na) (mg/L)	Dissolved Potassium (K) (mg/L)	Bicarbonate (HCO_3) (mg/L)	Carbonate (CO_3) (mg/L)	Dissolved Sulfate (SO_4) (mg/L)	Dissolved Chloride (Cl) (mg/L)	Dissolved Fluoride (F) (mg/L)	Dissolved Nitrite plus Nitrate (N) (mg/L)	Total Kjeldahl Nitrogen (N) (mg/L)	Total Phosphate (PO_4) (mg/L)	Total Ortho Phosphorus (P) (mg/L)	Total Phosphorus (P) (mg/L)	Dissolved Organic Carbon (C) (mg/L)	Dissolved solids (Sum of constituents) (mg/L)	Dissolved solids (Tons per day)	Hardness (Ca, Mg) (mg/L)	Specific conductance (micromhos)	pH (units)	Dissolved Oxygen (mg/L)	Biochemical Oxygen demand (5 day) (mg/L)	Turbidity (Jackson turbidity units)	Fecal Coliform bacteria (colonies per 100 milliliters)	Suspended solids (mg/L)
13011900	Buffalo Fork near Moran	435014110262101	11- 6-75	226	0.5	21	0	25	6.4	5.8	2.2	114	0	7.9	4.1	0.2	0.00	0.00	----	----	0.01	1.2	129	79	89	220	7.6	----	---	-	---	--
			6-27-76	1,630	7.0	19	20	16	3.6	3.2	1.5	68	0	5.1	1.6	.1	----	.18	0.15	0.02	.05	2.0	84	370	55	130	7.5	9.8	3.8	5	B2	7
			7-24-76	1,200	14.0	18	60	12	2.6	2.6	1.7	52	0	3.3	1.5	.1	.01	.42	.12	.05	.04	1.5	68	220	41	100	7.5	8.0	4.3	1	B4	2
			8-22-76	440	11.0	21	20	19	4.3	4.6	2.2	83	0	5.5	2.1	.1	.01	.51	.15	.01	.05	3.4	100	119	65	160	7.7	7.9	2.2	1	B16	3
			10-11-76	255	9.0	21	20	22	5.9	5.4	2.1	94	0	7.1	3.3	.1	.00	.86	.09	.04	.03	7.3	113	78	79	205	7.7	9.2	1.8	1	<1	10
13012500	Spread Creek near Moran	434726110321401	6-27-76	200	14.0	7.7	10	24	5.3	3.3	.9	104	0	6.3	1.3	.1	----	.30	.09	.01	.03	2.8	100	54	82	180	8.0	8.4	2.7	9	B6	18
			7-25-76	34.6	18.5	8.4	20	34	6.6	4.7	1.4	139	0	6.7	1.5	.2	.07	.43	.03	.01	.01	3.0	132	12	110	250	8.0	7.3	4.7	3	31	0
			8-21-76	25	17.5	8.3	30	40	8.6	4.6	1.4	157	0	9.1	.5	.2	.08	.42	.00	.00	.00	1.5	150	10	140	280	8.1	8.1	2.3	1	B3	2
			10-11-76	49.6	10.0	7.6	30	36	8.0	5.3	1.4	142	0	9.1	1.4	.1	.06	.33	.00	.01	.00	11	139	18	120	270	8.0	9.1	2.1	1	<1	14
--------	Snake River above Moose	433955110421401	11- 5-75	930	6.0	15	0	26	5.1	8.1	1.8	103	0	8.3	3.4	.4	.00	.05	----	----	.03	2.8	119	299	86	195	7.2	----	---	-	---	--
			6-26-76	5,550	11.0	12	30	15	2.8	4.4	1.4	55	0	6.0	1.9	.3	----	.38	.09	.02	.03	1.6	71	1,060	49	115	7.6	8.1	4.8	6	B7	1
			7-24-76	5,350	16.0	6.9	10	8.9	1.5	3.4	1.6	37	0	7.3	2.6	.3	.06	.69	.09	.01	.03	9.7	51	737	28	90	7.3	7.3	3.4	1	21	3
			8-21-76	4,950	15.0	13	10	15	3.2	7.6	1.7	59	0	8.8	4.1	.7	.06	.46	.00	.01	.00	2.2	83	1,110	51	140	7.7	8.5	2.4	1	B10	3
			10-11-76	990	8.0	15	0	22	4.9	7.7	2.0	87	0	9.1	4.0	.6	.06	.24	.00	.01	.00	1.5	108	289	75	205	8.2	10.0	1.8	1	B10	10
--------	Snake River below Moose	433902110430601	11- 5-75	990	6.0	15	0	29	5.7	8.4	1.9	110	0	9.9	3.4	.4	.01	.12	----	----	.00	2.3	128	342	96	175	7.5	----	---	-	---	--
			6-26-76	5,610	12.0	14	40	16	3.3	5.3	1.5	64	0	6.4	1.8	.4	----	.10	.09	----	.03	2.1	80	1,210	54	140	7.8	8.5	3.2	-	B3	7
			7-24-76	5,410	17.5	14	20	14	2.6	6.6	1.9	61	0	6.9	4.2	.5	.04	.60	.06	.02	.02	2.1	81	1,180	46	138	7.6	7.6	2.5	3	B11	4
			8-21-76	5,010	16.0	14	30	17	3.2	8.3	1.9	70	0	9.0	4.5	.7	.07	.65	.00	.00	.00	2.1	93	1,260	56	160	7.8	8.5	2.1	1	B7	3
			10-11-76	1,050	9.0	15	10	23	5.2	7.8	1.9	91	0	10	3.9	.6	.02	.10	.00	.01	.00	1.1	112	318	79	220	8.2	10.2	3.3	1	<1	12