MONTANA FISH AND GAME DEPARTMENT
ENVIRONMENT AND INFORMATION DIVISION

JOB PROGRESS REPORT

State Montana Title Beartooth-Absaroka Wildlife - Mining Research

Project No. FW-2-R-2

Job No. 1-b Title Planning Inventory, Fisheries

Period Covered July 1, 1972 to June 30, 1973

Contract Report Period January 1, 1973 to December 31, 1973

ABSTRACT

Chemical and biological investigations were undertaken in streams draining an area of southcentral Montana where mining development is expected. Water quality was generally good. Waters are mostly soft and low in dissolved materials. Data on metals content of stream sediments are also given. Standing crops of stream bottom macroinvertebrates were variable, both in time and location. At most stations groups of organisms considered sensitive to pollution were dominant.

Fish population estimates were made on 17 sections in 15 streams. Standing crops were moderately low in larger streams, but moderately high in some brushy, meandering tributaries. Estimates were made on 12 sections in consecutive years. Values were mostly similar from one year to the next. Fish tended to remain in the same stream section from one year to the next. Fish growth was somewhat less than state averages.

Limited data on fish stomach contents suggest fish cropped a wide variety of aquatic organisms. Survival to hatching of trout eggs placed in artificial redds averaged less than 50 percent in 1972 and 83 percent in 1973. Differences in water temperature probably caused the differential survival. Limited data are given on spawning trout and egg survival in the Goose Lake inlet stream. Acid mine drainage at the head of the Stillwater River affects the river for several miles downstream.

BACKGROUND

Several thousand acres of mining claims are located along or near the north edge of the Beartooth-Absaroka Mountain Range in southcentral Montana (Figures 1 and 2). Extensive mining in this area seems likely in the near future. Chemical and biological data on waters draining the area were mostly

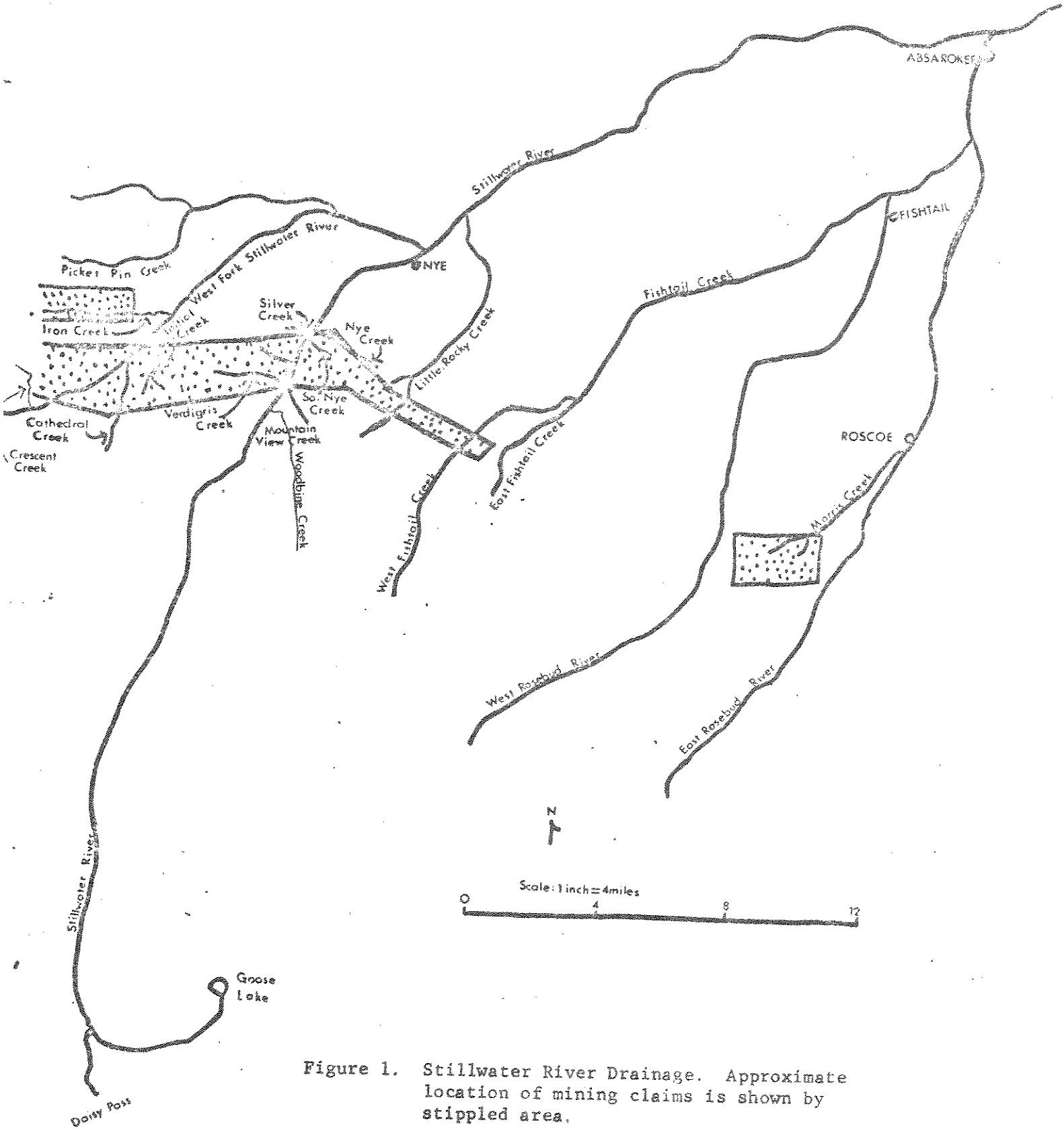

Figure 1. Stillwater River Drainage. Approximate location of mining claims is shown by stippled area.

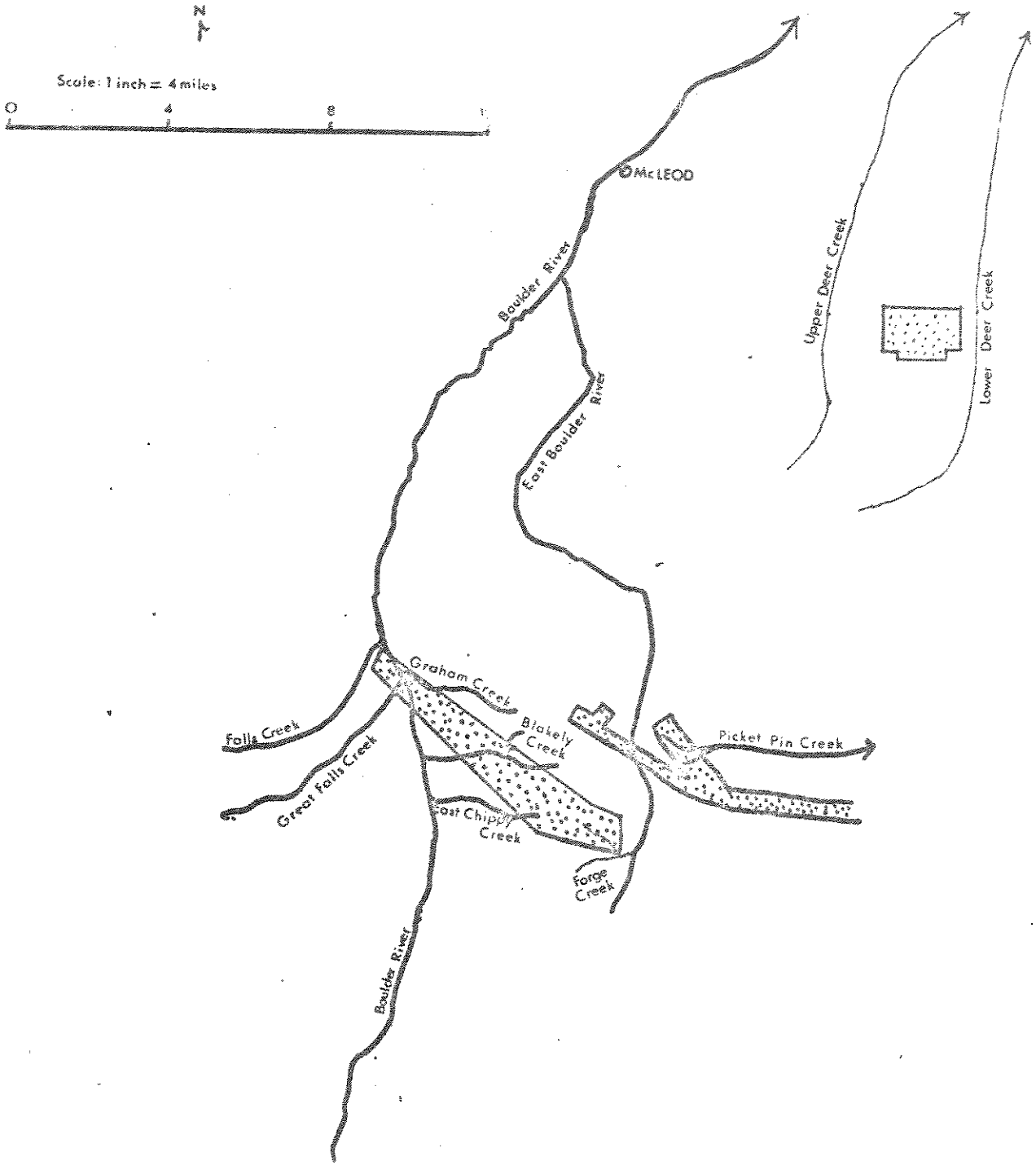

Figure 2. Boulder River and Deer Creek Drainages. Approximate location of mining claims is shown by stippled area.

lacking. The overall goal of protecting aquatic resources was undertaken initially by chemical and biological surveys at stations both upstream and downstream from mining claims. Although separated from the main block of mining claims, information was also collected relative to mining claims bordering Goose Lake and to acid mine drainage entering the Stillwater River near its head in the area of Daisy Pass.

OBJECTIVES

Job objectives were to obtain the following information at stations upstream and downstream from the complex of mining claims:

1. Basic water quality data
2. Metal concentrations in stream sediment
3. Numbers per square foot and species present in stream bottom fauna samples
4. Fish population estimates
5. Metal concentrations in fish tissues
6. Information on organisms present in fish stomachs
7. Survival of hatching of trout eggs placed in artificial redds
8. Limited biological data related to acid mine drainage near the head of the Stillwater River, and to mining claims near Goose Lake.

PROCEDURES

The report includes data collected from the beginning of this project, July 1, 1971 to December 31, 1974, a period of 30 months. A future report will include the remainder of the data.

Sampling Stations

Sampling stations were established at points upstream and downstream from the mining claims complex. Station locations are given in Table 1.

Water and Stream Sediment Quality Sampling

Water samples for analysis of general parameters (Table 2) were collected at irregular time intervals by other department personnel until October 1971. Samples at stations 001-004 were collected quarterly from November 1971 to November 1972. Samples at stations 005-011 were collected monthly from October 1971 to September 1972 and in November 1972. Stations 012-020, 023-027, 042, 044, 047 were sampled two to four times per year from February 1972 to November 1972. Station 043 was sampled periodically from June 1972 to October 1973. Samples were collected periodically at stations 038, 048, 051, 054, 055, and 058 from May 1973 to October 1973. Stations 021 and 022 were sampled in May 1972, June 1973 and September 1973. Stream sediment samples and water samples for part-per-billion level metal analysis were collected from March to October 1973.

TABLE 1. Location of water, stream sediment, bottom fauna and egg bioassay stations

Station Number	Stream	T	R	S*	Description
001	E. Rosebud River	7S	17E	11	Adjacent to Jimmie Joe Campground
002	E. Rosebud River	6S	18E	16	At bridge
003	W. Rosebud River	6S	17E	28	At Pine Grove Campground
004	W. Rosebud River	6S	17E	2	At bridge
005	Stillwater River	5S	15E	32	West channel 200 yds upstream from bridge at Woodbine Campground
006	Stillwater River	5S	15E	15	West channel 1.4 road miles north of the Mouat Mill
007	W. Fork Stillwater River	4S	15E	33	At bridge
008	E. Boulder River	3S	13E	29	At Anderson Springs resort
009	E. Boulder River	2S	13E	33	At Ewan Campground 200 yds upstream from mouth
010	Boulder River	4S	12E	15	At Falls Creek Campground
011	Boulder River	5S	12E	13	At Fleming Bridge
012	E. Fishtail Creek	5S	17E	19	At mouth
013	W. Fishtail Creek	5S	17E	19	At mouth
014	Morris Creek	6S	18E	8	200 yds downstream from MacKay Ranch house
015	Little Rocky Creek	5S	16E	21	At road crossing near Little Rocky Campground
016	Nye Creek	5S	15E	15	At road crossing 100 yds upstream from mouth
017	Initial Creek	5S	14E	14	At road crossing
018	Cathedral Creek	5S	14E	14	At road crossing near mouth
019	Iron Creek	5S	14E	12	Near mouth
020	Picket Pin Creek	5S	14E	3	At road crossing
021	Lower Deer Creek	2S	15E	20	At road crossing near National Forest boundary
022	Upper Deer Creek	2S	14E	12	At Rudd Cabin
023	East Chippy Creek	4S	12E	1	At road crossing near mouth
024	Blakely Creek	4S	12E	25	At road crossing near mouth
025	Graham Creek	4S	12E	23	At road crossing near mouth
026	Great Falls Creek	4S	12E	23	At mouth
027	Falls Creek	4S	12E	23	West channel at road crossing
028	E. Rosebud River	5S	18E	34	At Roscoe bridge
029	W. Rosebud River	5S	17E	23	At bridge
030	Fishtail Creek	5S	17E	19	At bridge
031	Little Rocky Creek	5S	16E	3	At crossing of Highway 419
032	Stillwater River	4S	16E	28	At USGS station 200 yds below mouth of West Fork
033	Stillwater River	4S	16E	28	At Moraine Fishing Access

TABLE 1. (continued)

034	Stillwater River	4S	17E	18	At Midnight Canyon Bridge
035	Stillwater River	3S	18E	35	At Johnson Bridge
036	West Fork Stillwater River	4S	14E	14	At Nye Bridge, South channel
037	West Fork Stillwater River	5S	14E	14	At Initial Creek campground
038	East Boulder River	5S	13E	11	0.5 miles upstream from road crossing
039	Boulder River	2S	13E	33	At Ewan Campground 50 yards downstream from bridge
040	Boulder River	2S	13E	1	At bridge
041	West Boulder River	2S	13E	15	At McLeod Bridge
042	Silver Creek	5S	15E	15	At crossing of Highway 419
043	Verdigris Creek	5S	15E	28	At crossing of Highway 419
044	Mountain View Creek	5S	15E	21	At crossing of Highway 419
045	Fishtail Creek	5S	17E	9	At bridge 100 yards upstream from mouth of Sheep Creek
046	East Rosebud River	5S	18E	15	At bridge
047	South Nye Creek	5S	15E	15	At trail crossing 200 yards upstream from mouth
048	Crescent Creek	5S	14E	29	At trail crossing near mouth
049	East Rosebud River	6S	18E	30	1 road mile downstream from TO Bar Ranch buildings
050	Boulder River	4S	12E	25	At Clydehurst Ranch buildings
051	Forge Creek	5S	13E	2	At road crossing near mouth
054	West Fork Stillwater River	5S	14E	30	Near mouth of Lightning Creek
055	Verdigris Creek	5S	15E	20	At wood culvert
058	Woodbine Creek	5S	15E	32	200 yards upstream from mouth

TABLE 2. Summarization of water quality of major streams, 1971-72.[1]

	East Rosebud River Station 001				East Rosebud River Station 002			
	Mean	Max.	Min.	No. of Samples	Mean	Max.	Min.	No. of Samples
Ca^{2}	4.1	5.7	2.0	9	5.6	8.6	2.6	9
Mg	1.1	1.5	0.6	9	1.4	1.8	0.7	9
Na	0.9	1.3	0.5	9	1.4	2.4	0.6	9
K	0.8	1.4	0.5	9	0.8	1.7	0.6	9
Si	2.2	3.0	1.0	9	3.5	6.0	1.3	9
HCO_3	17.1	24	10	9	24	36	11	9
CO_3	0	0	0	9	0	0	0	9
OH^3	0	0	0	9	0	0	0	9
Cl	0.3	1.0	0.0	9	0.5	1.4	0.1	9
SO_4	3.6	6.0	1.8	9	3.9	5.6	2.6	9
NO_3^4	0.3	0.7	0.0	9	0.4	0.9	0.0	9
F	0.0	0.1	0.0	9	0.0	0.1	0.0	9
pH (lab)	6.74	7.15	6.19	9	6.90	7.18	6.33	9
pH (field)	8.3	8.4	8.2	6	8.2	8.4	8.1	6
F°	43	57	32	8	43	60	32	9
Dis. Sol.	30.5	38.4	18.6	9	41.8	59.6	21.7	9
Hard.	14	20	9	9	20	28	10	9
Alk.	14	20	8	9	20	30	9	9
D. O.	11.2	13.0	8.5	5	11.3	13.0	8.5	6
JTU	1	4	0	4	2	3	0	4
Zn	<0.01	0.01	<0.01	9	<0.01	0.01	<0.01	9
Cd	<0.01	<0.01	<0.01	9	<0.01	<0.01	<0.01	9
Cu	<0.01	<0.01	<0.01	9	<0.01	<0.01	<0.01	9
Ni	<0.02	<0.02	<0.02	9	<0.02	<0.02	<0.02	9
Fe	0.02	0.08	0.00	9	0.12	0.41	<0.02	9
Mn	0.00	0.00	0.00	9	0.00	0.01	0.00	9

[1] Units are milligrams per liter except as indicated

[2] Standard chemical abbreviations, and as follows:

F° = Temperature, field
Dis. Sol. = Calculated Dissolved Solids
Hard. = Total Hardness as $CaCO_3$
Alk. = Total Alkalinity as $CaCO_3$
D. O. = Dissolved Oxygen, field
JTU = Turbidity, field

TABLE 2. (continued)

	West Rosebud River Station 003				West Rosebud River Station 004			
	Mean	Max.	Min.	No. of Samples	Mean	Max.	Min.	No. of Samples
Ca	4.3	10.5	2.6	9	5.2	8.6	3.3	9
Mg	0.9	1.3	0.4	9	0.9	1.4	0.6	9
Na	1.0	1.3	0.7	9	1.3	1.9	0.8	9
K	0.8	1.1	0.4	9	0.8	1.2	0.6	9
Si	2.5	4.3	0.0	9	3.6	7.0	1.0	9
HCO_3	17	34	10	9	20	27	15	9
CO_3	0	0	0	9	0.1	1.0	0.0	9
OH^3	0	0	0	9	0	0	0	9
Cl	0.5	1.4	0.1	9	0.4	1.0	0.1	9
SO_4	3.2	6.2	2.0	9	4.4	7.4	2.2	9
NO_3	0.3	0.8	0.0	9	0.2	0.7	0.0	9
F	0.0	0.1	0.0	9	0.0	0.1	0.0	9
pH (lab)	6.70	7.22	6.24	9	6.91	8.42	6.34	9
pH (field)	8.1	8.3	7.9	6	8.2	8.4	7.9	6
F°	43	57	32	8	44	60	32	8
Dis. Sol.	30.3	57.6	19.6	9	36.8	48.5	28.1	9
Hard.	15	31	10	9	17	26	12	9
Alk.	14	28	8	9	17	26	12	9
D. O.	11.1	12.0	8.6	6	10.9	12.0	8.3	5
JTU	3	8	0	4	2	3	0	4
Zn	<0.01	0.01	<0.01	9	<0.01	0.01	<0.01	9
Cd	<0.01	<0.01	<0.01	9	<0.01	<0.01	<0.01	9
Cu	<0.01	<0.01	<0.01	9	<0.01	<0.01	<0.01	9
Ni	<0.02	<0.02	<0.02	9	<0.02	<0.02	<0.02	9
Fe	0.02	0.07	0.02	9	0.03	0.12	0.00	9
Mn	0.00	0.01	0.00	9	0.00	0.01	0.00	9

TABLE 2. (continued)

	Stillwater River Station 005				Stillwater River Station 006			
	Mean	Max.	Min.	No. of Samples	Mean	Max.	Min.	No. of Samples
Ca	4.9	7.1	2.6	16	8.4	16.4	3.6	16
Mg	1.1	1.8	0.6	16	2.0	3.1	0.7	16
Na	1.4	2.5	0.6	16	1.6	2.7	0.6	16
K	0.7	1.6	0.4	16	0.8	1.5	0.4	16
Si	4.6	7.3	1.3	16	5.0	9.0	1.3	16
HCO_3	19	26	13	16	28	51	13	16
CO_3	0	0	0	16	0	0	0	16
OH^3	0	0	0	16	0	0	0	16
Cl	0.5	1.5	0.2	16	0.5	1.4	0.0	16
SO_4	4.5	7.4	2.0	16	8.3	14.0	2.8	16
NO_3	0.3	1.0	0.0	16	0.3	1.0	0.0	16
F	0.0	0.1	0.0	16	0.0	0.1	0.0	16
pH (lab)	6.81	7.24	6.32	16	6.88	8.12	6.04	16
pH (field)	8.3	8.4	7.8	13	8.2	8.5	7.0	13
F°	41	55	32	15	43	56	32	15
Dis. Sol.	37.0	48.6	23.4	16	54.3	92.0	26.8	16
Hard.	17	21	11	16	28	51	12	16
Alk.	15	22	10	16	23	42	10	16
D. O.	11.4	16.0	9.5	12	10.9	13.4	9.4	13
JTU	2	10	0	9	2	8	0	9
Zn	<0.01	0.01	<0.01	16	<0.01	0.02	<0.01	16
Cd	<0.01	<0.01	<0.01	16	<0.01	<0.01	<0.01	16
Cu	<0.01	0.01	<0.01	16	<0.01	0.02	<0.01	16
Ni	<0.02	<0.02	<0.02	16	<0.02	<0.02	<0.02	16
Fe	0.06	0.20	0.00	16	0.06	0.24	0.00	16
Mn	0.00	0.01	0.00	16	0.00	0.01	0.00	16

TABLE 2. (continued)

	West Fork Stillwater River Station 007				West Fork Stillwater River Station 05			
	Mean	Max.	Min.	No. of Samples	Mean	Max.	Min.	No. of Samples
Ca	13.0	21.0	5.0	16	6.1	7.1	5.5	4
Mg	4.0	6.7	0.5	16	1.9	2.8	0.4	4
Na	1.6	2.4	0.8	16	1.2	1.4	1.0	4
K	0.9	1.8	0.5	16	0.8	0.9	0.6	4
Si	6.8	10.0	2.0	16	5.5	7.0	3.0	4
HCO_3	57	94	22	16	25	30	19	4
CO_3	0	1	0	16	0	0	0	4
OH^3	0	0	0	16	0	0	0	4
Cl	0.4	1.1	0.2	16	0.8	2.0	0.2	4
SO_4	5.9	8.6	2.2	16	5.8	8.6	3.2	4
NO_3	0.2	1.0	0.0	16	0.4	0.7	0.2	4
F	0.0	0.1	0.0	16	0.0	0.0	0.0	4
pH (lab)	7.29	8.32	6.38	16	7.30	7.74	6.73	4
pH (field)	8.3	8.6	6.9	13	8.2	8.5	7.8	4
F°	42	53	32	15	41	43	39	3
Dis. Sol.	90.1	133.1	40.0	16	47.8	54.6	34.3	4
Hard.	48	76	21	16	24	28	16	4
Alk.	47	76	21	16	20	24	16	4
D. O.	10.8	12.8	9.0	12	10.0	10.5	9.3	4
JTU	0	2	0	10	0	2	0	4
Zn	<0.01	0.02	<0.01	16	<0.01	0.01	<0.01	3
Cd	<0.01	<0.01	<0.01	16	<0.01	<0.01	<0.01	3
Cu	<0.01	0.02	<0.01	16	<0.02	<0.02	<0.02	3
Ni	<0.02	<0.02	<0.01	16	<0.05	<0.05	<0.05	3
Fe	0.10	0.92	0.00	16	0.04	0.10	0.00	4
Mn	0.00	0.01	0.00	16	0.00	0.00	0.00	4

TABLE 2. (continued)

	East Boulder River Station 038				East Boulder River Station 008			
	Mean	Max.	Min.	No. of Samples	Mean	Max.	Min.	No. of Samples
Ca	3.8	6.3	2.0	4	23.8	32.0	10.4	16
Mg	1.4	1.6	1.2	4	5.7	6.9	2.0	16
Na	1.4	1.5	1.4	4	1.4	2.0	0.8	16
K	0.6	0.6	0.5	4	0.5	1.0	0.2	16
Si	7.2	9.6	3.8	4	6.7	10.0	2.6	16
HCO_3	17	24	13	4	89	122	36	16
CO_3	0	0	0	4	0	2	0	16
OH^3	0	0	0	4	0	0	0	16
Cl	0.6	1.2	0.3	4	0.3	1.0	0.0	16
SO_4	2.6	5.6	0.3	4	7.0	12.2	1.8	16
NO_3	0.4	0.8	0.1	4	0.1	0.8	0.0	16
F	0.0	0.0	0.0	4	0.0	0.1	0.0	16
pH (lab)	7.68	8.53	7.30	4	7.65	8.41	6.82	16
pH (field)	7.9	8.6	7.4	3	8.5	8.6	8.0	13
F°	51	57	44	3	40	52	32	16
Dis. Sol.	34.7	43.6	29.6	4	142.0	180.1	63.0	16
Hard.	15	21	11	4	82	105	35	16
Alk.	14	21	11	4	78	104	29	16
D. O.	8.7	9.4	8.0	3	11.0	12.1	9.2	12
JTU	2	5	0	3	1	5	0	10
Zn	-	-	-	-	<0.01	0.01	<0.01	16
Cd	-	-	-	-	<0.01	<0.01	<0.01	16
Cu	-	-	-	-	<0.01	<0.01	<0.01	16
Ni	-	-	-	-	<0.02	<0.02	<0.02	16
Fe	0.03	0.10	0.00	4	0.02	0.17	0.00	16
Mn	0.00	0.01	0.00	4	0.00	0.01	0.00	16

TABLE 2. (continued)

East Boulder River Station 009

	Mean	Max.	Min.	No. of Samples
Ca	41.6	55.0	17.9	16
Mg	9.5	15.3	3.2	16
Na	4.8	12.7	1.6	16
K	1.2	2.5	0.5	16
Si	7.1	11.0	3.2	16
HCO_3	141	178	59	16
CO_3	0	5	0	16
OH^3	0	0	0	16
Cl	1.4	3.3	0.3	16
SO_4	44.0	63.0	9.4	16
NO_3	0.3	1.00	0.00	16
F	0.0	0.2	0.0	16
pH (lab)	7.92	8.48	7.00	16
pH (field)	8.4	8.7	7.6	13
F°	42	58	33	16
Dis. Sol.	253.2	324.9	97.7	16
Hard.	150	196	57	16
Alk.	116	158	48	15
D. O.	11.1	12.4	9.3	12
JTU	4	20	0	10
Zn	<0.01	0.015	<0.01	16
Cd	<0.01	<0.01	<0.01	16
Cu	<0.01	<0.01	<0.01	16
Ni	<0.02	<0.02	<0.02	16
Fe	0.11	0.55	0.00	16
Mn	0.00	0.02	0.00	16

TABLE 2. (continued)

	Boulder River Station 010				Boulder River Station 011			
	Mean	Max.	Min.	No. of Samples	Mean	Max.	Min.	No. of Samples
Ca	9.0	13.2	4.8	16	8.7	14.2	4.8	11
Mg	2.2	3.5	0.8	16	2.2	2.8	1.4	11
Na	2.0	2.8	1.0	16	2.0	2.8	1.0	11
K	1.2	2.1	0.6	16	1.0	1.5	0.6	11
Si	7.7	11.0	3.0	16	9.0	11.0	3.2	11
HCO_3	37	54	23	16	36	47	24	11
CO_3	0	1	0	16	0	0	0	11
OH^3	0	0	0	16	0	0	0	11
Cl	0.5	1.5	0.1	16	0.4	0.6	0.1	11
SO_4	6.5	11.4	2.6	16	5.8	10.4	2.6	11
NO_3	0.2	0.8	0.0	16	0.3	0.7	0.0	11
F	0.02	0.13	0.00	16	0.01	0.12	0.00	11
pH (lab)	7.06	8.34	6.53	16	7.17	7.94	6.46	11
pH (field)	8.4	8.7	8.3	13	8.4	8.7	8.2	11
F°	40	54	32	16	41	52	31	10
Dis. Sol.	69.9	89.9	40.6	16	65.3	86.0	44.8	11
Hard.	31	46	20	16	31	44	20	11
Alk.	30	44	19	16	30	39	20	11
D. O.	11.1	12.0	8.9	13	10.7	12.0	9.1	11
JTU	3	8	0	9	1	7	0	8
Zn	<0.01	0.01	<0.01	16	<0.01	0.01	<0.01	11
Cd	<0.01	<0.01	<0.01	16	<0.01	<0.01	<0.01	11
Cu	<0.01	<0.01	<0.01	16	<0.01	<0.01	<0.01	11
Ni	<0.02	<0.02	<0.02	16	<0.02	<0.02	<0.02	11
Fe	0.10	0.68	0.00	16	0.07	0.27	0.00	11
Mn	0.00	0.03	0.00	16	0.00	0.01	0.00	11

Values for temperature, turbidity, pH, and dissolved oxygen were obtained in the field. Temperature was measured with a pocket mercury thermometer. Turbidity and pH were measured colorimetrically (Hach Chemical Co. field unit Model DR-EL). Dissolved oxygen was measured by the Winkler method.

Other parameters were analyzed at the Montana Bureau of Mines and Geology laboratory in Butte under contract agreement with the Montana Fish and Game Department. Field procedures used were suggested by laboratory personnel.

Water samples were collected in plastic bottles after three rinsings with river water at the sampling site. Bottles for non-metals analyses were filled to capacity to prevent air contact. One percent (by volume) of concentrated nitric acid was added in the field to bottles of water for metals analysis. Water samples for part-per-billion level dissolved metals analysis were filtered in the field, prior to acidification. Filter pads of 0.45 micron pore size obtained from the Gelman Instrument Co. were used for filtration.

Stream sediment samples for metals analysis were collected from the upper inch of sandy or silty deposits at each station. Sediments were transported to the laboratory in cloth bags. Prior to analysis in the laboratory samples were screened through material of 100 meshes per inch (0.0059 inch opening size). Only materials passing through the screening were retained for analysis.

Stream Bottom Macroinvertebrates

Bottom macroinvertebrates were sampled with a square foot sampler slightly modified from that described by Waters and Knapp (1961). One riffle sample per station was collected in August or October 1970 and in April 1971. Three samples per station were collected at later sampling dates.

Various non-riffle habitat types were sampled with a Needham hand screen to collect species not present in riffle samples. These samples were collected in May and November 1972 from stations on major streams and in August from tributary streams.

Samples were preserved in the field in 10 percent formalin and sorted to order (insects) or other taxonomic group for non-insect organisms at the Department of Fish and Game laboratory in Helena. The number and volume of organisms were obtained for each taxonomic group in each sample. All organisms were preserved for possible future identification to taxa.

Fish Studies

Population estimates were made using methods similar to those described by Vincent (1971). A computer program was used to make the required calculations. The basic technique involves capturing fish by electrofishing in a stream section and marking them in a manner recognizable at a future date, e.g. fin clip.

Several days later fish are again captured in the stream section, noting whether or not each fish is marked. Fish in each stream section were given a distinctive permanent mark each year (fins removed are shown in Table 13). They were aged from scale impressions. Fish were weighed to the nearest 0.01 pound and total lengths were taken to the nearest 0.1 inch.

Fish stomach and fish for metals analysis were collected during the last recapture run with the exception of section F-17 on the West Fork Stillwater River. Fish for metals analysis were collected September 1973 from this section. Fish stomachs were preserved in formalin and stomach contents were identified to order. Fish collected for metals analysis were frozen the day of collection and later shipped on dry ice by air freight to the Environmental Protection Agency laboratory in Denver, Colorado where the analysis was performed.

Egg Bioassays

Eggs were buried in artificial redds to determine survival rates during the incubation period. Redds were built by excavating the stream bottom in riffle areas to a depth of 12 to 14 inches, leaving a semi-spherical depression approximately 2.5 feet in diameter. This was filled with clean gravel averaging 0.84 inches in diameter.* Redds were allowed to settle and stabilize at least two weeks before egg placement.

Eyed cutthroat trout eggs were obtained from the Montana Fish and Game Department Yellowstone River Trout Hatchery at Big Timber for egg bioassays in 1972. For 1973 bioassays eyed rainbow trout eggs were obtained from Ennis National Fish Hatchery at Ennis. On both occasions eggs were placed in trays, covered with crushed ice, and placed in artificial redds the same day they were taken from the hatcheries.

Two different types of egg containers, both constructed to retain fry after hatching, were used to contain eggs in redds. A few eggs were placed in small perforated vials which were removed periodically to determine when hatching had occurred.

Three containers made of plastic screening were filled with 100 eggs each and buried four to six inches deep in each redd. Gravel chips were placed in the screen containers in 1973, but not in 1972. The redd at station 007, 1973 was not stable. Most of the gravel washed away between the time the redd was constructed and the day of egg placement. As an emergency measure the screen containers were placed on what little remained of the gravel from which the redd had been built and large (two to four inch) gravel was collected from the streambank and placed over the containers.

After hatching the screen containers were removed and the number of fry were counted.

* Diameters measured on gravel used in 1973. Gravel used in 1972 was of similar size.

Stillwater River Headwaters Area

Fish were seived from the Goose Lake inlet stream in July, 1972. Fish eggs were removed from natural redds by loosening the gravel with a shovel. A hand screen was held downstream from the redd to capture eggs removed. Other procedures in this area were with methods and equipment previously described.

FINDINGS

General Chemical Water Quality

Data for general water quality parameters are shown in Tables 2 through 7. Locations of sampling stations are given in Table 1. Stream locations are indicated in Figures 1 and 2.

Waters are of the calcium bicarbonate type (typical of fresh water), very soft to moderately hard, and generally low in dissolved material. A few streams have moderate levels of dissolved materials, these are: Silver Creek (spring source), Upper and Lower Deer Creeks, and the lower reaches of the East Boulder River. In general, human activities have probably modified water quality very little. Verdigris Creek (Stillwater River tributary) is an exception.

At station 043, near the mouth of Verdigris Creek, nickel and copper were as high as 0.59 and 0.14 mg/liter, respectively (Table 4). However, at station 055, which is approximately one mile upstream, these metals were below detection limits for all samples (Table 4). Between these two stations the stream passes through a gossan (area of decomposed rock of rusty color due to oxidized metal pyrites). One water sample was taken from a spring that emerges from the base of the gossan and enters Verdigris Creek. In this sample nickel and copper values were 0.68 and 0.31 respectively. The gossan and probably this spring contribute the greatly elevated amounts of metals found in Verdigris Creek near its mouth. This is not a natural chemical situation, but a result of natural and unnatural causes. The gossan surface has undergone considerable disturbance from road building. At any rate, water quality in Verdigris Creek is good upstream from the gossan.

Both Nye and South Nye Creeks are filled with mill tailings which have blown in from the Mouat tailings pond located a few hundred yards upstream. This has had no obvious effect on water chemistry in these two streams, but the natural stream bottoms have been almost completely destroyed in the lower 0.5 to 0.75 miles of these streams.

Tables 2 through 7 indicate discrepancies between field and laboratory pH measurements of 1.0 to 2.0 units. Laboratory values were always lower. Laboratory measurements were made one to two months following sample collection, while field pH was measured within a few minutes after sample collection. To find out which set of pH values was correct, a simultaneous comparison of laboratory and field pH meters was made on water that had been collected the day before (Table 8). Samples were collected January 24, 1973 and measurements made on January 25, 1973. There was good agreement between the two meters when measurements were made at the same time and soon after sample collection. Values of pH were in the

TABLE 3. Summarization of water quality data for stations on Rosebud tributaries, 1972.[1]

	East Fishtail Creek Station 012[2]		West Fishtail Creek Station 013[3]			Morris Creek Station 014[3]		
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.
Ca	10.8	10.2	5.1	8.7	3.0	16.5	20.0	10.8
Mg	3.8	3.8	1.1	1.6	0.6	3.6	4.9	2.2
Na	3.7	2.5	1.9	2.5	1.0	12.0	17.0	7.0
K	0.71	0.61	0.69	0.90	0.60	1.0	1.4	0.7
Si	11.4	8.7	7.9	11.0	5.0	16	18	14
HCO_3	55	52	22	32	15	92	115	66
CO_3	0	0	0	0	0	0	0	0
OH	0	0	0	0	0	0	0	0
Cl	0.5	0.4	0.3	0.6	0.1	0.8	1.3	0.3
SO_4	6.0	4.2	4.4	5.6	2.6	6.6	9.6	2.0
NO_3	0.7	0.0	0.4	0.8	0.0	0.4	1.0	0.2
F	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0
pH (lab)	6.75	6.65	6.64	7.18	6.40	7.08	7.11	6.90
pH (field)	8.5	8.4	8.3	8.5	8.1	8.4	8.4	8.3
F°	41	32	40	52	32	45	70	32
Dis. Sol.	89.2	86.0	43.9	61.7	28.3	150.4	187.4	105.8
Hard.	43	41	17	25	10	56	70	39
Alk.	45	43	18	27	12	75	84	54
D.O.	11.5	10.4	10.7	11.6	9.6	10.7	12.1	7.1
JTU	12	5	1	5	0	18	35	8
Zn	0.01	<0.01	<0.01	0.015	<0.01	<0.01	0.01	<0.01
Cd	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cu	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ni	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Fe	0.21	0.06	0.02	0.05	0.00	0.71	1.10	0.46
Mn	0.00	0.00	0.00	0.00	0.00	0.10	0.36	0.00

[1] Units are milligrams per liter except as indicated

[2] 2 samples - mean not calculated

[3] 4 samples

TABLE 4. Summarization of water quality data for stations on Stillwater River tributaries, 1972-73.[1]

	Little Rocky Creek Station 015[2]			Nye Creek Station 016[2]			Silver Creek Station 042[3]	
	Mean	Max.	Min.	Mean	Max.	Min.	Max.	Min.
Ca	14.3	18.2	11.2	9.4	10.4	8.7	50	49
Mg	4.5	5.6	3.7	7.6	7.7	7.5	18.0	17.8
Na	1.9	2.4	1.5	2.0	2.2	1.8	2.3	1.9
K	0.50	0.60	0.38	0.45	0.60	0.31	0.70	0.59
Si	10.5	12.8	8.7	17	18	16	12.8	8.6
HCO_3	67	80	54	67	69	64	147	143
CO_3	0	0	0	0	0	0	0	0
OH^3	0	0	0	0	0	0	0	0
Cl	0.2	0.4	0.0	0.1	0.1	0.1	0.4	0.1
SO_4	4.8	7.9	2.0	6.9	7.9	6.4	74	74
NO_3^4	0.4	0.7	0.0°	0.7	1.0	0.0	0.9	0.2
F	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
pH (lab)	6.73	6.77	6.69	6.97	7.16	6.78	8.42	7.28
pH (field)	8.3	8.5	8.1	8.5	8.5	8.4	8.6	8.6
F°	41	54	32	42	51	32	60	50
Dis. Sol.	103.9	128.6	86.3	111.2	115.1	105.1	304.5	300.6
Hard.	55	68	44	56	57	53	199	195
Alk.	55	66	44	55	57	52	126	121
D.O.	10.6	12.9	8.2	10.4	12.1	9.2	9.6	8.6
JTU	2	7	0	2	5	0	0	0
Zn	0.01	0.01	<0.01	<0.01	0.01	<0.01	0.01	0.01
Cd	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cu	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ni	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Fe	0.05	0.11	0.00	0.21	0.53	0.00	0.04	0.03
Mn	0.00	0.01	0.00	0.00	0.01	0.00	0.01	0.00

[1] Units are milligrams per liter except as indicated

[2] 3 samples except for lab pH which is 2

[3] 2 samples

[4] 2 samples except for lab pH which is 1

[5] 7 samples except 6 for Cadmium, Nickel, Copper and Zinc

[6] 4 samples except 3 for Cadmium, Nickel, Copper, Zinc and Temperature

[7] 2 samples except Silica which is 1

TABLE 4. (continued)

	Verdigris Creek Station 043[5]			Verdigris Creek Station 055[6]			Woodline Creek Station 058[7]	
	Mean	Max.	Min.	Mean	Max.	Min.	Max.	Min.
Ca	7.9	11.3	3.4	4.5	6.6	2.3	3.1	2.6
Mg	10.9	16.0	4.3	4.5	5.6	2.7	1.1	0.5
Na	2.3	3.0	1.5	1.8	2.0	1.4	1.2	1.0
K	0.75	1.1	0.5	0.6	0.7	0.4	0.6	0.5
Si	13.8	16	11	11.2	13.5	9.8	6	-
HCO_3	38	48	21	35	42	25	11	11
CO_3	0	0	0	0	0	0	0	0
OH^-	0	0	0	0	0	0	0	0
Cl	1.1	3.3	0.1	0.2	0.4	0.0	0.2	0.1
SO_4	36.7	61	7.2	3.4	4.4	2.4	3.0	2.9
NO_3	0.5	1.0	0.0	1.0	2.4	0.0	0.3	0.1
F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
pH (lab)	7.24	7.97	6.61	7.52	7.83	6.78	6.89	6.65
pH (field)	8.2	8.5	7.7	8.1	8.5	7.5	8.4	7.5
F°	48	59	32	41	47	37	43	42
Dis. Sol.	112.8	149.8	49.6	60.0	76.2	45.5	26.1	19.9
Hard.	65	93	26	30	37	20	11	10
Alk.	31	39	18	29	34	20	9	9
D.O.	9.6	10.7	8.5	9.8	10.4	8.9	10.6	10.4
JTU	4	10	0	0	0	0	8	0
Zn	<0.01	0.015	<0.01	<0.01	0.01	<0.01	<0.01	-
Cd	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Cu	0.10	0.14	0.05	<0.02	<0.02	<0.02	<0.02	-
Ni	0.40	0.59	0.09	<0.05	<0.05	<0.05	<0.05	-
Fe	0.30	0.58	0.17	0.05	0.10	0.00	0.05	0.00
Mn	0.04	0.06	0.01	0.00	0.00	0.00	0.00	0.00

TABLE 4. (continued)

	Mountain View Creek Station 044[4]		South Nye Creek Station 047[3]	
	Max.	Min.	Max.	Min.
Ca	17.4	15.0	17.9	8.8
Mg	17.9	12.2	9.8	6.8
Na	4.0	2.9	3.5	1.8
K	0.70	0.70	0.52	0.46
Si	0.21	0.16	18.5	16.0
HCO_3	136	102	101	58
CO_3	0	0	0	0
OH^-	0	0	0	0
Cl	2.0	0.0	0.8	0.5
SO_4	11.0	7.2	9.0	4.8
NO_3	2.2	0.3	0.8	0.0
F	0.0	0.0	0.0	0.0
pH (lab)	7.00	-	7.64	7.26
pH (field)	8.5	8.5	8.4	8.4
F°	52	36	49	37
Dis. Sol.	208.8	157.0	163.1	97.8
Hard.	118	88	85	50
Alk.	112	84	83	48
D.O.	11.2	9.0	10.8	9.7
JTU	10	0	12	5
Zn	0.01	0.01	0.01	0.01
Cd	<0.01	<0.01	<0.01	<0.01
Cu	<0.01	<0.01	<0.01	<0.01
Ni	<0.02	<0.02	0.02	<0.02
Fe	0.21	0.16	1.28	0.08
Mn	0.00	0.00	0.03	0.00

TABLE 5. Summarization of water quality data for stations on West Fork Stillwater River tributaries, 1972-73.[1,2,3]

	Initial Creek Station 017		Cathedral Creek Station 018		Iron Creek Station 019	
	Max.	Min.	Max.	Min.	Max.	Min.
Ca	34	23	4.1	3.5	21.0	10.7
Mg	11.3	8.2	2.9	2.8	4.5	2.9
Na	2.1	1.4	2.1	1.6	1.7	1.0
K	0.41	0.33	0.48	0.33	0.78	0.28
Si	11.4	10.0	10.0	8.6	10.0	8.7
HCO_3	154	112	28	27	87	48
CO_3	0	0	0	0	0	0
OH^3	0	0	0	0	0	0
Cl	0.2	0.2	0.3	0.3	0.3	0.3
SO_4	7.8	1.6	3.9	2.4	5.4	2.6
NO^4_3	0.1	0.0	0.2	0.0	0.2	0.0
F	0.0	0.0	0.0	0.0	0.0	0.0
pH (lab)	7.46	-	6.45	-	6.55	-
pH (field)	8.6	8.6	8.3	8.3	8.3	7.7
F°	36	32	36	32	39	36
Dis. Sol.	220.4	156.5	50.4	48.2	171.1	74.6
Hard.	130	90	22	20	70	39
Alk.	126	92	23	22	72	39
D.O.	10.8	9.7	10.8	8.7	10.0	5.0
JTU	4	0	2	0	7	0
Zn	0.01	<0.01	0.01	<0.01	0.01	<0.01
Cd	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cu	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ni	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Fe	0.06	0.02	0.06	0.00	0.06	0.06
Mn	0.01	0.01	0.01	0.00	0.01	0.01

[1] Units are milligrams per liter except as indicated

[2] 2 samples per station except for lab pH which is 1

[3] 2 samples except 1 for Zinc, Cadmium, Copper and Nickel

TABLE 5. (continued)

	Picket Pin Creek Station 020		Crescent Creek Station 048[3]	
	Max.	Min.	Max.	Min.
Ca	15.0	10.7	6.5	5.1
Mg	3.0	1.4	9.2	8.0
Na	1.7	1.3	0.8	0.5
K	0.19	0.16	0.5	0.4
Si	8.7	8.6	15.0	15.0
HCO_3	55	40	59	52
CO_3	0	0	0	0
OH^3	0	0	0	0
Cl	0.3	0.3	0.7	0.2
SO_4	4.7	2.0	7.3	3.8
NO_3^4	0.3	0.0	0.3	0.0
F	0.0	0.0	0.0	0.0
pH (lab)	6.50	-	7.01	6.87
pH (field)	8.6	8.2	8.5	8.4
F°	36	32	50	42
Dis. Sol.	88.7	64.6	98.5	86.1
Hard.	49	32	54	46
Alk.	45	33	48	43
D.O.	10.3	9.7	9.6	9.0
JTU	7	0	6	1
Zn	0.015	<0.01	<0.01	-
Cd	<0.01	<0.01	<0.01	-
Cu	<0.01	<0.01	<0.01	-
Ni	<0.02	<0.02	<0.02	-
Fe	0.05	0.02	0.55	0.10
Mn	0.02	0.00	0.03	0.00

TABLE 6. Summarization of water quality data for stations on Boulder River tributaries, 1972.[1,2]

	East Chippy Creek Station 023		Blakely Creek Station 024		Graham Creek Station 025	
	Max.	Min.	Max.	Min.	Max.	Min.
Ca	10.8	8.3	12.2	9.9	13.7	9.9
Mg	4.1	3.0	8.0	4.9	3.8	1.9
Na	0.83	0.83	1.4	1.0	2.2	1.3
K	0.67	0.64	0.32	0.26	0.20	0.18
Si	10.0	9.5	11.4	9.5	11.4	8.3
HCO_3	42	33	74	50	61	38
CO_3	0	0	0	0	0	0
OH	0	0	0	0	0	0
Cl	0.4	0.3	0.7	0.6	0.7	0.5
SO_4	14.3	6.8	6.3	4.4	5.4	3.2
NO_3	0.8	0.1	0.2	0.1	0.4	0.0
F	0.0	0.0	0.0	0.0	0.0	0.0
pH (lab)	6.82	-	7.08	-	6.79	-
pH (field)	8.5	8.2	8.5	8.3	8.5	8.1
F°	40	32	43	32	40	32
Dis. Sol.	84.0	53.9	114.3	80.7	98.6	40.0
Hard.	44	33	63	45	49	32
Alk.	34	27	61	41	50	31
D.O.	12.1	10.5	11.9	10.2	11.6	10.3
JTU	1	0	0	0	1	0
Zn	0.015	<0.01	0.01	<0.01	0.01	<0.01
Cd	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cu	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ni	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Fe	0.02	0.02	0.02	0.02	0.50	0.02
Mn	0.00	0.00	0.01	0.00	0.00	0.00

[1] Units are milligrams per liter except as indicated

[2] 2 samples per station except for lab pH which is 1 at stations 023, 024 and 025

TABLE 6. (continued)

	Great Falls Creek Station 026		Falls Creek Station 027	
	Max.	Min.	Max.	Min.
Ca	6.4	4.2	7.9	4.6
Mg	0.8	0.0	1.2	1.0
Na	2.1	1.1	3.0	1.1
K	0.9	0.9	1.0	0.9
Si	8.6	5.9	7.1	5.9
HCO_3	16	14	22	17
CO_3	0	0	0	0
OH	0	0	0	0
Cl	0.3	0.2	1.5	0.2
SO_4	11.6	6.6	12.0	4.0
NO_3	0.6	0.0	0.8	0.2
F	0.0	0.0	0	0
pH (lab)	6.66	6.37	7.17	6.37
pH (field)	8.4	7.8	8.4	8.4
F°	40	32	40	32
Dis. Sol.	46.9	33.8	56.2	35.4
Hard.	16	14	24	15
Alk.	13	11	18	14
D.O.	10.6	10.1	11.8	10.5
JTU	2	0	2	0
Zn	0.01	<0.01	0.01	<0.01
Cd	<0.01	<0.01	<0.01	<0.01
Cu	<0.01	<0.01	0.01	<0.01
Ni	<0.02	<0.02	<0.02	<0.02
Fe	0.08	0.02	0.09	0.02
Mn	0.00	0.00	0.00	0.00

TABLE 7. Summarization of water quality data for stations on miscellaneous tributary streams, 1972-73.[1]

	Forge Creek Station 051[2]			Upper Deer Creek Station 022[3]			Lower Deer Creek Station 021[3]		
	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.
Ca	3.4	4.9	1.3	34	42	28	27	35	23
Mg	3.3	3.4	3.2	5.2	6.3	4.3	4.1	5.0	3.4
Na	0.8	0.9	0.7	4.8	6.8	3.4	4.0	5.8	3.0
K	0.3	0.4	0.2	0.41	0.45	0.39	0.34	0.40	0.28
Si	8.1	9.4	6.9	12.6	13.7	12	13.6	14.0	13.0
HCO_3	23	27	20	120	149	100	91	123	84
CO_3	0	0	0	0	0	0	0	0	0
OH	0	0	0	0	0	0	0	0	0
Cl	0.6	1.0	0.2	0.4	0.6	0.3	0.7	1.6	0.2
SO_4	4.0	6.3	2.0	16.7	24	12.2	13.3	19.0	9.5
NO_3	0.2	0.5	0.0	0.1	0.2	0.0	0.3	0.7	0.0
F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
pH (lab)	7.38	7.58	7.16	7.62	8.20	7.13	7.59	7.98	7.34
pH (field)	7.9	8.5	7.3	8.5	8.6	8.3	8.4	8.5	8.4
F°	47	50	44	47	49	43	45	48	42
Dis. Sol.	43.8	49.1	34.5	195.0	243.5	160.9	161.5	204.6	137.2
Hard.	22	25	17	106	123	87	85	107	71
Alk.	19	22	16	99	123	82	80	101	69
D. O.	9.0	9.8	8.4	10.0	10.3	9.8	10.2	10.5	9.8
JTU	7	13	0	8	13	5	3	5	0
Zn	<0.01	<0.01	<0.01	-	<0.01	<0.01	-	<0.02	<0.01
Cd	<0.01	<0.01	<0.01	-	<0.01	<0.01	-	<0.01	<0.01
Cu	<0.02	<0.02	<0.02	-	<0.02	<0.02	-	<0.02	<0.01
Ni	<0.05	<0.05	<0.05	-	<0.05	<0.05	-	<0.05	<0.02
Fe	0.04	0.10	0.00	0.17	0.37	0.01	0.06	0.10	0.02
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00

[1] Units are milligrams per liter except as indicated

[2] 3 samples

[3] 3 samples except 2 for Zinc, Cadmium, Copper and Nickel

TABLE 8. Comparison of pH measurements made simultaneously with laboratory and field instruments

Stream	Station	Field Instrument	Laboratory Instrument	Difference
West Rosebud	004	7.98	7.91	+0.07
Stillwater	006	8.12	8.13	-0.01
West Fork Stillwater	007	8.45	8.24	+0.21
East Boulder	009	8.53	8.46	+0.07
Boulder	010	8.05	8.11	-0.06

range 7.9 - 8.5, agreeing with previous field measurements. Apparently pH values decreased considerably between time of collection and time of laboratory measurements. The conclusion is that of the pH values in Tables 2 through 7, the field measurements rather than the laboratory measurements indicate true pH values in streams.

Dissolved and Suspended Metal Concentrations

Part-per-billion level analysis was done for dissolved and total (suspended plus dissolved) metal concentrations at stations on major streams (Table 9). Even with the low detection limits, many samples did not contain detectable concentrations of some metals. For all stations and metals the relative proportions of dissolved and suspended were variable. For the higher values, most of the total was in the suspended rather than the dissolved fraction. Even the higher values in Table 9 are relatively low and indicative of clean, unmodified water quality.

Stream Sediment Quality

Concentrations of metals in stream sediments (Table 10) are surprisingly similar to values for the Earth's crust. These values as given by Wolfe and Rice (1972) are (in parts per million): Copper, 45; Nickel, 80; Lead, 15; Cadmium, 0.2; Zinc, 65; Iron, 50,000. The similarity of these values to those in Table 10 suggests a relatively unmodified condition in the study streams. The values for Nickel at station 006 on the Stillwater River seem to be an exception. The probable sources of apparently elevated nickel concentrations are Verdigris Creek, a small tributary carrying high nickel concentrations, and mill tailings, both a short distance upstream from station 006.

In general, values for all metals are somewhat lower at stations on the East and West Rosebud Rivers.

Stream Bottom Fauna

The generally pollution sensitive insect orders, Plecoptera, Tricoptera, and Ephemeroptera typically constituted the bulk of organisms in bottom fauna samples (Tables 11 and 12). These three orders usually made up 60 to 90 percent of organisms in samples.

Variability in numbers and volume of bottom fauna was high at most stations, but probably no more so than is characteristic of these organisms. Needham and Usinger (1956) took 100 one square foot samples from a single riffle. Numbers of organisms per sample ranged from 2 to 198. Data of this study are probably less variable than that reported by Needham and Usinger (1956).

Considering the 29 stations on larger streams reported in Table 11, relative richness of the bottom fauna is intermediate. Using a "richness index" developed by Lagler (1956) which considers numbers and volume of organisms, seven stations are "poor", sixteen rate "average richness" and six "exceptional richness". Of the seventeen stations on tributary streams (Table 11) all but one rate "poor".

TABLE 9. Total and dissolved concentrations (parts-per-billion) of metals for samples collected at 11 stations in 1973.

Collection Date	COPPER Total	COPPER Dis.	LEAD Total	LEAD Dis.	NICKEL Total	NICKEL Dis.	CADMIUM Total	CADMIUM Dis.
East Rosebud River-Station 001-Jimmie Joe Camp								
March	7	1	<5	<5	21	<5	<1	<1
May	3	<1	10	<5	<5	<5	<1	<1
July	<2	<2	<5	<5	<5	<5	<1	<1
August	<2	<2	<5	<5	<5	<5	<1	<1
September	4	3	5	2	4	<1	<1	<1
East Rosebud River-Station 002-At Bridge								
March	7	1	5	5	11	5	<1	<1
May	6	1	6	5	12	5	<1	<1
July	6	6	<5	<5	<5	<5	<1	<1
August	<2	<2	<5	<5	<5	<5	<1	<1
September	3	2	10	<1	3	2	<1	<1
West Rosebud River-Station 003-Pine Grove Campground								
March	5	1	<5	<5	24	<5	<1	<1
May	5	<1	<5	<5	<5	<5	<1	<1
July	2	2	<5	<5	<5	<5	<1	<1
August	<2	<2	<5	<5	<5	<5	<1	<1
September	3	3	7	3	5	<1	<1	<1
West Rosebud River-Station 004-First Bridge Below Pine Grove Campground								
March	19	1	<5	<5	11	<5	<1	<1
May	9	1	<5	<5	<5	<5	<1	<1
July	6	4	<5	<5	<5	<5	<1	<1
August	<2	<2	<5	<5	<5	<5	<1	<1
September	9	2	9	1	6	2	<1	<1
Stillwater River-Station 005-Woodbine Campground								
March	4	2	<5	<5	15	<5	<1	<1
May	17	3	<5	<5	<5	<5	<1	<1
July	<2	<2	<5	<5	<5	<5	<1	<1
August	3	3	<5	<5	<5	<5	<1	<1
September	4	4	12	<1	4	2	<1	<1
October	3	1	4	3	<1	<1	<1	<1

TABLE 9. (continued)

Collection Date	COPPER Total	COPPER Dis.	LEAD Total	LEAD Dis.	NICKEL Total	NICKEL Dis.	CADMIUM Total	CADMIUM Dis.
Stillwater River-Station 006-1.4 miles Below Mouat Mill								
March	3	3	<5	<5	16	<5	<1	<1
May	6	3	<5	<5	7	7	<1	<1
July	7	<2	<5	<5	<5	<5	<1	<1
August	4	2	<5	<5	<5	<5	<1	<1
September	3	3	5	<1	6	2	<1	<1
October	5	<1	5	2	<1	<1	<1	<1
West Fork Stillwater River-Station 007-Henry Grant's Cabin Bridge								
March	2	2	5	5	9	<5	<1	<1
May	3	1	<5	<5	20	<5	<1	<1
July	4	<2	<5	<5	<5	<5	<1	<1
August	2	2	<5	<5	<5	<5	<1	<1
September	4	3	3	<1	<1[1]	2[1]	<1	<1
October	4	<1	11	3	<1	<1	<1	<1
East Boulder River-Station 038-Placer Basin								
September	4	3	5	2	<1[1]	2[1]	<1	<1
October	3	1	5	4	<1	<1	<1	<1
East Boulder River-Station 008-Anderson Springs								
March	4	2	<5	<5	23	<5	<1	<1
May	26	<1	<5	<5	23	<5	<1	<1
July	2	2	<5	<5	<5	<5	<1	<1
August	5	3	<5	<5	<5	<5	<1	<1
September	2	2	8	3	<1	<1	<1	<1
October	4	2	11	5	<1	<1	<1	<1
Boulder River-Station 010-Falls Creek Campground								
March	6	1	<5	<5	9	<5	<1	<1
May	4	<1	<5	<5	<5	<5	<1	<1
July	3	2	<5	<5	10	<5	<1	<1
August	<2	<2	<5	<5	7	<5	<1	<1
September	2	2	8	<1	<1	<1	<1	<1
October	4	<1	4	2	<1	<1	<1	<1

[1] Error of unknown source

TABLE 9. (continued)

Collection Date	COPPER Total	COPPER Dis.	LEAD Total	LEAD Dis.	NICKEL Total	NICKEL Dis.	CADMIUM Total	CADMIUM Dis.
			Boulder River-Station 011-Flemming Bridge					
March	18	2	9	7	18	<5	<1	<1
May	2	1	<5	<5	<5	<5	<1	<1
July	2	2	<5	<5	<5	<5	<1	<1
August	2	2	<5	<5	<5	<5	<1	<1
September	2	1	4	<1	<1	<1	<1	<1
October	2	1	5	3	<1	<1	<1	<1

TABLE 10. Concentration (parts-per-million) of metals in stream sediments, 1973.[1]

Collection[2,3] Date	Copper	Nickel	Lead	Cadmium	Zinc	Iron (X 10^3)
East Rosebud River-Station 001-Jimmie Joe Campground						
March	19	30	15	1	27	15,000
May	20	32	16	<1	34	15,000
July	24	35	19	1	57	29,000
August	20	31	19	<1	36	26,000
September	22	35	32	<1	39	33,000
Range - all samples	13-39.5	21-52.5	15-57	<1-1	27-99.5	15,000-40,000
East Rosebud River-Station 002-At Bridge						
March	20	31	21	<1	33	15,000
May	12	21	22	<1	30	14,000
July	13	24	13	<1	34	20,000
August	11	22	15	<1	33	21,000
September	18	36	13	<1	48	26,000
Range - all samples	11-24	19.5-46	9-22	<1-1	28-55	13,000-32,000
West Rosebud River-Station 003-Pine Grove Campground						
March	9	18	12	<1	18	12,000
May	9	20	13	<1	22	9,000
July	9	20	50	1	29	18,000
August	10	19	15	<1	32	17,000
September	12	29	12	<1	57	18,000
Range - all samples	7-16.5	16.5-42	11.5-76	<1-1	18-107.5	9,000-22,000
West Rosebud River-Station 004-First Bridge Below Pine Grove Campground						
March	9	13	17	<1	18	12,000
May	9	16	16	<1	29	11,000
July	10	16	13	1	26	19,000
August	10	15	14	<1	38	21,000
September	8	16	12	<1	30	21,000
Range - all samples	5.5-13	10-18.5	10-17.5	<1-1	17.5-47	11,000-23,000

[1] Fractions of field samples passing through 100 mesh per inch screening were retained for analysis.

[2] All samples were collected in 1973.

[3] Values for July-Oct. are averages for three samples

TABLE 10. (continued)

Collection Date	Copper	Nickel	Lead	Cadmium	Zinc	Iron (X 10^3)
Stillwater River-Station 005-Woodbine Campground						
March	72	18	18	1	36	14,000
May	65	20	21	<1	46	11,000
July	48	16	25	<1	40	18,000
August	65	15	18	<1	55	20,000
September	56	14	12	<1	36	19,000
October	22	48	42	<1	48	25,000
Range - all samples	12.5-87	11-61	9.5-48.5	<1-1	24-71	11,000-27,000
Stillwater River-Station 006-1.4 miles Below Mouat Mill						
March	46	209	19	1	20	15,000
May	62	192	20	<1	34	17,000
July	101	107	18	2	59	27,000
August	70	196	20	1+	50	30,000
September	63	209	11	<1	30	28,000
October	20	35	52	<1	100	22,000
Range - all samples	17-110	25.5-330	9.5-57	<1-3.0	20-124.5	15,000-36,000
West Fork Stillwater River-Station 007-Henry Grant's Cabin Bridge						
March	40	85	20	1	27	16,000
May	31	68	20	<1	30	18,000
July	37	78	16	1.5	34	35,000
August	36	77	18	1.4	36	36,000
September	97	123	14	<1	104	34,000
October	37	91	28	<1	36	32,000
Range - all samples	28-212	60-193	12-31	<1-1.9	25.5-254.5	16,000-38,000
East Boulder River-Station 008-Anderson Springs						
March	46	78	20	1	33	16,000
May	33	70	26	<1	38	20,000
July	41	76	20	1.7	50	31,000
August	36	76	28	1.5	49	32,000
September	36	74	17	1.3	34	31,000
October	38	80	34	<1	47	33,000
Range - all samples	31-46.5	58-96	14-36	<1-2.0	25.5-54	16,000-38,000

TABLE 10. (continued)

Collection Date	Copper	Nickel	Lead	Cadmium	Zinc	Iron (X 10^3)
East Boulder River-Station 038-Placer Basin						
September	48	138	17	1	63	61,000
October	50	146	38	1.1	77	66,000
Range - all samples	45-53	132-148.5	16-55	<1-1.3	60-90	59,000-71,000
Boulder River-Station 010- Falls Creek Campground						
March	25	57	19	1	29	18,000
May	24	54	20	<1	40	30,000
July	20	44	14	1	44	45,000
August	19	40	19	1	37	39,000
September	22	49	13	1	44	38,000
October	126	46	42	<1	90	41,000
Range - all samples	20-132.5	36-85	10.5-64	<1-1.3	29-141.5	18,000-50,000
Boulder River-Station 011-Fleming Bridge						
March	21	40	14	1	30	18,000
May	26	45	25	<1	48	29,000
July	17	27	15	1.3	45	34,000
August	17	30	20	1.1	38	35,000
September	17	27	12	1.1	37	34,000
October	72	101	28	<1	53	35,000
Range - all samples	13.5-81	23.5-143	9-32.5	<1-2.0	20-72.5	18,000-43,000

TABLE 11. Number and volume (in parentheses) of macroinvertebrates collected in one square foot stream bottom samples for stations on larger streams

Date	Plecoptera	Tricoptera	Ephemeroptera	Diptera	Coleoptera	Annelida	Nemetoda	1 Other	Total
East Rosebud River-Station 001-Jimmie Joe Campground									
8-70	46	17	93	29	0	0	0	0	185
4-71	66(.5)	2(T)[2]	143(.2)	7(T)	0	0	0	0	218(.7)
10-71	39(.2)	1(T)	132(.5)	9(.1)	0	0	1(T)	0	151(.8)
10-71	8(.4)	8(.2)	43(.1)	1(T)	0	0	0	0	60(.7)
10-71	72(.2)	3(.1)	141(.6)	4(T)	0	0	0	0	220(.9)
5-72	11(T)	2(T)	81(.3)	12(.1)	0	0	0	3(T)	109(.4)
5-72	15(T)	1(T)	27(.1)	7(.3)	0	0	0	5(T)	55(.4)
5-72	3(T)	2(T)	22(.1)	8(.2)	0	0	0	2(T)	37(.3)
8-72	20(.2)	3(T)	94(.2)	6(T)	0	0	0	0	123(.4)
8-72	21(.3)	9(.2)	105(.2)	18(.3)	0	0	0	0	153(1.0)
8-72	55(.3)	20(.1)	190(.1)	32(.1)	0	62(T)	0	0	359(.6)
2-73	83(.4)	24(.2)	297(.9)	38(1.4)	0	0	1(T)	1(T)	444(2.9)
2-73	102(.6)	18(.2)	377(.6)	28(T)	4(T)	2(T)	0	0	531([illegible])
2-73	52(.1)	4(.1)	260(.8)	13(T)	2(T)	0	0	0	331(1.0)
East Rosebud River-Station 049-1 mile Below TO BAR Ranch									
8-70	47	0	95	17	0	0	0	0	159
4-71	23(.3)	57(.2)	149(.5)	12(T)	2(T)	0	0	0	243(1.0)
10-71	5(.1)	16(T)	83(.2)	5(T)	0	0	0	0	109(.3)
10-71	9(.2)	10(T)	189(.5)	1(T)	2(T)	0	1(T)	0	212(.7)
10-71	18(.5)	12(.1)	106(.3)	6(T)	0	0	1(T)	0	143(.9)

[1] Mostly Hydracarina and Turbellaria

[2] Trace

TABLE 11. (continued)

Date	Plecoptera	Tricoptera	Ephemeroptera	Diptera	Coleoptera	Annelida	Nematoda	Other	Total
East Rosebud River-Station 028-Town of Roscoe Bridge									
2-72	20(.2)	100(.7)	187(.7)	39(.2)	2(T)	9(T)	0	0	357(1.8)
2-72	30(.1)	92(1.0)	172(2.0)	11(.2)	1(T)	10(T)	0	1(T)	317(3.3)
2-72	6(T)	33(.5)	191(.4)	2(T)	0	1(T)	0	0	233(.9)
5-72	3(T)	12(.1)	78(.2)	3(T)	1(T)	0	0	0	97(.3)
5-72	0	103(.1)	26(.1)	5(T)	4(T)	1(T)	0	1(T)	140(.2)
5-72	14(.1)	17(.1)	71(.6)	3(T)	0	1(T)	0	0	106(.8)
8-72	12(.1)	17(.2)	90(.2)	18(T)	1(T)	0	0	0	138(.5)
8-72	3(T)	5(T)	32(T)	28(.1)	1(T)	8(T)	0	0	77(.1)
8-72	1(T)	8(T)	43(.1)	9(T)	1(T)	2(T)	0	0	65(.1)
2-73	25(.4)	98(1.2)	286(1.4)	12(.2)	4(T)	47(T)	0	0	473(3.2)
2-73	19(.2)	104(.4)	239(1.3)	14(.2)	1(T)	42(T)	0	0	419(2.1)
2-73	28(.1)	136(1.8)	212(1.3)	37(.6)	2(T)	62(T)	0	0	477(3.8)
East Rosebud River-Station 046-Bridge 4 miles Below Roscoe									
10-71	17(.1)	62(.2)	87(.3)	10(.1)	8(T)	0	26(T)	0	210(.7)
10-71	14(.3)	67(.7)	94(.2)	17(.2)	10(T)	0	35(T)	0	237(1.4)
10-71	25(.2)	99(1.1)	137(.5)	16(.2)	8(T)	0	29(T)	0	314(2.0)
2-72	13(.1)	25(.1)	86(.5)	2(.1)	0	0	0	0	126(.8)
2-72	28(.1)	50(.2)	272(1.1)	2(T)	0	0	0	0	352(1.4)
2-72	14(T)	71(.3)	229(.7)	1(T)	0	0	0	0	315(1.0)
5-72	6(.4)	159(.5)	141(.5)	5(T)	2(T)	4(0.8)	0	0	317(2.2)
5-72	8(T)	92(.1)	44(.4)	17(.1)	2(T)	15(T)	0	0	178(.6)
5-72	12(.1)	36(.3)	169(.6)	8(T)	1(T)	0	0	0	226(1.0)

TABLE 11. (continued)

Date	Plecoptera	Tricoptera	Ephemeroptera	Diptera	Coleoptera	Annelida	Nematoda	Other	Total
8-72	4(T)	23(.1)	76(T)	46(T)	1(T)	3(T)	0	0	153(.1)
8-72	17(T)	56(.2)	153(T)	61(.1)	1(T)	6(T)	0	0	294(.3)
8-72	23(T)	30(.1)	136(.1)	28(.2)	6(T)	2(T)	2(T)	0	227(.4)
2-73	36(.2)	48(.2)	205(1.0)	20(.8)	0	37(T)	0	1(T)	347(2.2)
2-73	9(T)	15(.1)	195(.8)	52(1.7)	0	0	0	0	271(2.6)
2-73	25(.4)	45(.3)	134(.7)	46(1.3)	1(T)	9(T)	1(T)	2(T)	263(2.7)
			West Rosebud River-Station 003-Pine Grove Campground						
8-70	50	3	102	31	4	5	0	2	197
4-71	18(.1)	17(.3)	103(.3)	13(T)	2(T)	0	63(T)	0	216(.7)
10-71	37(.1)	8(.1)	106(.3)	4(T)	3(T)	18(T)	0	0	318(.8)
10-71	59(.4)	16(.1)	260(.2)	9(.1)	5(T)	71(T)	0	0	420(.8)
10-71	62(.3)	27(.2)	249(.3)	5(.1)	1(.1)	15(T)	0	0	359(1.0)
2-72	60(.7)	41(.7)	288(.7)	15(T)	4(.1)	20(T)	4(T)	0	432([illegible])
2-72	155(.3)	32(.4)	400(.8)	49(.1)	7(T)	54(T)	0	0	697(1.6)
2-72	24(.2)	23(.3)	350(.6)	4(.1)	5(T)	3(T)	0	0	409(1.2)
5-72	8(T)	11(T)	55(.1)	23(.1)	13(T)	98(T)	0	0	208(.2)
5-72	20(.1)	10(T)	146(.3)	24(.4)	0	26(T)	0	0	226(.8)
5-72	19(.1)	10(T)	110(.6)	18(.1)	8(T)	116(T)	0	0	281(.8)
8-72	94(.1)	2(T)	59(T)	16(.6)	3(T)	91(T)	0	0	265(.7)
8-72	28(.1)	1(.1)	86(.1)	5(T)	0	1(T)	0	0	121(.3)
8-72	60(.2)	5(T)	162(.1)	6(.1)	0	95(.1)	0	0	328(.5)
2-73	33(.1)	14(.2)	87(.3)	8(.1)	5(T)	21(T)	0	0	168(.7)
2-73	41(.3)	14(.2)	152(.5)	37(.4)	14(T)	90(T)	0	0	348(1.4)
2-73	163(1.1)	66(1.7)	577(1.9)	46(.2)	10(.1)	149(T)	0	0	1011(5.0)

TABLE 11. (continued)

Date	Plecoptera	Tricoptera	Ephemeroptera	Diptera	Coleoptera	Amelida	Nematoda	Other	Total
West Rosebud River-Station 004-First Bridge Below Pine Grove Campground									
8-70	28	64	62	49	4	16	0	1	224
4-71	39(.4)	123(1.0)	219(.7)	6(T)	4(T)	0	62(T)	0	453(1.2)
10-71	6(.1)	12(.1)	48(.1)	3(T)	1(T)	11(T)	0	0	81(.3)
10-71	7(T)	14(.1)	36(.1)	5(T)	0	4(T)	0	0	66(.2)
	34(T)	20(.2)	97(.2)	10(.1)	3(.1)	9(T)	0	0	173(.6)
2-72	14(.1)	23(.1)	162(.5)	2(T)	4(T)	29(T)	0	0	234(.7)
2-72	18(.1)	28(.2)	107(.5)	2(T)	2(T)	25(T)	0	0	182(.8)
2-72	16(.2)	108(.5)	214(.8)	2(.1)	1(T)	11(T)	0	0	352(1.6)
5-72	4(T)	6(.1)	14(.1)	11(.1)	1(T)	35(T)	0	1(T)	72(.3)
5-72	7(.1)	5(.1)	45(.3)	20(.2)	0	19(.5)	0	0	96(1.2)
5-72	5(T)	8(T)	12(.1)	17(.4)	1(T)	52(T)	0	2(T)	97(.5)
8-72	21(T)	1(T)	30(T)	6(T)	4(T)	71(T)	0	0	133( )
8-72	17(T)	3(T)	38(T)	7(T)	1(T)	102(T)	0	0	168( )
8-72	16(T)	7(.1)	21(.1)	6(.1)	1(T)	75(T)	0	0	126(.3)
2-73	22(T)	43(.1)	107(.4)	5(.1)	0	31(T)	0	1(T)	209(.6)
2-73	50(.1)	35(.1)	266(.9)	3(T)	2(T)	20(T)	0	0	376(1.1)
2-73	14(T)	54(.1)	34(.2)	5(.3)	0	17(T)	0	0	124(.6)
West Rosebud River-Station 029-Wigwam Ranch Bridge									
8-70	5	18	127	59	10	0	0	0	219
4-71	29(.1)	53(.3)	190(.4)	22(T)	11(T)	1(T)	44(T)	0	350(.8)
10-71	52(.4)	76(2.0)	167(.7)	43(.1)	5(T)	41(T)	0	0	384(3.2)
10-71	27(.3)	101(.4)	134(.3)	38(T)	7(T)	35(T)	0	0	342(1.0)

TABLE 11. (continued)

Date	Plecoptera	Tricoptera	Ephemeroptera	Diptera	Coleoptera	Annelida	Nematoda	Other	Total
10-71	43(.2)	57(.5)	172(.4)	29(.1)	6(T)	51(T)	0	0	358(1.2)
2-72	27(.2)	152(1.1)	117(.4)	5(.1)	2(T)	7(T)	0	0	310(1.8)
2-72	25(T)	59(.5)	76(.2)	19(T)	3(T)	13(T)	0	1(T)	196(.7)
2-72	24(.4)	82(.2)	98(.5)	20(.1)	7(T)	1(T)	0	1(T)	233(1.2)
5-72	18(.5)	192(1.0)	96(1.0)	34(.1)	10(T)	77(T)	1(T)	0	428(2.6)
5-72	21(.3)	82(.6)	123(.2)	39(.2)	13(.1)	52(.1)	0	0	330(1.5)
5-72	5(.3)	108(.5)	22(.3)	22(.1)	19(T)	9(T)	0	3(T)	188(1.2)
8-72	20(.5)	94(.2)	290(.2)	66(T)	12(T)	49(T)	0	0	531(.9)
8-72	1(T)	9(T)	57(T)	21(T)	11(T)	42(T)	0	3(T)	144(T)
8-72	32(T)	29(.1)	150(.1)	46(T)	21(T)	164(T)	2(T)	1(T)	445(.2)
2-73	12(T)	22(T)	80(.6)	10(T)	5(T)	16(T)	0	0	145(.6)
2-73	8(T)	28(.4)	51(.3)	32(.2)	0	5(T)	0	0	124(.9)
2-73	21(.3)	18(.2)	43(.2)	16(T)	1(T)	9(T)	0	1(T)	109(.7)
Fishtail Creek-Station 030-Bridge near 4K Ranch									
10-71	34(T)	4(T)	71(.1)	72(1.1)	12(T)	3(T)	0	0	196(1.2)
10-71	14(T)	1(T)	19(.1)	20(2.1)	7(T)	2(T)	0	0	63(2.2)
10-71	38(.1)	15(.1)	85(.1)	59(1.3)	11(.1)	2(T)	0	0	210(1.7)
2-72	17(.3)	51(T)	119(.3)	322(1.9)	40(T)	1(T)	0	52(.1)	602(2.6)
2-72	26(T)	78(.1)	126(.2)	424(3.5)	103(.1)	0	3(T)	23(T)	783(3.9)
2-72	8(T)	78(.1)	113(.2)	826(.4)	80(T)	0	0	31(T)	1140(.7)
5-72	18(.1)	203(1.1)	103(.4)	46(.1)	5(T)	91(.1)	0	36(.1)	502(.19)
5-72	6(.1)	36(.4)	42(.2)	23(T)	1(T)	31(T)	0	0	139(.7)
5-72	7(T)	50(.1)	184(.8)	12(T)	5(T)	109(.1)	0	31(.1)	398(1.1)

TABLE 11. (continued)

Date	Plecoptera	Tricoptera	Ephemeroptera	Diptera	Coleoptera	Annelida	Nematoda	Other	Total
8-72	8(T)	56(.2)	80(.2)	36(T)	4(.1)	8(T)	0	17(.1)	209(.6)
8-72	14(.1)	30(.1)	49(.1)	7(T)	8(T)	3(T)	0	15(.1)	126(.4)
8-72	23(T)	38(T)	68(.1)	39(.7)	5(T)	30(T)	0	50(.1)	253(.9)
2-73	54(.1)	69(.2)	359(.7)	32(T)	9(T)	125(T)	10(T)	44(.1)	702(1.1)
2-73	144(.7)	122(1.5)	528(1.2)	97(.1)	12(T)	289(T)	0	188(.5)	1380(4.0)
2-73	49(.1)	73(.5)	269(.4)	35(.1)	10(T)	98(.1)	5(T)	80(.2)	619(1.4)
				Fishtail Creek-Station 045-Mouth of Sheep Creek					
10-71	54(.6)	120(1.2)	140(.3)	27(.3)	11(.1)	94(.1)	0	2(T)	448(2.5)
10-71	28(.1)	111(1.1)	139(.2)	78(.1)	15(T)	146(.1)	0	1(T)	518(1.6)
10-71	41(.8)	102(1.1)	111(.2)	23(.1)	10(T)	88(T)	0	0	375(2.2)
2-72	35(.5)	233(.5)	222(.6)	80(.1)	15(.1)	97(.1)	0	0	682(1.9)
2-72	33(.3)	215(.4)	172(.5)	21(.5)	8(T)	46(T)	0	0	495(1.[illegible])
2-72	6(.1)	34(.2)	62(.2)	9(.1)	6(T)	16(T)	0	0	133(.[illegible])
5-72	11(.4)	58(.3)	61(.4)	40(.1)	19(.1)	24(T)	0	3(T)	216(1.3)
5-72	6(.1)	118(.5)	47(.2)	28(.1)	15(T)	39(T)	0	3(T)	256(0.9)
5-72	5(.1)	45(.1)	57(.4)	34(.2)	17(T)	19(T)	0	3(T)	180(.8)
8-72	16(.3)	14(.1)	191(.5)	24(.3)	19(T)	16(T)	1(T)	3(T)	284(1.2)
8-72	22(.5)	31(.4)	161(1.2)	22(.1)	17(.1)	17(T)	3(T)	2(T)	275(2.3)
8-72	6(.2)	6(T)	39(.5)	26(.1)	3(T)	16(T)	1(T)	3(T)	100(.8)
2-73	75(.2)	109(1.0)	328(.5)	91(.1)	9(T)	28(T)	0	0	640(1.8)
2-73	34(1.7)	144(.6)	229(.3)	29(T)	22(T)	20(T)	0	1(T)	479(2.6)
2-73	108(.4)	130(.8)	623(1.2)	63(.2)	12(T)	83(T)	0	1(T)	1020(2.6)

TABLE 11. (continued)

Date	Plecoptera	Tricoptera	Ephemeroptera	Diptera	Coleoptera	Amelida	Nemotoda	Other	Total
Little Rocky Creek-Station 015-Little Rocky Campground									
8-72	62(.1)	27(.1)	74(.4)	10(T)	6(T)	127(T)	0	4(T)	310(.6)
8-72	17(.1)	11(.1)	47(.4)	3(T)	4(T)	10(T)	0	0	92(.6)
8-72	41(.1)	60(.7)	129(.5)	22(.1)	2(T)	167(.1)	0	14(.1)	435(1.6)
Little Rocky Creek-Station 031-Highway 419 Crossing									
10-71	34(T)	4(T)	71(.1)	72(1.1)	12(T)	3(T)	0	0	196(1.2)
10-71	14(T)	1(T)	19(.1)	20(2.1)	7(T)	2(T)	0	0	63(2.2)
10-71	38(.1)	15(.1)	85(.1)	59(1.3)	11(.1)	2(T)	0	0	210(1.7)
2-72	17(.3)	51(T)	119(.3)	322(1.9)	40(T)	1(T)	0	52(.1)	602(2.6)
2-72	26(T)	78(.1)	126(.2)	424(3.5)	103(.1)	0	3(T)	23(T)	783([illegible])
2-72	8(T)	78(.1)	113(.2)	826(.4)	80(T)	0	0	31(T)	1140(.7)
5-72	1(T)	67(.4)	92(.5)	247(.5)	22(.1)	1(T)	0	16(T)	446(5.3)
5-72	5(.1)	103(.3)	60(.1)	164(.5)	12(T)	2(T)	0	14(.1)	360(1.1)
5-72	5(.1)	65(.3)	117(.7)	170(1.5)	7(T)	6(T)	1	17(.1)	388(2.7)
8-72	14(T)	56(.6)	218(.5)	15(.1)	24(T)	0	0	12(.1)	339(1.3)
8-72	8(T)	46(.4)	89(.4)	9(T)	2(T)	0	0	1(T)	155(.8)
8-72	17(T)	28(.2)	157(.2)	20(T)	19(.1)	0	0	5(T)	246(.5)
2-73	28(.4)	101(.6)	113(.5)	171(.4)	48(.1)	0	13(T)	27(.1)	501(2.1)
2-73	16(.1)	93(.5)	51(.3)	172(1.0)	65(.1)	6(T)	15(T)	13(T)	431(2.0)
2-73	44(.1)	62(.1)	148(.2)	432(2.3)	46(T)	0	1(T)	30(T)	763(2.7)

TABLE 11. (continued)

Date	Plecoptera	Tricoptera	Ephemeroptera	Diptera	Coleoptera	Annelida	Nematoda	Other	Total
Stillwater River-Station 005-Woodbine Campground									
8-70	43	18	74	168	4	2	0	0	309
4-71	15(.1)	9(.1)	163(.2)	5(T)	1(T)	0	10(T)	0	203(.4)
10-71	30(.1)	14(.3)	85(.1)	22(T)	2(T)	27(T)	0	0	180(.5)
10-71	24(.1)	22(.3)	84(.1)	40(T)	3(T)	39(T)	0	0	212(.5)
10-71	5(T)	5(T)	48(.1)	3(T)	1(T)	5(T)	0	0	67(.1)
2-72	61(.2)	14(.2)	329(.5)	7(T)	1(T)	0	1(T)	0	413(.9)
2-72	39(.1)	11(.2)	344(.7)	5(.1)	0	1(T)	0	0	400(1.1)
2-72	69(.5)	6(T)	215(.3)	7(T)	1(T)	0	2(T)	0	300(.8)
5-72	0	0	108(.4)	1(T)	0	0	0	0	109(.4)
5-72	14(.3)	1(T)	154(.6)	10(.1)	0	0	0	0	179(1.0)
5-72	12(.1)	2(.1)	97(.5)	7(.1)	3(T)	41(T)	0	0	162(.8)
8-72	5(T)	1(T)	14(T)	12(T)	0	0	0	0	32(T)
8-72	10(T)	0	12(T)	16(T)	1(T)	0	0	0	39
8-72	5(.1)	6(T)	24(.1)	19(T)	0	0	0	0	54(.2)
2-73	19(.3)	2(T)	360(.5)	8(T)	1(T)	0	1(T)	0	391(.8)
2-73	30(.1)	5(T)	403(.4)	11(.1)	2(T)	0	0	0	451(.6)
2-73	47(.2)	26(.3)	366(.7)	29(T)	0	0	3(T)	0	471(1.2)
Stillwater River-Station 006-1.4 miles Below Mouat Mill									
8-70	11	4	145	41	2	0	0	0	203
4-71	92(.4)	83(.3)	300(.1)	65(T)	0	0	0	0	540(.8)
10-71	30(.3)	52(.6)	254(.3)	63(.2)	0	1(T)	0	0	400(1.4)
10-71	10(.1)	2(.4)	135(.3)	8(.4)	0	4(T)	0	0	159(1.2)
10-71	19(.1)	12(.3)	71(.2)	5(.1)	0	0	0	0	107(.7)

TABLE 11. (continued)

Date	Plecoptera	Tricoptera	Ephemeroptera	Diptera	Coleoptera	Annelida	Nematoda	Other	Total
2-72	126(.3)	51(.9)	409(.9)	105(.1)	1(T)	23(T)	0	1(T)	716(2.2)
2-72	29(T)	26(.2)	339(.8)	41(.1)	0	2(T)	0	1(T)	438(1.1)
2-72	100(.6)	39(.4)	456(.8)	45(T)	0	7(T)	0	1(T)	648(1.8)
5-72	41(.7)	5(T)	152(.2)	29(.2)	0	2(T)	0	0	229(1.1)
5-72	17(.2)	0	84(.3)	13(T)	0	27(T)	0	0	141(.5)
5-72	14(.1)	1(T)	98(.2)	6(T)	0	6(T)	0	0	125(.3)
8-72	13(.2)	4(T)	86(.1)	28(.2)	1(T)	9(T)	0	1(T)	142(.5)
8-72	19(T)	3(.1)	110(.2)	17(T)	2(T)	15(T)	0	1(T)	167(.3)
8-72	3(T)	0	70(.2)	10(.1)	0	0	0	0	83(.3)
2-73	55(.2)	17(.1)	195(.2)	28(T)	1(T)	0	1(T)	0	297(.5)
2-73	130(.5)	97(.9)	461(.9)	120(.4)	0	23(T)	1(T)	0	832(2.7)
2-73	47(.1)	35(.5)	241(.8)	20(T)	1(T)	0	1(T)	0	345(1.4)
				Stillwater River-Station 032-USGS Gaging Station					
4-71	31(.1)	131(.5)	505(.7)	120(.1)	3(.1)	0	0	0	790(2.5)
10-71	30(.2)	13(.1)	89(.2)	13(.1)	2(T)	0	0	0	147(.6)
10-71	20(.1)	15(.1)	57(.3)	20(.1)	2(T)	3(T)	1(T)	1(T)	119(.2)
10-71	24(T)	4(T)	61(.2)	1(T)	0	0	0	0	90(.2)
2-72	30(.2)	58(.3)	225(.8)	47(.3)	4(T)	24(T)	0	0	388(1.6)
2-72	44(.1)	86(.8)	201(1.0)	32(.3)	0	25(T)	0	0	388(2.2)
2-72	32(.1)	18(.1)	125(.5)	28(.1)	3(T)	46(T)	0	0	252(.8)
5-72	18(.2)	3(T)	161(.4)	5(T)	0	0	0	0	187(.6)
5-72	14(.1)	5(.1)	139(.3)	4(T)	0	2(T)	0	0	164(.5)
5-72	24(.3)	9(.1)	223(.5)	5(T)	0	0	0	0	261(.9)
8-72	32(.1)	3(T)	206(.3)	32(T)	0	0	0	0	273(.4)
8-72	38(T)	0	111(.1)	21(T)	0	0	0	0	170(.1)
8-72	13(.1)	3(T)	120(.2)	21(T)	1(T)	0	0	0	158(.3)
2-73	14(.1)	80(.5)	81(.5)	64(.3)	3(T)	19(T)	0	0	261(1.4)
2-73	36(.4)	107(.4)	140(.8)	80(.3)	2(T)	33(T)	0	4(T)	402(1.9).
2-73	103(.2)	94(.2)	180(.9)	78(.4)	4(T)	133(T)	1(T)	0	593(1.7)

TABLE 11. (continued)

Date	Plecoptera	Tricoptera	Ephemeroptera	Diptera	Coleoptera	Annelide	Nematoda	Other	Total
Stillwater River-Station 033-Moraine Fishing Access									
8-70	47	31	163	26	3	3	0	2	275
4-71	25(.1)	101(.9)	154(.6)	3(T)	3(.1)	18(T)	0	0	304(1.7)
10-71	91(.5)	105(1.1)	388(1.3)	64(.3)	1(T)	2(T)	0	0	651(1.7)
10-71	67(.2)	179(1.0)	197(.7)	39(.6)	1(T)	8(T)	0	0	491(2.5)
10-71	57(.3)	91(1.0)	177(.9)	229(.5)	4(T)	23(T)	0	1(T)	582(2.7)
2-72	89(.5)	156(1.8)	401(.9)	185(.4)	18(.1)	70(T)	2(T)	0	921(3.7)
2-72	93(1.1)	125(.8)	465(1.5)	99(.4)	5(T)	114(.1)	0	2(T)	903(3.9)
2-72	68(.7)	122(.7)	297(2.2)	65(.3)	3(T)	54(T)	0	1(T)	610(3.9)
5-72	34(.2)	25(.1)	215(1.0)	11(.1)	2(T)	2(T)	0	0	289(1.4)
5-72	13(.5)	6(.2)	105(.7)	3(.1)	2(T)	0	0	0	129(1.5)
5-72	24(.2)	17(.3)	82(.5)	14(T)	0	72(T)	0	0	209(1.0)
8-72	57(.1)	6(T)	188(.2)	35(T)	9(T)	4(T)	1(T)	0	300(.3)
8-72	73(T)	2(T)	180(.3)	37(.2)	30(T)	9(T)	0	0	331(
8-72	37(.4)	4(T)	253(.5)	25(.2)	2(T)	0	0	0	321(1.1)
2-73	141(2.8)	158(1.6)	225(1.8)	323(.2)	3(T)	35(T)	1(T)	2(T)	888(6.4)
2-73	124(.7)	143(1.0)	204(1.1)	100(1.0)	8(T)	118(T)	0	7(T)	704(3.8)
2-73	48(1.5)	70(1.0)	203(1.4)	134(.4)	5(T)	62(T)	0	3(T)	525(4.3)
Stillwater River-Station 034-Midnight Canyon Bridge									
8-70	21	41	159	30	7	0	0	0	258
4-71	45(.3)	198(.7)	577(1.0)	48(.2)	10(T)	0	0	0	878(2.2)
8-71	41(.6)	51(.2)	112(.8)	121(.4)	13(T)	0	0	0	338(1.8)
8-71	47(1.6)	425(2.1)	191(.5)	46(.3)	9(T)	67(T)	0	0	785(4.5)
8-71	36(1.5)	197(3.3)	151(.7)	101(.4)	19(T)	0	9(T)	0	513(5.9)
2-72	156(.6)	216(.6)	320(1.3)	228(.7)	7(T)	84(T)	14(.1)	2	1027(3.3)
2-72	66(.6)	168(.7)	210(.3)	142(.5)	6(T)	22(T)	0	0	614(2.1)

TABLE 11. (continued)

Date	Plecoptera	Tricoptera	Ephemeroptera	Diptera	Coleoptera	Annelida	Nematoda	Other	Total
2-72	112(.7)	276(1.0)	238(.6)	167(.4)	10(.1)	98(T)	3(T)	1(T)	905(2.8)
5-72	15(.1)	2(T)	188(1.2)	4(T)	0	2(T)	0	0	211(1.3)
5-72	12(T)	1(T)	345(1.7)	135(.1)	1(T)	7(T)	0	0	501(1.8)
5-72	16(.1)	3(T)	108(.3)	20(.1)	1(T)	10(T)	0	0	158(.5)
8-72	61(.2)	103(.2)	348(.5)	75(.3)	10(T)	32(T)	0	4(T)	634(1.2)
8-72	43(.1)	45(.1)	293(.3)	74(.3)	7(T)	33(T)	0	2(T)	497(.8)
8-72	21(.1)	34(.2)	112(.2)	22(T)	5(T)	0	0	0	194(.5)
2-73	185(1.5)	234(1.9)	325(1.6)	163(1.3)	3(T)	167(T)	1(T)	0	1081(6.3)
2-73	28(.7)	95(.7)	169(.8)	108(.3)	11(T)	68(T)	3(T)	1(T)	483(2.5)
2-73	26(1.5)	56(.3)	171(1.1)	69(.5)	5(T)	57(T)	0	2(T)	386(3.4)
				Stillwater River-Station 035-Johnson Bridge					
8-70	29	74	64	324	1	2	0	0	494
10-71	41(.4)	524(8.8)	156(.2)	28(T)	19(T)	0	29(T)	0	797(9[illegible])
10-71	39(.2)	533(9.1)	109(.5)	42(.3)	24(T)	0	20(T)	0	767(1[illegible]1)
10-71	32(.1)	242(3.1)	205(.4)	60(.6)	14(T)	0	30(T)	0	583(4.2)
2-72	51(.5)	190(1.3)	119(.8)	13(.2)	17(T)	18(T)	1(T)	0	409(2.8)
2-72	22(.4)	82(.7)	112(.3)	10(T)	5(T)	9(T)	0	0	240(1.4)
2-72	26(.2)	248(1.7)	162(.2)	31(.5)	19(.1)	41(T)	2(T)	0	529(2.7)
5-72	3(.1)	3(T)	9(.1)	30(.1)	0	1(T)	0	0	46(.3)
5-72	2(T)	0	4(.1)	35(.1)	0	7(T)	0	0	48(.2)
5-72	7(T)	28(.2)	106(.7)	258(1.1)	10(T)	7(T)	0	1[3]	417(2.0)

[3] Snail - no volume taken

TABLE 11.

Date	Plecoptera	Tricoptera	Ephemeroptera	Diptera	Coleoptera	Annelida	Nematoda	Other	Total
8-72	7(T)	80(.3)	50(.2)	137(.1)	0	0	0	0	274(.6)
8-72	5(T)	174(1.2)	41(.2)	136(.1)	6(T)	0	3(T)	0	365(1.5)
8-72	5(T)	38(.1)	81(.3)	110(.1)	5(T)	0	1(T)	0	240(.5)
2-73	42(.7)	338(2.8)	328(.5)	117(.6)	15(T)	40(T)	0	0	880(4.6)
2-73	26(.6)	345(3.8)	500(.8)	165(.5)	9(T)	28(T)	1(T)	0	1074(5.7)
2-73	66(1.5)	499(5.7)	421(.7)	155(1.0)	31(.1)	59(T)	1(T)	0	1233(9.0)
			West Fork Stillwater River-Station 037-Initial Creek Campground						
8-70	19	18	208	20	0	0	0	0	265
10-71	53(.1)	47(.1)	94(.4)	3(T)	0	24(T)	0	0	221(.6)
10-71	65(T)	35(.2)	137(.4)	3(T)	2(T)	39(T)	0	0	281(.6)
10-71	43(T)	28(.1)	74(.2)	7(.4)	1(T)	17(T)	0	0	170(.[illegible])
5-72	1(T)	6(T)	6(.1)	1(T)	0	33(.1)	0	0	47(.2)
5-72	4(T)	3(T)	7(.1)	4(T)	0	46(T)	0	0	64(.1)
5-72	9(T)	11(.1)	48(.2)	19(.1)	0	140(.1)	0	1(T)	228(.5)
8-72	24(T)	12(T)	66(.3)	5(.1)	0	67(T)	0	0	174(.4)
8-72	21(T)	6(T)	44(.2)	11(T)	0	50(T)	0	0	132(.2)
8-72	13(T)	6(T)	71(.2)	4(.1)	0	34(T)	0	0	128(.3)
			West Fork Stillwater River-Station 007-Henry Grant's Cabin Bridge						
8-70	18	15	224	8	4	3	0	0	272
4-71	69(.1)	14(.1)	228(1.2)	5(T)	8(T)	0	23(T)	0	347(1.4)
10-71	90(.2)	13(T)	64(.1)	3(.3)	36(T)	99(T)	0	0	305(.6)

TABLE 11. (continued)

Date	Plecoptera	Tricoptera	Ephemeroptera	Diptera	Coleoptera	Annelida	Nematoda	Other	Total
10-71	71(.4)	25(.1)	138(.3)	18(.3)	11(T)	3(T)	0	0	266(1.1)
10-71	103(.2)	20(.4)	70(.3)	2(.4)	1(T)	27(T)	0	0	233(1.3)
2-72	186(.2)	22(.2)	89(.5)	13(.3)	0	17(T)	4(T)	3(T)	334(1.2)
2-72	170(.4)	37(.2)	115(.6)	64(2.5)	0	36(T)	0	4(T)	426(3.7)
2-72	230(.5)	25(.2)	196(1.1)	59(2.5)	2(T)	13(T)	1(T)	2(T)	528(4.3)
5-72	48(.1)	6(.1)	366(.9)	10(T)	0	31(T)	0	0	461(1.1)
5-72	54(.1)	9(T)	260(.6)	104(.2)	3(T)	19(T)	0	1(T)	450(.9)
5-72	61(.1)	31(.2)	283(1.1)	24(.2)	6(T)	38(T)	0	1(T)	444(1.6)
8-72	76(.2)	6(T)	97(.3)	59(.1)	1(T)	62(T)	0	1(T)	302(.6)
8-72	6(T)	3(T)	29(.1)	2(T)	1(T)	2(T)	0	0	43(.1)
8-72	25(.1)	1(T)	39(.2)	11(.7)	1(T)	0	0	2(T)	79(1.0)
2-73	277(.4)	46(.4)	265(1.3)	26(.3)	3(T)	195(T)	0	10(T)	822(2.4)
2-73	71(.2)	55(.4)	251(1.5)	20(.1)	4(T)	108(T)	0	14(T)	523(2.2)
2-73	100(.6)	73(.5)	214(1.4)	41(.7)	15(T)	333(.1)	11(T)	17(T)	804(3.7)
			West Fork Stillwater River-Station -36-Nye Bridge, So. Channel						
8-70	26	27	207	16	3	18	0	1	298
10-71	85(.4)	17(.3)	182(1.1)	80(.2)	8(T)	0	34(T)	0	406(2.0)
10-71	26(.1)	58(.5)	93(.6)	13(T)	9(T)	0	24(T)	0	223(1.2)
10-71	40(.3)	26(.4)	136(1.1)	82(.3)	5(T)	0	8(T)	0	297(2.1)
2-72	153(.5)	23(.1)	348(1.6)	180(.3)	8(T)	242(.1)	0	1(T)	955(2.6)
2-72	161(.7)	38(.6)	441(2.4)	80(.6)	13(T)	187(.1)	1(T)	4(T)	925(4.4)
2-72	83(.2)	39(.3)	136(.6)	31(.1)	9(.1)	52(T)	0	1(T)	351(1.3)
5-72	17(.5)	0	88(.4)	11(T)	3(T)	10(T)	0	2(T)	131(.9)
5-72	22(.1)	2(T)	68(.5)	37(.1)	1(T)	7(T)	0	0	137(.7)

TABLE 11. (continued)

Date	Plecoptera	Tricoptera	Ephemeroptera	Diptera	Coleoptera	Annelida	Nemstoda	Other	Total
5-72	12(.5)	3(.1)	28(.7)	0	0	0	0	0	43(1.3)
8-72	27(T)	7(.1)	79(.3)	32(T)	4(T)	109(T)	5(T)	3(T)	266(.4)
8-72	29(.1)	5(.3)	124(.1)	25(.2)	6(T)	11(T)	0	1(T)	201(.7)
8-72	58(.3)	29(.5)	151(.4)	29(T)	4(T)	66(T)	0	2(T)	339(1.2)
2-73	227(1.6)	47(.6)	419(2.1)	134(.3)	5(T)	142(T)	0	1(T)	975(4.6)
2-73	89(.5)	27(.2)	324(2.5)	56(1.3)	9(T)	190(.1)	0	3(T)	698(4.6)
2-73	36(.1)	33(.1)	121(.8)	32(.3)	2(T)	63(T)	0	5(T)	292(1.3)
East Boulder River-Station 038-Placer Basin									
8-72	15(.1)	14(T)	12(T)	15(.5)	15(T)	1(T)	0	2(T)	74(.6)
8-72	40(.1)	6(T)	53(.2)	12(T)	10(T)	3(T)	0	1(T)	125(.3)
8-72	38(.1)	20(.1)	28(.2)	9(.2)	19(T)	0	1(T)	2(T)	117(.6)
East Boulder River-Station 008-Anderson Springs									
10-70	63	52	239	64	24	1	0	7	450
4-71	54(.1)	8(T)	120(.3)	1(T)	12(T)	0	22(T)	0	217(.4)
10-71	12(T)	8(.2)	55(.3)	0	5(T)	0	5(T)	0	85(.5)
10-71	83(.3)	43(.3)	135(.8)	13(T)	16(T)	1(T)	18(T)	0	309(1.4)
10-71	89(1.0)	33(1.2)	118(.6)	9(T)	7(T)	0	2(T)	0	258(1.8)
2-72	106(.5)	8(.1)	174(1.0)	10(.3)	6(T)	28(T)	0	7(T)	339(1.9)
2-72	103(.5)	12(.1)	171(.8)	13(.1)	2(T)	11(T)	0	5(T)	317(1.5)
2-72	107(.5)	11(T)	111(.5)	4(T)	5(T)	10(T)	0	1(T)	249(1.0)

TABLE 11. (continued)

Date	Plecoptera	Tricoptera	Ephemeroptera	Diptera	Coleoptera	Annelida	Nematoda	Other	Total
5-72	27(.5)	12(.1)	137(.7)	4(T)	10(.1)	28(T)	0	1(T)	219(1.4)
5-72	53(.1)	12(T)	208(.7)	8(.4)	13(.1)	146(.1)	0	5(T)	445(1.4)
5-72	20(.1)	12(.1)	105(.3)	7(.3)	17(.1)	59(.1)	0	5(T)	225(1.0)
8-72	2(T)	16(.1)	28(.2)	4(T)	0	0	0	0	50(.3)
8-72	26(.1)	55(.2)	81(.3)	4(T)	1(T)	1(T)	0	9(.1)	177(.7)
8-72	36(.1)	24(T)	93(.3)	39(.1)	6(T)	31(T)	0	5(T)	234(.5)
2-73	43(.2)	26(.4)	166(1.0)	9(T)	25(T)	20(T)	0	4(T)	293(1.6)
2-73	37(.1)	9(.2)	130(.2)	3(T)	3(T)	7(T)	0	3(T)	192(.5)
2-73	68(.3)	10(.2)	243(1.8)	14(T)	14(T)	59(T)	1(T)	6(T)	415(2.3)
			East Boulder River-Station 009-Ewan Campground						
10-70	98	162	152	261	4	0	0	0	677
4-71	82(.1)	217(2.0)	585(1.0)	790(.9)	10(T)	0	10(T)	0	1694(4.9)
10-71	44(1.1)	279(3.2)	142(1.8)	124(1.7)	4(T)	0	51(T)	0	644(7.[illegible]
10-71	64(.7)	307(4.1)	146(1.4)	138(.5)	2(T)	0	23(T)	0	682(6.[illegible]
10-71	76(1.3)	385(5.4)	142(1.0)	236(1.5)	2(T)	0	49(T)	0	890(9.2)
2-72	226(.6)	353(2.5)	599(.8)	1077(.8)	5(T)	166(T)	2(T)	2(T)	2430(4.7)
2-72	207(2.5)	104(.4)	320(.4)	1176(.8)	10(T)	269(T)	3(T)	0	2089(4.1)
2-72	70(.2)	184(.9)	194(.2)	337(.5)	4(T)	102(T)	0	2(T)	893(1.7)
5-72	8(.2)	13(.1)	39(.2)	63(2.2)	1(T)	41(T)	0	6(T)	171(2.7)
5-72	10(.1)	54(.4)	200(.8)	193(1.8)	6(T)	74(T)	0	9(T)	546(3.1)
5-72	7(.1)	34(.1)	169(1.1)	260(2.1)	3(T)	8(T)	6(T)	1(T)	488(3.4)
8-72	98(.3)	35(.4)	311(.6)	165(.2)	5(T)	17(T)	1(T)	4(T)	636(1.5)
8-72	154(.5)	14(.1)	224(.6)	135(.7)	10(T)	8(T)	0	10(.1)	555(2.0)
8-72	34(.1)	41(.4)	84(.2)	122(.2)	2(T)	23(T)	0	1(T)	307(.9)
2-73	42(1.8)	508(1.8)	145(.3)	161(1.3)	39(T)	18(T)	0	4(T)	917(5.2)
2-73	268(2.3)	261(1.8)	104(.4)	762(2.4)	31(T)	0	0	2(T)	1428(6.9)
2-73	170(1.9)	266(1.1)	69(.2)	963(2.9)	47(.1)	0	2(T)	0	1517(6.2)

TABLE 11. (continued)

Date	Plecoptera	Tricoptera	Ephemeroptera	Diptera	Coleoptera	Annelida	Nematoda	Other	Total
Boulder River-Station 011-Flemming Bridge									
10-70	31	67	103	16	0	33	0	0	250
4-71	127(1.2)	29(.4)	131(1.4)	34(T)	0	0	37(T)	0	358(3.0)
10-71	51(.1)	18(.2)	39(.1)	6(T)	0	0	6(T)	0	120(.4)
10-71	75(.2)	33(.7)	292(.9)	2(.4)	0	0	34(T)	0	436(2.2)
10-71	19(.1)	18(.7)	101(.4)	0	0	0	8(T)	0	146(1.2)
5-72	22(.5)	4(.1)	29(.1)	66(.4)	0	1(T)	0	2(T)	124(1.1)
5-72	16(.7)	0	11(T)	61(T)	0	0	0	0	88(.7)
5-72	20(.1)	1(T)	12(.1)	2(T)	0	0	0	0	35(.2)
8-72	28(.8)	12(T)	113(.3)	6(T)	0	3(T)	2(T)	2(T)	166(1.1)
8-72	15(T)	48(.2)	126(.6)	12(.5)	0	0	0	1(T)	202(1.3)
8-72	30(1.0)	78(.4)	190(.5)	13(T)	2(T)	6(T)	2(T)	3(T)	324(1.9)
2-73	11(.2)	47(.5)	230(.8)	2(T)	0	4(T)	0	1(T)	295(1.5)
2-73	10(.1)	43(.4)	310(1.5)	3(T)	0	15(T)	0	2(T)	383(2.[illegible])
2-73	56(.2)	93(.3)	237(1.0)	10(T)	1(T)	5(T)	0	3(T)	406(1.[illegible])
Boulder River-Station 050-Clydehurst Ranch									
10-70	35	28	138	5	3	13	0	0	222
4-71	48(.1)	76(1.0)	118(.3)	31(T)	0	0	0	0	273(1.4)
10-71	154(.2)	94(.4)	153(.6)	4(T)	2(T)	62(.1)	0	0	469(1.3)
10-71	77(.2)	66(.3)	130(.5)	4(.1)	1(T)	69(T)	0	0	347(1.1)
10-71	169(.2)	141(1.1)	255(1.0)	13(.1)	0	24(T)	0	0	602(2.4)

TABLE 11. (continued)

Date	Plecoptera	Tricoptera	Ephemeroptera	Diptera	Coleoptera	Annelida	Nematoda	Other	Total
Boulder River-Station 010-Falls Creek Campground									
10-70	40	29	99	4	5	21	0	0	198
4-71	38(.2)	14(.1)	93(.8)	7(T)	0	0	74(T)	0	226(1.1)
10-71	116(.3)	62(.4)	172(.6)	9(.1)	0	3(T)	3(T)	0	365(1.4)
10-71	50(.1)	55(.3)	121(.4)	11(.2)	0	4(T)	0	0	241(1.0)
10-71	109(.3)	86(.5)	150(.4)	7(.2)	1(T)	37(T)	0	0	390(1.4)
2-72	70(.4)	25(.1)	117(.7)	13(T)	4(T)	69(.1)	0	1(T)	299(1.3)
2-72	73(.6)	12(.2)	136(.9)	9(.1)	2(T)	61(.1)	0	0	293(1.9)
2-72	17(.1)	2(T)	44(.4)	3(T)	2(T)	10(T)	0	0	78(.5)
5-72	8(.3)	1(T)	10(T)	3(T)	0	0	0	0	22(.3)
5-72	19(1.0)	5(T)	40(.2)	22(T)	0	0	0	0	86(1.2)
5-72	21(.3)	0	39(.2)	16(T)	0	0	0	0	76(.5)
8-72	12(T)	23(.2)	58(.2)	15(.1)	1(T)	1(T)	0	0	110(.5)
8-72	9(T)	40(.3)	118(.2)	11(T)	6(T)	2(T)	0	1(T)	187(.5)
8-72	30(.1)	74(.4)	137(.4)	19(.1)	2(T)	42(T)	1(T)	0	305(1.[illegible])
2-73	38(1.0)	105(1.6)	257(1.6)	19(.3)	4(T)	23(T)	0	0	446(4.[illegible])
2-73	13(.4)	123(.8)	211(2.0)	11(T)	1(T)	2(T)	0	0	361(3.2)
2-73	16(.2)	72(.6)	184(1.1)	12(T)	3(T)	69(T)	0	0	356(1.9)
Boulder River-Station 039-Ewan Campground									
10-70	40	29	99	4	5	21	0	0	198
4-71	38(.2)	14(.1)	93(.8)	7(T)	0	0	74(T)	0	226(1.1)
10-71	116(.3)	62(.4)	172(.6)	9(.1)	0	3(T)	3(T)	0	365(1.4)
10-71	50(.1)	55(.3)	121(.4)	11(.2)	0	4(T)	0	0	241(1.0)
10-71	109(.3)	86(.5)	150(.4)	7(.2)	1(T)	37(T)	0	0	390(1.4)
2-72	70(.4)	25(.1)	117(.7)	13(T)	4(T)	69(.1)	0	1(T)	299(1.3)
2-72	73(.6)	12(.2)	136(.9)	9(.1)	2(T)	61(.1)	0	0	293(1.9)
2-72	17(.1)	2(T)	44(.4)	3(T)	2(T)	10(T)	0	0	78(.5)

TABLE 11. (continued)

Date	Plecoptera	Tricoptera	Ephemeroptera	Diptera	Coleoptera	Annelida	Nematoda	Other	Total
5-72	8(.2)	5(T)	53(.2)	29(.7)	1(T)	18(T)	0	0	114(1.1)
5-72	14(.2)	15(T)	12(.1)	11(.2)	0	3(T)	0	0	55(.5)
5-72	21(.2)	22(.1)	72(.4)	11(T)	0	15(T)	0	0	141(.7)
8-72	20(.2)	20(.1)	143(.4)	107(.2)	10(T)	0	0	0	300(.9)
8-72	15(T)	8(T)	39(.1)	36(.1)	2(T)	2(T)	0	2(T)	104(.2)
8-72	15(.1)	30(.2)	172(.3)	35(.1)	4(T)	1(T)	0	2(T)	259(.7)
2-73	3(T)	144(.2)	43(.1)	49(T)	1(T)	0	0	1(T)	241(.3)
2-73	73(.4)	118(.5)	171(.8)	255(1.1)	4(T)	47(T)	0	22(T)	690(2.8)
2-73	26(.9)	171(.5)	77(.3)	62(.3)	4(T)	19(T)	0	13(T)	372(2.0)
Boulder River-Station 040-Fuller Draw Bridge									
10-71	17(1.2)	103(.3)	91(.2)	20(T)	4(T)	0	0	0	234(1.7)
10-71	5(T)	44(.1)	30(.1)	3(.1)	0	13(T)	0	0	97(.3)
10-71	28(.5)	210(1.1)	102(.3)	1(T)	1(T)	19(T)	0	0	366(1.[illegible])
2-72	84(.4)	282(.9)	461(1.1)	96(2.1)	6(T)	425(.1)	0	0	1354(4.6)
2-72	74(.6)	375(1.0)	651(1.7)	34(.6)	4(T)	736(.2)	1(T)	0	1875(4.1)
2-72	158(.3)	290(1.0)	648(2.4)	29(.5)	4(T)	855(.3)	0	0	1984(4.5)
5-72	20(.7)	55(.1)	146(.4)	11(T)	1(T)	4(.2)	1(T)	0	238(1.4)
5-72	51(.3)	210(.4)	147(.5)	126(.1)	15(T)	89(T)	0	0	638(1.3)
5-72	55(1.5)	342(.5)	208(.5)	42(T)	3(T)	18(T)	0	1(T)	669(2.5)
8-72	13(.3)	38(.2)	152(.3)	68(.6)	6(T)	14(T)	0	0	291(1.4)
8-72	24(1.0)	37(.2)	164(.2)	140(.3)	8(T)	8(T)	3(T)	0	384(1.7)
8-72	37(1.1)	54(.4)	153(.3)	144(.5)	13(T)	25(T)	3(T)	1(T)	430(2.4)
2-73	9(.1)	306(.6)	228(.7)	244(.9)	24(T)	158(T)	0	0	969(2.3)
2-73	37(2.1)	120(.3)	89(.2)	109(.5)	4(T)	50(T)	0	0	410(3.1)
2-73	36(1.5)	641(2.5)	365(1.7)	222(1.4)	14(T)	176(.1)	7(T)	11(T)	1472(7.2)

TABLE 11. (continued)

Date	Plecoptera	Tricoptera	Ephemeroptera	Diptera	Coleoptera	Annelida	Nematoda	Other	Total
West Boulder River-Station 041-McLeod Bridge									
10-70	18	10	139	6	5	56	0	2	236
4-71	7(.1)	7(.1)	55(.2)	21(T)	1(T)	0	1(T)	0	89(.4)
10-71	29(.2)	21(.4)	178(.6)	10(T)	4(T)	0	18(T)	0	260(1.2)
10-71	25(.7)	34(.7)	126(.4)	3(T)	2(T)	125(T)	0	0	315(1.8)
10-71	33(.1)	6(T)	96(.4)	7(T)	1(T)	28(T)	0	0	171(.5)
2-72	54(.2)	10(T)	91(.2)	4(T)	2(T)	52(T)	2(T)	0	215(.4)
2-72	75(.2)	10(T)	123(.2)	9(T)	3(T)	0	2(T)	1(T)	223(.4)
2-72	62(.1)	12(.1)	113(.2)	10(T)	1(T)	30(T)	3(T)	0	231(.4)
5-72	24(.9)	8(.3)	92(.6)	17(.1)	1(T)	7(.6)	0	0	149(2.5)
5-72	96(2.1)	12(.1)	389(1.0)	47(.1)	3(T)	1(T)	0	0	548(3.3)
5-72	13(.1)	0	63(.3)	5(T)	0	0	0	0	81(.4)
8-72	28(.3)	27(.3)	344(.3)	60(.1)	2(T)	65(T)	3(T)	0	529(1.0)
8-72	43(.1)	28(.7)	406(.6)	124(.1)	2(T)	18(T)	4(T)	0	625(1.[illegible]
8-72	19(.1)	19(.1)	521(.8)	157(.1)	2(T)	20(T)	4(T)	0	742(1.1)
2-73	37(.2)	39(.2)	266(1.1)	20(.1)	1(T)	137(T)	0	1(T)	501(1.6)
2-73	71(1.1)	61(.2)	338(1.2)	86(1.1)	5(T)	200(T)	2(T)	2(T)	765(3.6)
2-73	16(.1)	64(.5)	227(1.0)	21(.2)	3(T)	84(T)	0	0	415(1.8)

TABLE 12. Number and volume (in parentheses) of macroinvertebrates collected in one square foot stream bottom samples for stations on tributary streams, August, 1972.[1]

Plecoptera	Trichoptera	Ephemeroptera	Diptera	Coleoptera	Annelida	Nematoda	Other[2]	Total
Morris Creek-Station 014-MacKay Ranch								
12(T)[3]	28(.1)	23(.1)	14(.1)	11(.1)	1(T)	0	0	89(.4)
35(T)	62(.1)	95(.2)	25(.1)	21(T)	3(T)	0	0	241(.4)
3(T)	121(.2)	62(.1)	25(.1)	29(.1)	3(T)	0	0	243(.5)
East Fishtail Creek-Station-012-At Mouth								
56(T)	59(.1)	68(.1)	108(.1)	19(T)	215(.1)	0	97(.2)	613(.5)
31(T)	62(.2)	14(.1)	34(T)	4(T)	65(T)	0	21(.1)	231(.4)
58(.2)	61(.3)	53(.1)	46(T)	5(T)	301(T)	0	62(.1)	586(.7)
West Fishtail Creek-Station 013-At Mouth								
37(.3)	50(.1)	44(.2)	29(.1)	2(T)	97(T)	0	32(T)	291(.7)
33(.1)	23(.1)	32(T)	23(T)	4(T)	103(T)	0	6(T)	224(.2)
43(T)	61(.3)	59(.1)	168(T)	1(T)	43(T)	0	47(T)	422(.4)
Verdigris Creek-Station 043-Highway 419 Crossing								
0	0	0	1(T)	0	0	0	0	1(T)
0	2(T)	0	1(T)	0	0	0	0	3(T)
1(T)	0	0	0	0	0	0	0	1(T)

[1] Samples collected August, 1972

[2] Mostly Hydrocarina and Turbellaria

[3] Trace

TABLE 12. (continued)

Plecoptera	Tricoptera	Ephemeroptera	Diptera	Coleoptera	Amelida	Nematoda	Other	Total
Mountain View Creek-Station 044-Highway 419 Crossing								
10(T)	5(.2)	27(T)	2(T)	0	0	0	0	44(.2)
21(T)	6(T)	27(.1)	4(T)	0	0	0	0	58(.1)
3(T)	7(.2)	23(.1)	16(T)	2(T)	4(.1)	0	0	55(.4)
Silver Creek-Station 042-Highway 419 Crossing								
5(T)	15(.1)	132(.3)	7(.1)	17(T)	3(.1)	4(T)	0	183(.6)
15(.1)	16(.1)	134(.2)	28(.1)	37(T)	2(T)	2(T)	0	234(.5)
0	1(T)	8(T)	1(T)	5(T)	1(1.1)	2(T)	0	18(.1)
Nye Creek-Station 016-Road Crossing near Mouth								
0	1(T)	3(T)	0	0	0	1(T)	2(T)	7(T)
0	1(T)	8(T)	8(T)	1(T)	0	0	2(T)	20(T)
4(T)	2(T)	6(T)	24(T)	1(T)	5(T)	0	1(T)	43(T)
Cathedral Creek-Station 018-Road Crossing near Mouth								
9(T)	7(.2)	15(.2)	37(.1)	0	0	0	0	68(.5)
21(T)	18(.1)	33(.1)	18(T)	0	0	0	0	90(.2)
23(.1)	5(T)	14(.1)	102(.1)	0	1(T)	0	1(T)	146(.3)

TABLE 12. (continued)

Plecoptera	Tricoptera	Ephemeroptera	Diptera	Coleoptera	Annelida	Nematoda	Other	Total
			Initial Creek-Station 017-Road Crossing					
6(T)	3(.1)	8(.1)	223(.2)	1(T)	17(T)	0	0	258(.4)
5(T)	0	6(T)	24(T)	0	6(T)	0	0	41(T)
5(T)	1(T)	6(T)	7(T)	0	10(T)	0	0	29(T)
			Iron Creek-Station 019-At Mouth					
4(.1)	3(.1)	31(T)	12(T)	0	112(T)	0	1(T)	163(.2)
9(T)	0	30(T)	3(T)	0	1(T)	0	0	43(T)
5(T)	0	16(T)	0	0	58(T)	1(T)	0	80(T)
			Picket Pin Creek-Station 020-Raod Crossing					
58(.1)	6(T)	303(.7)	87(.1)	10(T)	35(T)	1(T)	89(.1)	589(1.0)
32(.1)	6(T)	295(.7)	118(.1)	8(T)	33(T)	2(T)	100(.2)	594(1.1)
38(T)	4(.1)	127(.3)	88(T)	2(T)	8(T)	1(T)	57(.1)	325(.5)
			Lower Deer Creek-Station 021-Road Crossing near Forest Boundary					
4(T)	14(T)	50(.1)	5(T)	5(T)	0	0	5(T)	88(.1)
13(T)	11(T)	57(.1)	1(T)	3(T)	0	0	4(T)	91(.1)
33(T)	8(.1)	80(.1)	7(.2)	0	10(T)	0	10(T)	166(.5)

TABLE 12. (continued)

Plecoptera	Trichoptera	Ephemeroptera	Diptera	Coleoptera	Annelida	Nematoda	Other	Total
			Upper Deer Creek-Station 022-At Rudd Cabin					
42(.2)	62(.3)	97(.3)	71(.2)	37(T)	57(T)	1(T)	2(T)	369(1.0)
23(.1)	128(.4)	175(.4)	73(.8)	39(T)	47(T)	1(T)	4(T)	490(1.7)
26(.1)	130(.2)	131(.4)	53(.3)	43(.1)	23(T)	0	6(T)	412(1.1)
			East Chippy Creek-Station 023-Road Crossing near mouth					
45(T)	8(.1)	168(.1)	10(T)	0	89(T)	0	2(T)	322(.2)
22(T)	5(.1)	160(.1)	6(T)	0	1(T)	0	2(T)	196(.2)
20(T)	5(T)	75(.1)	4(T)	0	27(T)	0	0	131(.1)
			Blakely Creek-Station 024-Road Crossing near Mouth					
24(.1)	5(.1)	26(.1)	18(T)	0	0	0	42(.4)	115(.7)
0	0	36(.1)	5(T)	0	0	0	3(T)	44(.1)
2(T)	1(T)	10(.1)	1(T)	0	0	0	7(.1)	21(.2)
			Great Falls Creek-Station 026-At Mouth					
18(.1)	2(.1)	119(.7)	4(T)	0	1(T)	1	1(T)	145(.9)
8(.1)	5(.3)	67(.3)	3(T)	0	0	0	1(T)	84(.7)
6(T)	4(.4)	91(.2)	1(T)	0	0	0	0	102(.6)

TABLE 12. (continued)

Plecoptera	Trichoptera	Ephemeroptera	Diptera	Coleoptera	Annelida	Nematoda	Other	Total
		Falls Creek-Station 027-West Channel at Road Crossing						
31(.2)	15(.2)	118(1.0)	20(T)	5(T)	6(T)	0	0	195(1.4)
13(T)	16(T)	52(.3)	7(T)	0	1(T)	0	0	89(.3)
6(T)	22(.1)	97(.8)	9(.1)	0	8(T)	0	0	142(1.0)

Dent (1971) has also sampled bottom fauna in the same streams and at some of the same stations reported in this study. He used a Surber sampler and reported consistently fewer numbers of organisms per square foot than found in this study. For comparison, the following are average number of organisms per square foot in October 1971 for stations on nearby portions of the Stillwater, West Fork Stillwater, East Boulder and Boulder Rivers, respectively (data of Dent, 1971, given first): 83 and 267, 84 and 246, 91 and 739, 106 and 402. At the same station (031) on Little Rocky Creek, the corresponding numbers are 36 and 156. Dent's (1971) data are similar to that of this study in proportions of insect orders present in the various samples.

In personal correspondence with Mr. Dent, he stated that he felt his Surber sampler had failed to capture many of the organisms present in each square foot covered by the sampler. Waters and Knapp (1961) and Needham and Usinger (1956) both felt the Surber sampler had considerable shortcomings.

Low numbers of organisms in May 1972 for some stations on the Boulder River, and for station 035 on the Stillwater River (Table 11) were probably caused by sampling on newly flooded stream bottom. Streams were rising rapidly at the time May 1972 samples were collected. Many samples probably came from stream bottom that had been covered with water for only a few days.

Almost complete absence of organisms in samples from station 043 on Verdigris Creek (Table 12) is likely due to previously discussed adverse chemical conditions.

In addition to bottom fauna data shown in Tables 11 and 12, samples were collected in May, July and October, 1973. These samples have yet to be sorted and tabulated. Results will be given in a future report.

Fish Populations

Table 13 is a summary of physical characteristics, fish species captured, and fin clips made on fish in stream sections. These sections were used for estimation of fish population parameters.

Fish population data are given in Tables 14 and 15. Estimates for some species shown in a previous report (Stewart, 1973) are not shown in these tables because reexamination of the data indicated that the number of recaptured fish was not sufficient for a reliable estimate. Some estimates in Table 14 made in 1972 differ slightly from a previous report (Stewart, 1973). These differences are due to recalculation of the estimates using a slightly refined computer program.

Hatchery fish were captured in small numbers in only one of the stream sections (F-2, Stillwater River), despite the fact that they are stocked in all of the larger streams.

TABLE 13. Physical data for electrofishing sections and fish species captured.

Stream	Section No.	Location T	R	S	Length (feet)	Mean Width (feet)	Species[1] Captured 1971 or 1972[2]	Species[1] Captured 1973	Fin Clip 1971 or 1972[2]	Fin Clip 1973
East Rosebud	F-14	6S	18E	19,20	6283	77.6	Rb, LL,Wf Catostomus sp	--	none	--
Morris Creek	F-12	6S	18E	8	1347	8.4	Eb,LL,Ct unidentified cyprinid	same	left pelvic	adipose
West Fishtail	F-10	5S	17E	19	2270	20.3	Rb,Eb,LL	same	right pelvic	right pectoral plus adipose
East Fishtail	F-9	5S	17E	19	2073	14.8	Rb,Eb, LL	same	right pectoral	left pelvic
Fishtail	F-11	5S	17E	8,17,18	3948	27.5	Rb,Eb,LL,Wf	same	adipose	left pectoral
Stillwater	F-1	5S	15E	28	2986	109.5	Rb,Eb,LL,Wf Longnose sucker Longnose dace	same plus Mountain sucker	right pelvic	adipose
Stillwater	F-2	5S	15E	10,11,15	6710	91.6	Rb,Eb,LL,Wf Longnose sucker Longnose dace	same	adipose	left pelvic
Stillwater	F-3	5S	15E	1,2	5578	82.5	Rb,Eb,LL,Wf Longnose sucker	--	none	--
Silver Creek	F-7	5S	15E	15	1289	6.4	Rb,Eb,LL	same	left pectoral	adipose plus left pelvic
Nye Creek	F-6	5S	15E	15	1453	5.0	Rb,Eb,LL	same	right pectoral	adipose plus right pectoral

[1]Abbreviations are: Rb=Rainbow Trout; Ct=Cutthroat Trout; Eb=Brook Trout; LL=Brown Trout; Wf=Mountain Whitefish

[2]1971 for sections F-3 and F-14; others are 1972

TABLE 13. (continued)

Stream	Section No.	Location T	R	S	Length (feet)	Mean Width (feet)	Species Captured 1971 or 1972	1973	Fin Clip 1971 or 1972	1973
Mtn. View	F-5	5S	15E	21	2589	4.8	Rb,Eb,LL Longnose dace	same plus Longnose sucker	adipose plus left pelvic	right pelvic
Little Rocky	F-8	5S	16E	3,4	2590	13.9	Ct,LL	same plus Rb	adipose plus right pelvic	right pector
Picket Pin	F-16	4S	14E	25	2059	13.5	Ct,Eb,LL	same plus Rb	adipose	left pelvic
W. Fork Stillwater	F-17	4S	15E	33	2293	41.2	--	Rb,LL,Wf	--	adipose
Lower Deer	F-18	2S	15E	16,17,20	6160	25.2	--	Rb-Ct hybrid Eb, LL	--	adipose
Boulder	F-4	3S	12E	26,35	5236	81.4	Rb,Eb unidentified cyprinid	same	adipose	left pelvic
East Boulder	F-13	4S	13E	2,11	2410	28.2	Rb,Ct,LL	Rb,LL only	adipose	right pelvic

TABLE 14. Fish population estimates for stream sections where estimates were made in 1972 and 1973.

Age Class	Mean length (inches) 1972	1973	Mean weight (pounds) 1972	1973	Estimated number 1972	1973	Estimated weight (pounds) 1972	1973	pounds per acre 1972	1973	Mortality rate from 1972 to 1973*
Morris Creek-Section F-7-Brook Trout-June 1972, June 1973											
I	5.0	4.4	0.05	0.03	465	758	23	21			
II	7.6	6.9	0.17	0.12	105	142	18	17			0.69
III	9.0	9.2	0.28	0.27	78	25	22	7			0.76
				Totals	648 (±87)**	925 (±189)	63 (±6)	45 (±6)	242	173	
East Fishtail Creek-Section F-9-Rainbow Trout-July 1972, July 1973											
I	-	2.8	-	0.01	-	112	-	1			
II	4.9	4.7	0.05	0.04	16	69	1	3			
III and older	8.3	7.8	0.28	0.22	10	24	3	5			0.09
				Totals	26 (±11)	205 (±84)	4 (±2)	9 (±3)	4.3	13	
West Fishtail Creek-Section F-10-Brook Trout-July 1972, July 1973											
I	4.6	4.6	0.04	0.04	118	93	4	4			
II and older	7.7	7.2	0.19	0.16	28	57	5	9			0.61
				Totals	146 (±70)	150 (±42)	9 (±5)	13 (±5)	9.4	12	

*Defined as: $\frac{\text{1972 estimate for age N - 1973 estimate for age N+1}}{\text{1972 estimate for age N}}$

**95 percent confidence interval in parentheses

TABLE 14. (continued)

Age Class	Mean Length (inches) 1972	1973	Mean weight (pounds) 1972	1973	Estimated number 1972	1973	Estimated weight (pounds) 1972	1973	Pounds per acre 1972	1973	Mortality rate from 1972 to 1973
Fishtail Creek-Section F-11-July 1972, August 1973											
Rainbow Trout											
I	-	3.7	-	0.01	-	1002	-	14			
II	5.5	6.0	0.08	0.09	174	158	13	15			
III	8.0	8.0	0.22	0.21	41	86	9	18			0.50
IV and older	10.8	10.8	0.52	0.50	29	34	15	17			0.51
				Totals	244 (±101)	1280 (±270)	37 (±12)	64 (±8)	15.7	27	
Brown Trout											
I	-	4.8	-	0.04	-	330	-	14			
II	6.9	7.3	0.14	0.17	94	84	13	14			
III	9.8	10.4	0.39	0.46	56	90	22	42			0.04
IV and older	12.7	13.5	0.83	0.96	49	67	41	64			0.37
				Totals	199 (±46)	571 (±84)	76 (±18)	134 (±19)	30.5	53	
Little Rocky Creek-Section F-8-Brown Trout-June 1972, July 1973											
I	-	3.8	-	0.01	-	70	-	1			
II	6.7	7.1	0.13	0.14	76	30	10	4			
III and older	11.2	10.7	0.62	0.53	65	73	40	38			0.48
				Totals	141 (±17)	173 (±33)	50 (±6)	43 (±12)	59	53	

TABLE 14. (continued)

Age Class	Mean Length (inches) 1972	1973	Mean Weight (pounds) 1972	1973	Estimated number 1972	1973	Estimated Weight (pounds) 1972	1973	Pounds per acre 1972	1973	Mortality rate from 1972 to 1973
Stillwater River-Section F-1-May 1972, May 1973											
Brook Trout											
0	3.9	3.6	0.02	0.01	234	494	4	7			
I	5.6	6.0	0.06	0.08	151	296	9	22			
II	8.2	9.6	0.19	0.28	38	10	7	3			0.93
				Totals	423 (±190)	800 (±203)	20 (±8)	32 (±8)	2.7	4.1	
Rainbow Trout											
0	A	2.4	A	0.01	A	481	A	5			
I		4.2		0.03		357		10			
II		6.9		0.12		54		6			
III and older		11.7		0.62		44		27			
				Totals		936 (±346)		48 (±19)		6.3	
Mountain Whitefish											
All	-	B	-	B	336 (±195)	B	167 (±97)	B	22		
Stillwater River-Section F-2-March, April 1972; March, April 1973											
Brown Trout											
0	-	3.5	-	0.01	-	1208	-	17			
I	6.0	5.9	0.08	0.08	377	462	30	35			
II	9.1	9.5	0.26	0.29	258	96	67	28			0.75
III	11.9	12.6	0.55	0.65	187	109	103	70			0.58
IV and older	15.0	15.3	1.14	1.18	79	50	90	59			0.81
				Totals	901 (±172)	1925 (±597)	290 (±33)	209 (±23)	20.6	15	

[A] Sample size insufficient for reliable estimate

[B] No estimate attempted

TABLE 14. (continued)

Age Class	Mean Length (inches) 1972	1973	Mean Weight (pounds) 1972	1973	Estimated number 1972	1973	Estimated Weight (pounds) 1972	1973	Pounds per acre 1972	1973	Mortality rate from 1972 to 1973
Brook Trout											
0	4.2	4.0	0.02	0.02	134	1296	3	29			
I	6.8	6.6	0.11	0.10	128	81	14	8			0.40
II	9.5	9.0	0.28	0.23	53	9	15	2			0.93
				Totals	315 (±147)	1386 (±831)	32 (±16)	39 (±19)	2.3	2.7	
Mountain View Creek-Section F-5-Brook Trout-June 1972, June 1973											
I	4.5	4.6	0.04	0.04	100	84	4	3			
II	8.7	6.7	0.26	0.12	11	15	3	2			0.85
				Totals	111 (±64)	99 (±23)	7 (±5)	5 (±2)	25	14	
Nye Creek-Section F-6-Brook Trout - June 1973											
I	A	4.1	A	0.02	A	3	A	<1			
II and older		6.3		0.10		10		1			
				Totals		13 (±5)		1	A	6.0	
Silver Creek-Section F-7-Brown Trout-June 1972, June 1973											
0	2.6	2.4	0.01	0.01	192	1036	2	10			
I	5.0	5.0	0.05	0.05	106	258	5	13			
II	7.1	7.0	0.14	0.13	78	57	11	7			0.46
III	9.2	8.9	0.27	0.24	24	19	6	5			0.75
				Totals	400 (±140)	1370 (±262	24 (±5)	35 (±3)	127	185	

TABLE 14. (continued)

Age Class	Mean Length (inches) 1972	1973	Mean Weight (pounds) 1972	1973	Estimated number 1972	1973	Estimated Weight (pounds) 1972	1973	Pounds per acre 1972	1973	Mortality rate from 1972 to 1973
Picket Pin Creek-Section F-16-August, September, 1972; September 1973											
Brook Trout											
I	5.3	5.4	0.06	0.06	49	241	3	14			
II and older	8.8	8.1	0.30	0.24	47	38	14	9			0.60
				Totals	96 (±13)	279 (±34)	17 (±1)	23 (±3)	27	38	
Brown Trout											
I	4.4	4.2	0.03	0.02	22	70	1	2			
II	6.4	6.3	0.09	0.09	42	14	4	1			0.37
III	9.4	8.3	0.35	0.23	33	12	12	3			0.70
IV and older	11.3	12.0	0.59	0.69	8	7	5	5			0.83
				Totals	105 (±14)	103 (±27)	22 (±3)	11 (±2)	34	19	
Cutthroat Trout											
I	5.1	5.2	0.05	0.05	27	23	1	1			
II	7.3	7.6	0.16	0.16	13	10	2	2			
III and older	9.5	9.4	0.34	0.33	8	14	3	5			0.61
				Totals	48 (±12)	47 (±12)	6 (±2)	8 (±2)	9	11	0.37
East Boulder River-Section F-13-July, August 1972; August 1972											
Rainbow Trout											
I	4.0	3.9	0.02	0.02	37	116	1	2			
II	5.1	5.2	0.05	0.05	145	41	7	2			
III	6.2	6.3	0.09	0.10	252	63	23	6			0.56
IV	8.2	7.3	0.21	0 15	62	203	13	31			0.19
V and older	10.3	8.9	0.35	0.27	6	43	2	11			0.36
				Totals	502 (±80)	466 (±70)	46 (±6)	52 (±6)	29	35	

TABLE 14. (continued)

Age Class	Mean Length (inches) 1972	1973	Mean Weight (pounds) 1972	1973	Estimated number 1972	1973	Estimated Weight (pounds) 1972	1973	Pounds per acre 1972	1973	Mortality rate from 1972 to 1973
Brown Trout											
II	4.1	4.7	0.02	0.04	11	46	<1	2			
III	6.2	6.1	0.09	0.09	49	30	4	3			
IV	7.5	7.7	0.16	0.18	15	33	2	6			0.32
V and older	10.9	9.2	0.51	0.32	7	21	4	7			0.07
				Totals	82 (±25)	130 (±26)	10 (±3)	18 (±5)	7	11	
Boulder River-Section F-4-April 1972; March, April 1973											
Rainbow Trout											
0	A	2.5	A	0.01	-	957	A	9			
I	5.5	5.0	0.07	0.05	98	139	6	7			
II	9.0	8.8	0.26	0.23	91	88	24	21			0.11
III	12.9	12.0	0.79	0.63	68	242	54	151			-
IV and older	16.8	16.1	1.67	1.50	249	250	415	374			0.21
				Totals	506 (±192)	1676 (±465)	499 (±253)	562 (±173)	51	58	
Brook Trout											
0	3.5	3.2	0.01	0.01	1787	6927	23	74			
I	6.0	5.6	0.08	0.06	955	1361	74	86			0.24
II	8.6	9.1	0.20	0.25	124	511	25	127			0.47
III	12.7	12.3	0.66	0.62	12	43	8	26	13	32	0.66
				Totals	2878 (±937)	8842 (±2221)	130 (±25)	313 (±90)			

TABLE 15. Fish population estimates for stream sections where one estimate was made.

Age Class	Mean Length (inches)	Mean Weight (pounds)	Estimated number	Estimated weight (pounds)*	Pounds per acre
		East Rosebud River-Section F-14-Brown Trout-November 1971			
I	5.8	0.06	135	9	
II	9.1	0.25	159	40	
III	12.1	0.57	113	65	
IV	16.6	1.49	53	79	
		Totals	460(±105)	193(±55)	17.2
		Stillwater River-Section F-3-Brown Trout-November 1971			
I	6.0	0.06	604	39	
II	8.9	0.25	544	135	
III	12.3	0.65	224	145	
IV and older	15.3	1.24	150	186	
		Totals	1522(±460)	505(±101)	47.8
		West Fork Stillwater River-Section F-17-April, May 1973			
		Rainbow Trout			
I	4.3	0.03	359	10	
II	6.3	0.09	93	8	
III and older	8.4	0.23	177	41	
		Totals	629(±108)	59(±9)	27.7
		Brown Trout			
I	4.8	0.04	34	1	
II	7.3	0.16	20	3	
III and older	10.5	0.48	27	13	
		Totals	81(±30)	17(±6)	8.3
		Lower Deer Creek-Section F-18-Brown Trout-June, July 1973			
I	4.4	0.03	197	6	
II	7.5	0.17	44	7	
III	11.2	0.50	58	29	
IV and older	14.1	0.88	38	34	
		Totals	337(±76)	76(±11)	21.3

*95 percent confidence interval in parentheses

I was unable to age whitefish from scales and this species sustained considerable handling mortality. Consequently, only one estimate was made for whitefish, and this was not specific for fish age.

Estimates were not made for species captured infrequently. Underyearling and yearling fish were often not captured in sufficient numbers to be estimated, although efforts were made to catch these small fish. Greater success was experienced in capturing underyearling and yearling fish in 1973 than in 1972.

Fish ages shown in Tables 14 and 15 are equal to numbers of annuli on scales. Except for fish captured in June when annuli were formed, fish had experienced some portion of a growing season beyond the indicated age. Growth rates, while generally slightly less than state averages reported by Brown (1971), are commensurate with the relatively low summer water temperatures and short growing seasons.

Standing crops of trout in pounds per acre (Tables 14 and 15) on larger streams are somewhat lower than those reported by Vincent (1969) for rivers in southwestern Montana. Some of the tributary streams had moderately high trout standing crops. Carlander (1953) reports standing crop values for trout streams in North America to be largely in the range of 10 to 150 pounds per acre, with an approximate median of 60. Compared to Carlander's (1953) date, standing crops of trout in streams of this study range from moderately low to high.

Total estimates in Table 14 suggest considerable variation in standing crops of trout from 1972 to 1973 in many of the stream sections. This may be misleading. In 1973 an estimate for yearling or underyearling fish was added in the total estimate, if adequate numbers of fish were sampled. In 1972 an estimate for these younger fish was often lacking in the total estimate, because adequate numbers were not sampled. Also, a consideration of confidence limits minimizes apparent differences in standing crops between years. For example, on Section F-1, Stillwater River, the mean total estimates of brook trout for 1972 and 1973 were 423 and 800. However, by considering the highest probable value in the 1972 estimate (613), and the lowest probable value in the 1973 estimate (597), it is evident that there is overlap in the ranges of probable fish numbers for the two years. However, even with these considerations there are definite differences between the two years in some stream sections for numbers of underyearling and yearling fish.

There was generally good agreement between average lengths of year classes from 1972 to 1973 (Table 14). For the few cases where differences were relatively large, average sizes were calculated from very small samples of fish.

Age structures in Tables 14 and 15 were mostly typical. Some of the small imbalances can be explained on the basis of confidence intervals, but larger imbalances are probably real. These imbalances can occur by differential year class survival and migration, but no certain explanation can be confidently advanced for specific instances of year class imbalance in Tables 14 and 15.

Almost no movement was noted from one stream section to another from 1972 to 1973. Minor exchange of fish occurred only between sections on Fishtail Creek (F-11), East Fishtail Creek (F-9), and West Fishtail Creek (F-10). These sections are close together. East and West Fishtail Creek sections are separated by only about 500 yards. The Fishtail Creek section is approximately 1.5 stream miles from the other two.

A complicating factor has been introduced on Section F-2 on the Stillwater River. In March 1973 over one-third of the length of this section was modified by adjacent landowners, largely by pushing streambed gravel onto streambanks. Part of this modification occurred a few days prior to the 1973 fish population estimate, and part of it while the estimate was being made. Of the fish age I and older, both brook and brown trout may have decreased from 1972 to 1973, but the full affect of the modification may not have occurred at the time the 1973 estimate was made.

Work was also done near the mouths of small tributary streams not reported in Tables 14 or 15. N_o fish were captured in South Nye, Verdigris, Initial, and Graham Creeks. Only a single rainbow trout was captured in a 900 feet section near the mouth of Cathedral Creek. In Blakely Creek, fish are present only in the lowest 200 feet of stream. In Iron Creek, rainbow trout appear to be distributed through the lower reaches in small numbers. These and other similar streams not yet investigated are small, very steep and have only marginal fish habitat at best. Winter flows are unknown, but some of them may dry up during this season. Verdigris Creek has concentrations of metals (Table 4) that probably prevent establishment of fish.

Other Fish and Game Department personnel electrofished a portion of the East Boulder River in Placer Basin (T5S, R13E, Section 11) in the summer of 1971. No fish were found and hatchery cutthroat trout were subsequently stocked. A 1600 feet section in the same location was electrofished in the summer of 1972. Four of the stocked fish were captured. These ranged in length from 6.3 to 7.5 inches.

Fish Population Stability

Stability* percentages for eight stream sections where data was sufficient to make the appropriate calculations are given in Table 16. Considering the one-year period involved, stability was high. It averaged 56 percent for all sections and species. Average percentages by species are: brook trout, 38 percent; brown trout, 60 percent; rainbow trout, 56 percent; cutthroat trout, 93 percent. Precision of the stability estimates is similar to the precicion of population estimates (Table 14) which were used in calculation of stability.

* Stability, as used here, indicates the percentage of fish present in stream sections in 1972 that remained in the section one year later, with mortality calculations for that period considered.

TABLE 16. Number of fish marked in 1972, number of recaptures in 1972, and stability of fish populations in stream sections.

Stream	Section Code	Species	Age (1973)	No. marked in 1972	No. of recaptures in 1973 of fish marked in 1972	Stability (percent)
Morris Creek	F-12	Brook trout	II	176	29	42
			III	60	21	87
Fishtail Creek	F-11	Rainbow trout	III	51	33	81
			IV and older	31	19	95
		Brown trout	III	40	34	68
			IV and older	52	27	66
Little Rocky Creek	F-8	Brown trout	III and older	104	34	46
Stillwater River	F-2	Brown trout	II	91	12	32
			III	124	29	42
			IV and older	142	21	66
Silver Creek	F-7	Brown trout	II	82	13	18
			III	50	13	70
Picket Pin Creek	F-16	Brook trout	II and older	77	31	54
		Brown trout	II	16	11	65
			III	34	15	70
			IV and older	37	5	50
		Cutthroat trout	II	15	13	~100
			III and older	20	17	86
East Boulder River	F-13	Rainbow trout	III	55	26	91
			IV	115	93	81
			V and older	44	13	41
		Brown trout	IV	24	16	92
			V and older	13	12	92
Boulder River	F-4	Rainbow trout	II	27	1	8
			III	25	5	24
			IV and older	61	7	24
		Brook trout	I	185	10	23
			II	274	9	12
			III	52	1	8

Metals Concentrations in Fish Muscle Tissue

Concentrations of various metals in fish muscle tissue are shown in Table 17. In general the precision of the determinations is plus and minus the detection limit. The mercury concentrations are mostly low and probably represent natural background levels in fish muscle from this area. A comprehensive examination of literature concerning natural levels of metals in fish tissue has not yet been made. The significance of values in Table 17 will be discussed in a future report.

Samples of fish for tissue-metals analysis have also been collected from the West Fork Stillwater River, East Boulder River, and from an additional section on the Stillwater River. The analysis of these fish has yet to be done.

Trout Egg Bioassays

Overall average survival of eyed trout eggs placed in artificial redds (Table 18) was considerably higher in 1973 (83 percent) than in 1972 (45 percent). Differences in conditions and procedures between the two years were: rainbow trout eggs used in 1973 and cutthroat trout eggs in 1972; gravel clips placed in egg containers in 1973, but not in 1972; April-May incubation in 1972 and September-October incubation in 1973. The last factor seems most significant. During 1972 water temperatures were in the 32-40°F range for most of the incubation period, while 1973 water temperatures were largely in the 40-55°F range. Water temperatures below 40°F are suboptimal for both species.

Effect of egg transport from hatchery to artificial redds was negligible. Over 90 percent of control eggs, transported to the field but subsequently returned to the hatchery for incubation, survived to hatching both years.

In 1972 spring runoff began the last few days that eggs were in redds. This caused complete loss of eggs and fry at stations 010 and 011, and partial loss at stations 006, 008 and 028. In 1973 the small numbers of eggs (10 or 20) used in vials was not sufficient to indicate complete hatching of eggs in screen containers. Consequently although all eggs had hatched in vials, some screen containers were removed from redds before all eggs had hatched. Had these eggs been left in redds until hatching, average survival at stations 005, 008, and 010 would have been 3 percent, 8 percent and 6 percent higher, respectively, than shown in Table 18. This problem can be solved in the future by leaving screen containers in redds for two or three days after all eggs have been hatched in vials.

Fish Stomach Contents

Approximately 12 fish stomachs per stream section were examined from sections of the Stillwater, Boulder and East Boulder Rivers. This analysis was made to determine organisms which may be of special importance as fish food. A wide variety of organisms was found in stomachs. No particular bottom fauna species appeared to be of great significance as fish food. In stomachs containing several organisms two or more species were always present. Many more fish stomachs would have to be examined to reach any firm conclusion concerning fish foods.

TABLE 17. Concentration (mg/gram net weight) of metals in fish muscle tissue.

Species[1]	Length (inches)	Weight (pounds)	Mercury	Copper	Nickel	Cadmium	Lead
			Fishtail Creek-Section F-11-July 1972				
Rb[2]	4-5	-	<0.05	0.4	2.4	0.1	<1
Rb	6.5	0.10	<0.05	0.4	3.5	0.2	<1
Rb	6.5	0.14	<0.05	0.2	1.0	<0.1	<1
Rb	6.8	0.12	<0.05	0.2	1.0	0.1	<1
Rb	8.0	0.20	<0.05	0.2	<0.5	<0.1	<1
Rb	8.0	0.19	<0.05	-	<0.5	<0.1	<1
Rb	9.6	0.32	<0.05	0.1	1.5	<0.1	<1
Rb	10.0	0.38	<0.05	0.2	1.0	0.1	<1
Rb	11.8	0.65	<0.05	0.1	1.0	0.1	<1
Rb	13.0	0.78	<0.05	0.4	<0.5	<0.1	<1
LL[2]	4.5	-	<0.05	0.1	<0.5	<0.1	<1
LL[2]	4.5	-	<0.05	0.2	1.0	0.2	<1
LL	6.5	0.10	<0.05	0.1	1.0	0.2	-
LL	6.6	0.10	<0.05	0.2	1.0	<0.1	<1
LL	7.0	0.11	<0.05	0.4	1.5	0.2	<1
LL	7.4	0.16	<0.05	-	<0.5	0.1	<1
LL	8.8	0.22	<0.05	0.2	<0.5	0.2	<1
LL	9.3	0.32	<0.05	0.3	<0.5	<0.1	<1
LL	9.7	0.34	<0.05	0.1	1.0	<0.1	<1
LL	9.9	0.38	-	0.2	<0.5	<0.1	<1
LL	12.0	0.64	-	0.4	<0.5	<0.1	<1
LL	12.2	0.72	<0.05	0.2	<0.5	<0.1	<1
LL	12.5	0.80	<0.05	0.1	<0.5	<0.1	<1
LL	15.3	1.47	<0.05	0.1	<0.5	0.1	<1
Eb	7.5	0.20	<0.05	0.1	<0.5	<0.1	<1
Eb	7.7	0.20	<0.05	<0.1	<0.5	0.1	<1
Eb	10.7	0.50	<0.05	0.5	1.0	0.2	<1
Wf	15.0	1.30	<0.05	0.1	<0.5	<0.1	<1
			Stillwater River-Section F-1-May 1972				
Rb[2]	5	-	<0.05	<0.5	<0.5	0.2	<1
Rb	7.4	0.12	<0.05	0.5	1.5	0.2	<1
Rb	7.8	0.14	<0.05	0.5	1.0	0.1	<1
Rb	7.8	-	<0.05	<0.5	1.0	0.1	<1
Rb	11.1	0.51	0.15	<0.5	0.5	0.6	<1
Rb	13.3	0.81	0.45	<0.5	0.5	0.6	<1
LL	6.8	0.11	<0.05	<0.5	<0.5	0.2	<1
LL	7.1	0.13	<0.05	<0.5	0.5	0.2	<1
LL	8.1	0.21	<0.05	0.6	<0.5	0.5	<1
LL	13.3	0.64	0.20	<0.5	<0.5	0.5	<1
LL	13.5	0.86	<0.05	0.5	3.5	<0.1	<1

[1]Abbreviations are: Rb=Rainbow Trout; Eb=Brook Trout; LL=Brown Trout; Wf=Mountain Whitefish

[2]Composite of several fish

TABLE 17. (continued)

Species[1]	Length (inches)	Weight (pounds)	Mercury	Copper	Nickel	Cadmium	Lead
			Stillwater River-Section F-1 (con'd)				
Eb[2]	<5	-	<0.05	<0.5	0.5	0.2	<1
Eb	6.6	0.10	0.4	<0.5	<0.5	0.5	<1
Eb	7.3	0.12	<0.05	<0.5	0.5	0.2	<1
Eb	7.8	0.14	<0.05	-	-	-	-
Eb	8.3	0.18	<0.05	3.4	1.0	0.3	<1
Eb	8.5	0.21	<0.05	<0.5	<0.5	0.3	<1
Eb	8.6	0.20	<0.05	-	1.0	-	<1
Wf[2]	<6	-	<0.05	<0.5	0.5	0.3	<1
Wf	9.8	0.40	<0.05	0.5	0.5	0.6	<1
Wf	10.1	0.34	<0.05	0.6	1.0	0.5	<1
Wf	10.9	0.40	<0.05	<0.5	<0.5	0.5	<1
Wf	11.3	0.38	<0.05	0.8	1.5	0.1	<1
Wf	12.6	0.59	<0.05	<0.5	0.5	0.9	-
Wf	13.7	0.68	<0.05	0.7	0.5	0.3	<1
Wf	13.7	0.70	<0.05	<0.5	1.5	0.7	<1
			Boulder River-Section F-4-April, 1972				
Rb[2]	5	-	<0.05	0.5	0.5	0.3	<1
Rb	5.6	0.05	0.11	0.5	<0.5	0.7	1.5
Rb	7.0	0.15	<0.05	0.5	0.5	0.2	<1
Rb	7.1	0.15	<0.05	0.5	1.0	0.5	<1
Rb	8.3	0.21	<0.05	<0.5	1.0	0.3	<1
Rb	8.7	0.23	<0.05	<0.5	<0.5	0.1	<1
Rb	8.7	0.22	<0.05	<0.5	0.5	0.2	<1
Rb	12.4	0.72	<0.05	<0.5	<0.5	0.3	<1
Rb	13.4	0.88	<0.05	<0.5	0.5	0.2	<1
Rb	15.4	1.35	<0.05	-	-	-	-
Rb	17.5	2.05	<0.05	0.5	1.0	0.5	1
Rb	17.7	1.96	<0.05	<0.5	<0.5	0.1	<1
Rb	18.0	1.80	<0.05	<0.5	<0.5	<0.1	<1
Rb[2]	21.6	3.18	<0.05	<0.5	<0.5	0.1	<1
Eb[2]	<5	-	<0.05	0.5	<0.5	0.3	<1
Eb	5.8	.07	0.05	<0.5	<0.5	0.1	<1
Eb	6.0	.07	<0.05	<0.5	<0.5	-	<1
Eb	6.1	.08	<0.05	<0.5	<0.5	<0.1	<1
Eb	7.6	.13	<0.05	<0.5	<0.5	<0.1	<1
Eb	8.1	.14	<0.05	<0.5	<0.5	<0.1	<1
Eb	8.7	.19	<0.05	<0.5	<0.5	0.1	<1
Eb	9.2	.22	<0.05	<0.5	0.5	0.4	1
Eb	9.8	.30	<0.05	<0.5	<0.5	<0.1	<1

TABLE 17. (continued)

Species[1]	Length (inches)	Weight (pounds)	Mercury	Copper	Nickel	Cadmium	Lead	Zinc
			Stillwater River-Section F-2-April, 1972					
Rb[2]	<6.0	-	<0.05	1.1	1.6	0.6	<2	28
Rb	7.5	0.15	<0.05	<0.5	4.2	<0.5	<2	9.0
Rb	9.0	0.28	<0.05	0.9	1.4	<0.5	<2	9.5
Rb	9.1	0.30	<0.05	0.9	2.4	0.6	<2	7.5
Rb	9.7	0.38	<0.05	0.7	1.6	0.6	<2	5.0
Rb	10.6	0.40	<0.05	1.1	2.6	0.7	<2	12
Rb	12.5	0.60	<0.05	<0.5	2.0	1.0	<2	4.5
Rb	14.8	1.00	<0.05	0.9	<1.0	<0.5	<2	7.5
Rb	15.3	1.22	<0.05	1.0	1.6	1.0	<2	7.0
Rb	15.4	1.30	<0.05	<0.5	<1.0	0.6	<2	4.5
Rb	17.4	2.16	<0.05	1.4	<1.0	<0.5	<2	7.0
Eb[2]	<6.0	-	<0.05	0.6	<1.0	<0.5	<2	13
Eb	6.3	0.12	<0.05	<0.5	1.4	<0.5	<2	7.0
Eb	6.4	0.08	<0.05	0.8	2.0	0.6	<2	16
Eb	6.8	0.09	<0.05	0.7	<1.0	<0.5	<2	13
Eb	7.1	0.10	<0.05	1.5	1.0	<0.5	<2	15
Eb	8.5	0.18	<0.05	0.6	1.8	<0.5	<2	8.5
Eb	8.8	0.25	<0.05	0.7	1.4	0.6	<2	14
Eb	9.3	0.26	<0.05	0.7	3.4	<0.5	<2	4.5
Eb	11.1	0.40	<0.05	<0.5	2.8	<0.5	<2	16
LL[2]	<6.0	-	<0.05	1.3	1.2	0.8	<2	10
LL	6.4	0.13	<0.05	1.3	1.1	<0.5	<2	17
LL	6.4	0.08	<0.05	0.6	<1.0	<0.5	<2	12
LL	7.8	0.20	<0.05	0.6	<1.0	<0.5	<2	5.5
LL	7.8	0.18	<0.05	1.4	1.2	<0.5	<2	16
LL	10.3	0.34	<0.05	<0.5	3.5	0.6	<2	14
LL	10.3	0.35	<0.05	<0.5	4.0	0.6	<2	8.0
LL	10.8	0.44	<0.05	0.6	1.1	0.5	<2	4.5
LL	12.9	0.71	<0.05	<0.5	2.8	1.0	<2	16
LL	15.5	1.30	<0.05	0.7	1.3	<0.5	<2	4.0
LL	15.6	1.05	<0.05	0.9	<1.0	0.6	3	7.5
LL	15.7	1.22	<0.05	0.7	1.1	<0.5	<2	4.0
LL	15.7	1.28	<0.05	1.2	1.0	0.6	<2	22

TABLE 18. Percentage survival to hatching of eyed cutthroat (1972) and eyed rainbow (1973) trout eggs placed in artificial redds.

Station Number	Date eggs placed in redds	Date eggs removed from redds	Percentage survival in egg containers 1	2	3	Mean Survival
East Rosebud River						
001	4-20-72	5-15-72	51	39	33	41
001	9-19-73	10-4-73	96	91	81	89
028	4-20-72	5-15-72	43	-	-	-
028	9-19-73	10-3-73	80	98	73	84
West Rosebud River						
003	4-20-72	5-15-72	27	34	34	32
003	9-19-73	10-4-73	84	76	79	80
004	4-20-72	5-15-72	69	63	62	65
004	9-19-73	10-3-73	97	90	89	92
Stillwater River						
005	4-19-72	5-16-72	42	47	51	46
005	9-19-73	10-3-73	92	88	89	90
006	4-19-72	5-16-72	7	-	-	-
006	9-19-73	10-3-73	85	86	89	87
West Fork Stillwater River						
007	4-19-72	5-16-72	50	59	51	53
007	9-19-73	10-11-73	66	85	78	76
East Boulder River						
008	4-19-72	5-17-72	40	-	-	-
008	9-18-73	10-8-73	66	78	85	76
Boulder River						
010	9-18-72	10-5-73	79	70	75	75
011	9-18-73	10-12-73	90	73	81	81

Stillwater River Headwaters Area

On July 27, 1972 cutthroat trout spawners were sampled with a seine in the inlet stream to Goose Lake (Figure 1). This stream is approximately 1000 feet long and connects Goose Lake with Little Goose Lake. Eighty fish were captured. This number appeared to be about half the fish present in the stream on that day. Fish ranged in length from 6.9 to 16.2 inches and from 0.11 to 1.35 pounds. Most females were ripe and some were spawned out. Scales were collected, but could not be aged with any confidence because scale circuli did not form recognizable annuli in many instances.

Redds in the inlet stream were sampled on September 6, 1972. All live eggs had hatched but fry were still in the gravel. No redds were found in the lower half of the stream. Drainage from a pit dug on an adjacent mining claim had contributed silt to the lower portion of the stream, but fine material was also present in gravels in the upper portion. A total of 1168 dead eggs and live sac fry were removed from three redds. Overall survival to hatching of sac fry and dead eggs recovered from redds was 54 percent and varied from 1 percent to 84 percent for the three redds. Noreason for the large variability in survival was apparent.

Acidic mine drainage originates from Daisy Pass area (Figure 1). Water from many seeps and springs in the disturbed area has pH values of approximately 2.5 to 4.0, with some concentrations of over one hundred milligrams per liter of metals such as aluminum, copper, iron, and zinc (unpublished data, Custer National Forest, U. S. Forest Service). Little or no data was available, however, on affects of acid drainage on the upper Stillwater River.

Results of work done in this area in August 1972 are shown in Table 19. The pH had reached 5.6 at the mouth of the unnamed creek (here called Daisy Creek) which drains the area disturbed by mining activities. Values of pH in the Stillwater downstream from this point were above 8.0 (Table 19). Metal concentrations had dropped to values probably not acutely toxic to organisms at a distance of 0.4 stream miles below Daisy Creek.

Bottom fauna is depressed severely for at least 1.5 miles below the mouth of Daisy Creek. The population recovers below the confluence of Goose Creek and the Stillwater River (Table 19). Iron precipitate and other metals in the stream are the apparent causes of depressed bottom fauna populations.

Fish were not found in the Stillwater River upstream from the acid drainage, nor in Goose Creek before it empties into the Stillwater River. This apparent lack of fish cannot be explained. The only fish captured in this area of the Stillwater was 6.5 stream miles below the mouth of Daisy Creek (Table 19). Fish may be present farther up the Stillwater River, but numbers are probably extremely low. Fish may not survive in many streams in this area because of the high elevation, severe winter conditions, and unknown but possibly very low water flow rates in winter.

TABLE 19. Summary of physical, chemical, and biological conditions in the Stillwater River downstream from the Daisy Pass headwaters area, 1972.

Distance from mouth of acid stream	pH	Cu (mg/liter)	Mn (mg/liter)	Zn (mg/liter)	Condition of stream bottom	Bottom fauna	Fish
50 feet upstream	8.5	--	--	--	Clean gravel	Plentiful diverse	None captured
150 feet downstream	8.1	--	--	--	Heavy iron precipitate	Few present; probably maintained by drift from upstream; obviously depressed	None captured
0.4 miles downstream	8.4	0.05*	0.16*	0.02*	Iron precipitate	Very few present; obviously depressed	None captured
1.5 miles downstream	8.5	--	--	--	Iron precipitate	Few present; mostly diptera; obviously affected	None captured
2.7 miles downstream above Goose Creek	8.5	0.07	0.06	0.015	Iron precipitate	Recovering; diptera still dominant	None captured
below Goose Creek	8.4	0.02	0.02	0.015	Faint iron precipitate	Present, largely recovered; numbers low, but diverse forms present	None captured
6.5 miles downstream	--	--	--	--	--	--	One brook trout captured by hook and line
8.5 miles downstream	--	--	--	--	--	--	Several fish seen in river

* unpublished data - Custer National Forest, U. S. Forest Service

RECOMMENDATIONS

An additional year will be required to obtain needed physical, chemical and biological data on all streams that could be affected by mining in the area.

Data on general water quality perameters are sufficient for now, except for a few tributary streams which will be sampled in 1974. The one major deficiency is the lack of intensive turbidity and suspended solids data. Especially intensive sampling is needed during runoff. Additional data on metals content of sediments in tributary streams are also needed.

Sampling of bottom fauna will soon reach the point of limited return at stations where sampling was started in 1970 or 1971. At these stations sampling will be completed, for the present time, in 1974. Sampling should continue at a few locations that remain unsampled or inadequately sampled.

More fish population data are needed. Work to date has been concentrated on larger streams at points immediately up and downstream from mining claims. Fish population estimates are also needed at downstream locations where fish are more numerous. Qualitative electrofishing should be accomplished on unsampled portions of larger streams and on the upper reaches of tributary streams.

Additional samples of fish for metals analyses should be collected at the time of fish population work in previously unsampled locations. Egg bioassays should be repeated in the fall, to confirm the higher survival rates found at this season. A few new stations are needed for egg bioassays.

Work on the Rosebud drainage should be discontinued for the present time. Mining claims in this area are not being maintained and any development in the near future seems unlikely.

These recommendations are contingent on the status of mining remaining unchanged. Should operational development be announced during the period of this study, more emphasis should be placed on specific streams draining the area of development.

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5-22-3346-1
5-22-3360-1
5-22-3752-1
5-22-3864-1
5-22-4275-1
5-22-4280-1
5-22-4508-1
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