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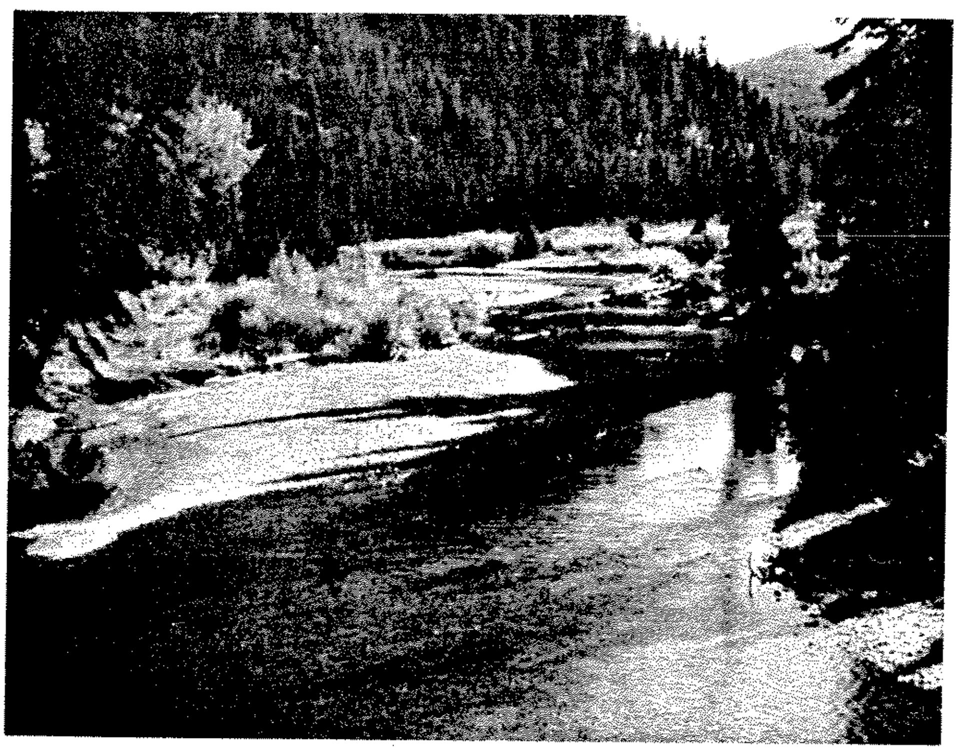
UPPER BLACKFOOT RIVER STUDY

A Premining Inventory of Aquatic and Wildlife Resources



Montana Department of Fish and Game
Environment and Information Division
in cooperation with
The Anaconda Company

By
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REPORT SUPPLEMENT

As this report was being finalized, an event occurred in the Blackfoot River drainage which may alter some of the baseline information given in this report.

On or about June 19, 1975, a severe rainstorm added moisture to an already melting snowpack. The resulting heavy runoff, plus failure of the bypass facilities around the Mike Horse tailings dam filled the area behind the dam, overtopped and breached the structure. This sequence of events released approximately 100,000 tons of gray-colored, pyritic mine tailings deposits into the Blackfoot River.

The severity of the storm and high water conditions which washed out the access road greatly hampered repair efforts. Temporary repairs completed 9 days later allowed most of the water flowing through the tailings to be diverted around the tailings pond. However, seepage of water through the pond area continued to carry lesser amounts of tailings downstream 22 days after the dam failed. The Anaconda Company substantially rehabilitated the dam and installed new bypass structures in the fall of 1975 to prevent similar occurrences in the future. A new pond will be formed behind the repaired dam.

It is unknown how far downstream the tailings were carried, but for several days the gray-colored water was apparent at the mouth of Landers Fork, 15 miles downstream. High, muddy waters of Landers Fork obscured the dark gray color of the Blackfoot below their confluence to a point not noticeably different from the normal runoff conditions in the river. It is suspected the tailings were carried many more miles downstream in a more diluted form.

Cutthroat trout populations in the tailings pond and in the 300 feet of Beartrap Creek below the tailings dam were destroyed by the floodwaters. Also, the water quality, bottom fauna, fisheries and other data given in this report may have undergone changes due to mine tailings deposition in the stream channel. These changes will have occurred only in the main Blackfoot River and not in its tributaries. Biological and water quality sampling were conducted during the period by the Departments of Fish and Game and Health and Environmental Sciences and U. S. Forest Service. A summary report of the events and findings will be prepared by the Department of Fish and Game.

A possible result of the tailings pollution may be depression of aquatic biota further downstream than is presently occurring. This will not be known until further biological sampling is done on the river. If it is found that water quality and biological conditions are changed from that described in this report, further data will have to be collected to establish a new baseline of information to use in the event a mining operation begins in the Heddleston District.

Four fish ponds were constructed in the stretch of river between Anaconda Creek and Pass Creek during dam reconstruction. These ponds will improve the poor habitat conditions existing prior to dam failure, but only time will tell whether a fishery will develop in them.

ABSTRACT

This report is a compilation of chemical and biological data collected in anticipation of an open pit copper mining venture by the Anaconda Company in the headwaters of the Blackfoot River near Lincoln, Montana. Data are presented on stream water quality from 1968 through 1973, both laboratory and field analyses; streamflow; suspended sediment (turbidity); bottom fauna identified to lowest possible taxa; fish species present, their distribution and relative abundance, plus fish population estimates in selected stream sections; diurnal variations of dissolved oxygen; biological oxygen demand and coliform bacteria; continuous streamflow and temperature data and field and laboratory water quality data collected by the U. S. Geological Survey at two stations under contractual agreement with the Department of Fish and Game.

Information is presented on heavy metals concentrations in game fish and streambed sediments. Fish tagging and return data and data from spawning areas are also given.

General data on wildlife distribution, location and use of elk calving areas and winter ranges are presented. Elk migration patterns based on radio telemetry of three cow elk are given.

Water quality was generally good in the Blackfoot River and its tributaries. Degraded water quality existed in the extreme headwaters of the Blackfoot River due to acid mine drainage from the abandoned Mike Horse Mine and other tunnels. This lower water quality was reflected in bottom fauna populations which were poor in affected areas but good in areas unaffected by mine drainage. Diversity indices were calculated from bottom fauna data.

Principal fish species found in the study area were cutthroat trout, brook trout, brown trout and mountain whitefish. A total of 10 fish species was collected in the area. These included six salmonids, two suckers, one dace and one sculpin. Trout were found in all waters sampled except those with acid mine drainage in the Mike Horse Mine area. Intermittent fish populations were present in those streams which annually dry up due to natural lowering of the water table. Cutthroat and brook trout predominated in the Blackfoot River above Landers Fork, whereas brown trout predominated below. Mountain whitefish were present in most areas, but most were found in the Blackfoot River downstream from Poorman Creek.

Wildlife in the study area included elk, mule deer, white-tailed deer, moose, black and grizzly bears, mountain lions, bobcats, beavers and three species of mountain grouse. There have been unconfirmed reports of bighorn sheep in the area. Bald and golden eagles were also present, as were several species of waterfowl and furbearers.

Proposed mining facilities have the potential for causing water quality problems in the Blackfoot River and some of its tributaries.

A tailings pond is proposed to cover a portion of an elk calving area. Fisheries and wildlife habitat would be eliminated by the proposed open pit mine and other facilities. The increased human population in the small upper Blackfoot valley may have an additional adverse impact on fisheries and wildlife areas. Subdivisions along the Blackfoot River pose potential problems in maintaining the natural stream course due to channel and/or streambank modifications for flood protection.

Recommendations are given to prevent or mitigate damage to wildlife habitat with development.

An appendix to the report contains original basic data collected during the study.

RECOMMENDATIONS

1. The Anaconda Company or any other developer of the Heddleston properties should inform the Department of Fish and Game at the earliest stages of mining development so that environmental impacts can be determined before development plans proceed too far for reversal.

2. The mining developer should work closely with all federal, state and county agencies and local governing bodies to develop the mining complex with the least possible impact to the land, its wildlife and the social structure of the Lincoln valley.

3. Development of the mining complex will create the potential for serious sediment pollution problems as a result of road construction, removal of overburden, and ore excavation. Adequate measures to control stream sedimentation from any source should be undertaken by the mining developer. This is also true for any discharge of toxic metals which might occur.

4. A less damaging tailings pond site or, preferably, other waste disposal methods should be found. Hardscrabble Basin and Alice Creek should not be used for these purposes. Alternative and comparable tailings pond sites were not located in the area.

5. The proposed clarification pond is in a poor location from an environmental standpoint. Not only would the Blackfoot River have to be channelized for its construction, but the pond's location in the river floodplain has the potential for flood washout and spillage of metal deposits which would be intercepted from runoff from the stockpiles and mine area and transported to the pond. An alternative to pond use or a new location for the pond should be investigated.

6. Mining properties in the Alice Creek drainage not actually needed for mining purposes should be relinquished to the Department of Fish and Game for wildlife management in accordance with conditions agreed to in the March 16, 1970 letter from the Anaconda Company to the Director, Montana Fish and Game Department.

7. Follow-up water quality and biological monitoring should be initiated if extensive mining development should occur in the Mike Horse area. The cost of this program should be a responsibility of the mining developer.

8. Loss of elk calving range or other wildlife lands due to mining development, although irreplaceable, should be compensated for by acquisition of other wildlife lands, such as private land for winter big game range. This expense should be the responsibility of the mining developer.

9. Subdivision development in the Lincoln area poses a potential threat to the natural meandering course of the Blackfoot River by requiring streambank stabilization. Present and future planners should strongly consider the effect of river alteration on the stability of the river system and locate subdivisions away from riverbanks or other flood-prone areas.

10. The private lands shown as critical winter range in Figure 24 should be acquired if they become available from landowners willing to sell.

11. The feasibility of limiting motor vehicle access to the Spencer Bar calving area in May and June should be investigated.

12. Streamflow reservations in the project area should be submitted to the Department of Natural Resources under the 1973 Montana Water Use Act so that flows necessary to adequately sustain fish and wildlife can be obtained prior to mining development.

ADDITIONAL STUDIES NEEDED

1. Very little data were obtained on the Dolly Varden. Its status is practically unknown and more data should be gathered on its status, distribution and migratory habits.

2. Electrofishing indicated that mountain whitefish move within the river system on fall spawning migrations. More data should be gathered on the status and migratory habits of this species.

3. More data on spawning success, locations of spawning areas and the degree of spawning movement of resident cutthroat, brook and brown trout would increase the knowledge of these fisheries and should be obtained.

4. Additional data should be collected on fish populations in sections of the Blackfoot River and tributaries not sampled during this study to increase this knowledge for future planning purposes in the Blackfoot drainage.

5. The analysis of stream sediments for metal concentrations may shed new light on the origin of these metals and their effects on fish and wildlife. Additional sediment data should be obtained from the study area.

6. The three radioed elk studied during the period furnished good data on the migratory habits of elk which utilize the Scapegoat Wilderness. However, more elk should be banded with radio transmitters on both their winter and spring ranges to gain more complete data on these animals. The amount of information gained from radio telemetry is many times greater than that obtained from other marking methods and is well worth the additional expense of aerial tracking.

7. A study should be initiated to determine if there is competition for food between elk and domestic cattle and sheep utilizing the Spencer Bar area in the spring.

8. The effect of the high groundwater table and individual sewage disposal systems in the Lincoln area on Blackfoot River water quality is unknown. Data should be gathered on this potential problem.

9. A detailed chemical/biological study should be done on those portions of the Blackfoot River and tributaries affected by mine drainage to determine existing problem areas, what factors are depressing aquatic life, where the recovery zones are, and what causes the recovery. Such a study should include effects of mine drainage on water-oriented wildlife such as beavers, muskrats, mink, mice and shrews.

INTRODUCTION

This is the final report on the Upper Blackfoot River Study. A progress report was prepared by Dale (1971) under contractual agreement with the Department of Fish and Game. It included water quality data collected from February 1968 to March 1970. After issuance of the first report, a position of Environmental Planning Ecologist was established to continue gathering water quality data and expand the project to include biological data as well. This position was established in December 1970 under a project entitled "Heddleston Mining Development Project." The project title was later changed to "Upper Blackfoot River Study." Information contained in this second and final report includes all water quality and biological data obtained from February 1968 through August 1973.

At the time this study was begun in 1968, the Anaconda Company was actively considering development of an open pit copper and molybdenum mine in the Heddleston mining district. The district lies near the continental divide in the headwaters of the Blackfoot River near Lincoln, Montana. It was thus imperative that chemical and biological data be collected before development began to establish a "baseline" of existing ecological conditions. Mining on a commercial scale has not begun at this time, however, and it is unknown if or when development will occur.

The Blackfoot River drainage is an important hunting, fishing and recreational area. High water quality and other environmental standards must be maintained to perpetuate this use. State and federal regulations govern the maintenance of environmental quality, and adequate data are necessary to aid in development and enforcement of suitable standards.

DESCRIPTION OF THE STUDY AREA

The Blackfoot River flows 122 miles in a westerly direction from its source near the continental divide to its confluence with the Clark Fork River at Bonner, a small lumber industry town 7 miles east of Missoula, Montana (Figure 1). Principal tributary streams in downstream order are: Alice Creek, Landers Fork, Nevada Creek, North Fork, Monture Creek and Clearwater River. The source of the Blackfoot River is the confluence of Anaconda and Beartrap Creeks within the proposed mining area.

Mining in the upper Blackfoot valley began about 1865. Between 1865 and 1871, about $7 million in high grade placer gold was taken from the gravels of Lincoln Gulch, 2 miles west of Lincoln. Mining activity at the source of the Blackfoot River dates from 1889 when William Heddleston and George Padbury discovered the Calliope lode. They built an arrastra on Pass Creek and recovered about $11,000 in gold from the Calliope mine. Access to the Heddleston mining district was then limited to foot or horseback. Prospecting in later years produced very little gold, but some amounts of lead and other ores. Recovery of these metals required smelting, and the Mike Horse mill was eventually constructed on Mike Horse Creek in 1919. During the 1920's, as access and transportation improved, additional quantities of lead, silver and gold, and small but appreciable amounts of copper were mined and shipped to other smelting facilities. Mining continued intermittently through World War II, especially at the Mike Horse Mine. Operations at the Mike Horse ceased about 1953. In recent years the Anaconda Company has discovered a porphyry copper deposit in an area north of the Mike Horse Mine. There are several abandoned mineral prospects in the area, but there are no actively producing or developing mines (Pardee and Schrader 1933 and Mudge, et al. 1971). Core drilling and tunnel exploration by the Anaconda Company have recently occurred in the Mike Horse area. Several small prospectors are also active nearby.

Topography and geology of the Blackfoot valley near Lincoln were influenced by glacial activity. Glacial ice invaded the valley from the north at least twice. During the first advance ice moved down the broad valley north of Lincoln and was joined by ice from Landers Fork and Alice Creek which was moving down the Blackfoot valley. The main ice mass of the second advance moved down Copper Creek and Landers Fork, overflowed the east side of the Landers Fork valley in T 15N, R 7W, Section 18, continued southeastward and blocked the Alice Creek valley, forcing Alice Creek to cut a canyon in the rock on the east side of the valley. A unique area locally known as Spencer Bar in Hardscrabble Basin was formed by this glacial activity (Figure 2). (From Alden 1953 and Coffin and Wilke 1971. More detailed geological information is available in these references.)

Population of the Blackfoot valley is about 2,200 people. Agriculture and timber are the main industries. Most of the land adjacent to the river is private, mixed with some state and BLM land. There is very little national forest land adjacent to the river, but a good share of the mountainous terrain is on national forest land. Most surface water which makes up the Blackfoot River originates from tributaries which arise on and flow through national forest land.

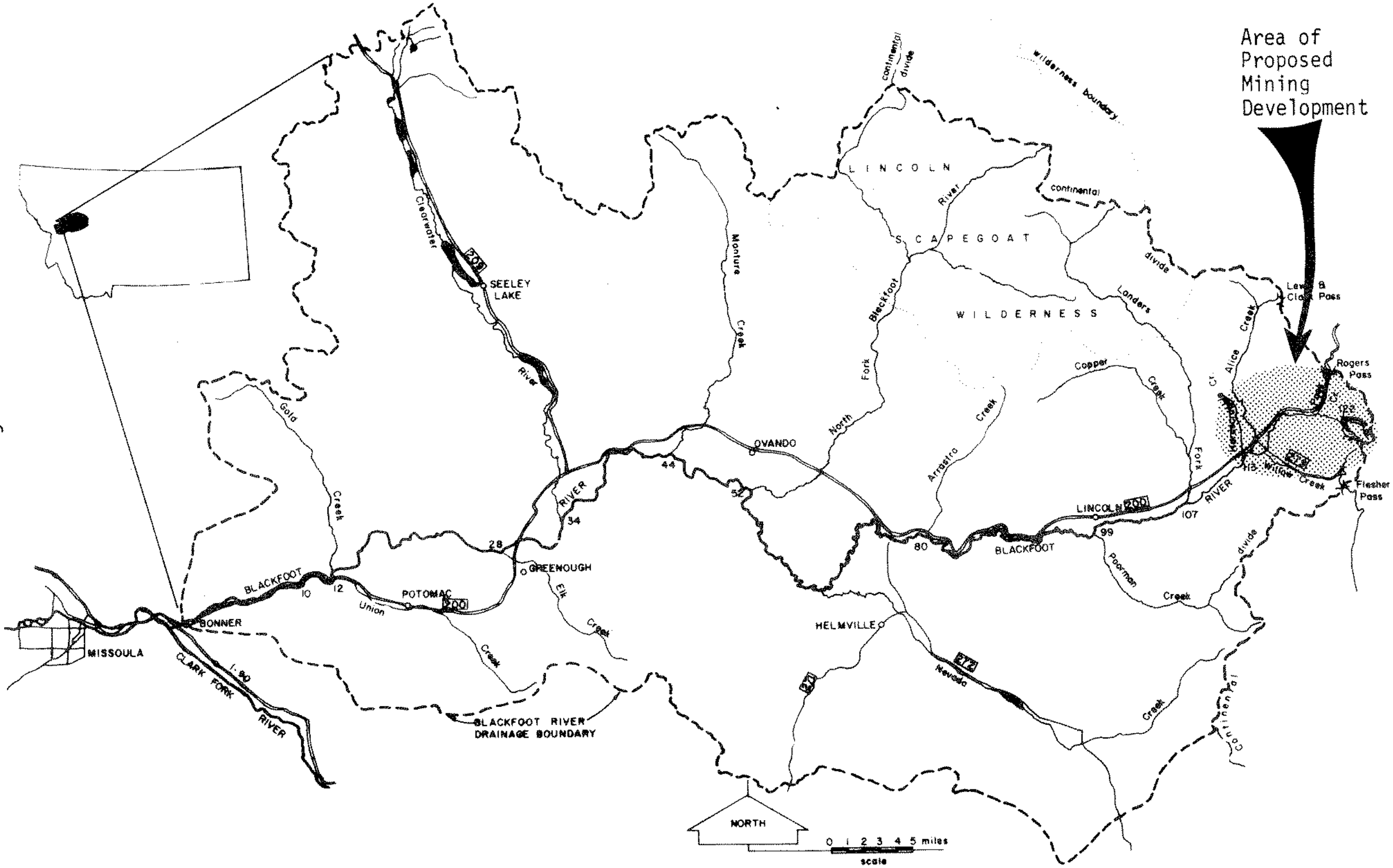


Figure 1. Blackfoot River drainage. Numbers along main river are river miles above mouth.

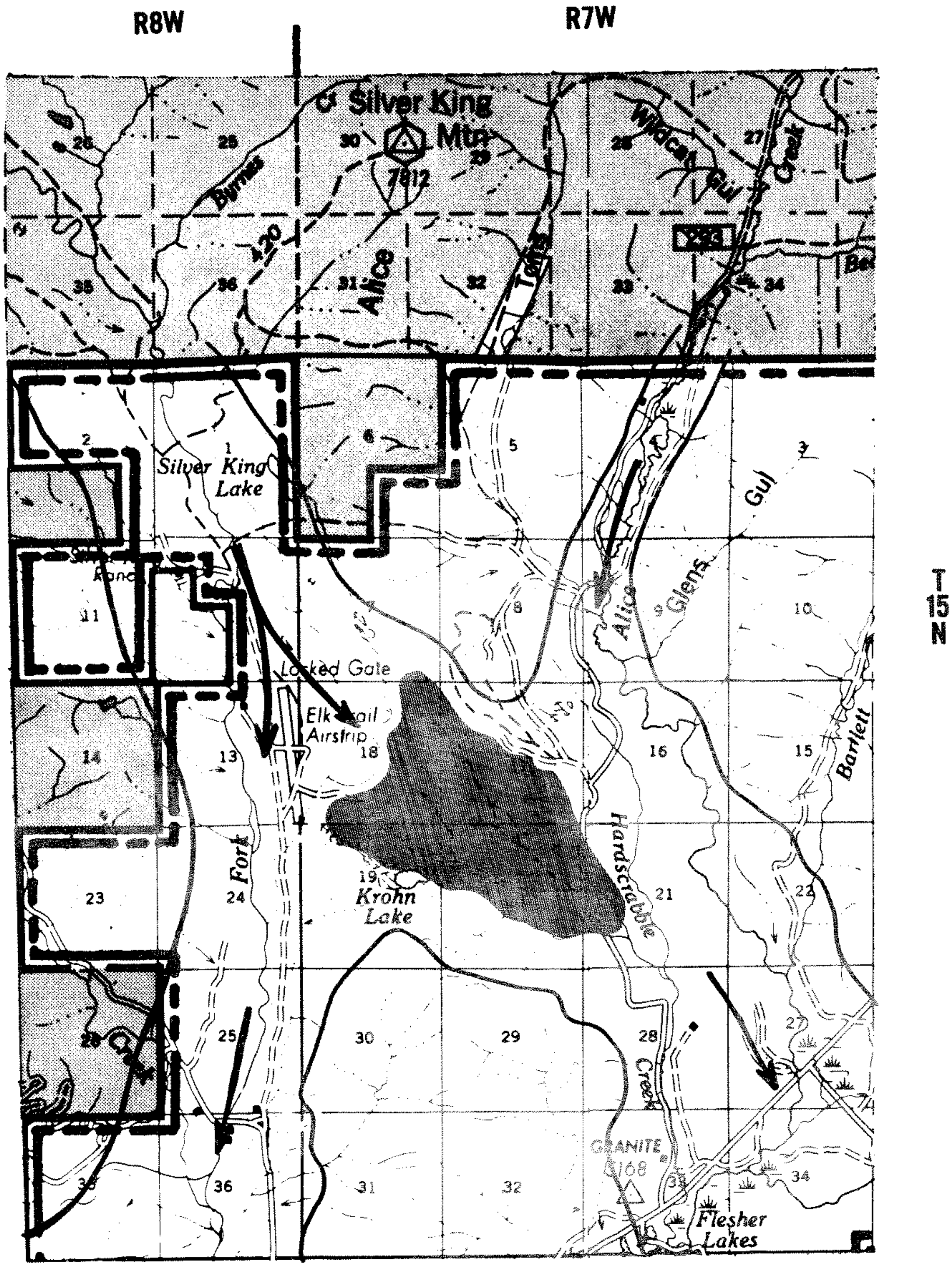
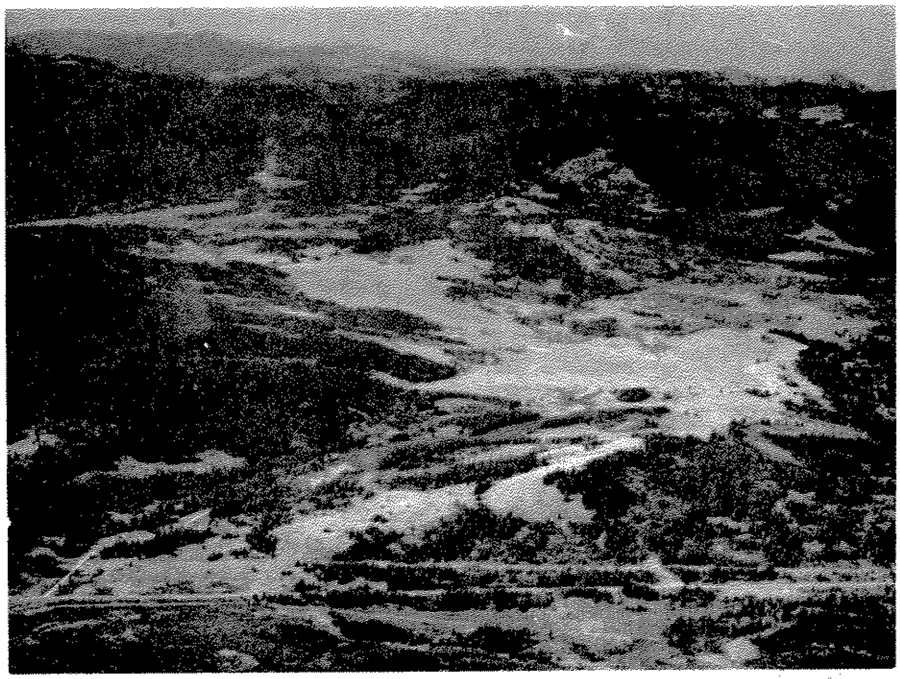


Figure 2. Limits of glacial activity and direction of ice flow in Landers Fork and Alice Creek valleys. Shaded area is Spencer Bar (from Coffin and Wilke 1971).



Spencer Bar in Hardscrabble Basin was formed during the second glacial advance which spilled over from Landers Fork drainage (background). October 29, 1974.

The Blackfoot River is, for all practical purposes, "free-flowing" from source to mouth. There is a small diversion dam at the mouth of the stream which serves a wood products mill at Bonner. There is a small irrigation reservoir on Nevada Creek, a southern tributary. The Clearwater River flows through a series of natural lakes on its course down the valley. Waters of Landers Fork, North Fork and Monture Creek originate in wilderness or roadless areas. Logging activities are prevalent on both private and public lands in nearly every major subdrainage where this activity is allowed.

Hunting, fishing and other forms of recreation are important in the Blackfoot drainage. The Blackfoot River contains wild populations of rainbow, cutthroat, brook and brown trout, Dolly Varden and mountain whitefish. Elk, mule deer, white-tailed deer and black and grizzly bears inhabit the drainage, as do three species of mountain grouse (blue, Franklin's and ruffed).

A principal state highway (Route 200) runs the length of the Blackfoot drainage, providing access to recreation areas as well as a main transportation route for local and commercial vehicles between Missoula and Great Falls, two of the larger cities in the state.

There is currently a USGS (U. S. Geological Survey) gaging station near Bonner. Streamflow records at several discontinued stations are also available in USGS surface water records.

The basin has a drainage area of 2,290 square miles above the USGS gaging station 5.6 miles upstream from Bonner. The total drainage area is about 2,320 square miles.

Very little water is appropriated from the Blackfoot River at the present time. Water withdrawn from the stream is primarily used for private irrigation of pastures and haylands. An irrigation ditch about 1/8 mile below the mouth of Landers Fork diverts a significant amount of flow from the river during extreme low flow periods.

The proposed location of mining facilities determined the location of the sampling stations. The elevation of sampling stations ranged from 3,400 feet at Rainbow Bend to 5,050 feet at Pop's Place (Weizel and Newell 1970). Location of proposed mining facilities and a description of how the complex would operate are described by Coffin and Wilke (1971) from a report by the Montana Water Resources Board (1970). Figure 3 shows the location of these facilities as was known by those authors in 1971.

Previous studies related to impact of mining development in the Lincoln area have been done by Coffin and Wilke (1971) and Williams (1970).

HISTORY AND METHODS1/

Water Quality

A water quality sampling program was begun by the Department of Fish and Game and University of Montana in February 1968, and was continued until March 1970. Five stations on the main Blackfoot River were sampled monthly, and tributary streams were sampled every 3 months for a total of 12-15 samples each month. Sampling at the Pop's Place station was discontinued in September 1968 when sampling there was assumed by the USGS under contract with the Department of Fish and Game. The USGS called this station "Blackfoot River near Lincoln, Montana."

Tributary sampling was discontinued in March 1970. Only the five main Blackfoot River stations continued to be sampled. These were: (1) Rainbow Bend, (2) Blackfoot Canyon camp (3.5 miles above Arrastra Creek), (3) Dalton, (4) Hogum and (5) Flesher. Field testing at all stations was also discontinued at this time. This schedule was maintained with few changes until February 1971 when sampling of Poorman Creek and Alice Creek again began. The Rainbow Bend station was discontinued at this time. Willow Creek (Flesher), and Hardscrabble Creek were added in October 1971 since they had never been sampled before.

1/ Specific methods for each sampling program described here can be found in the Appendices.

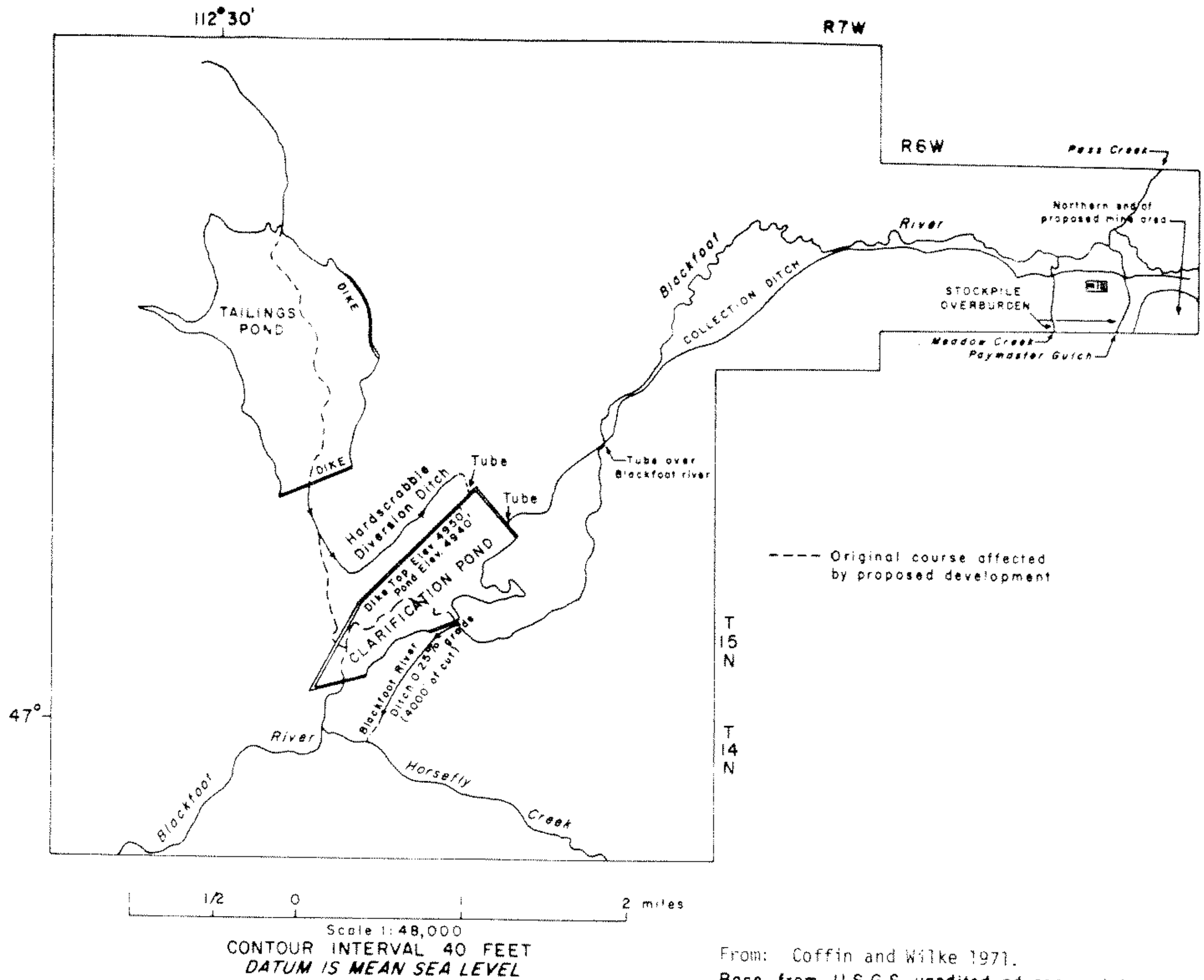
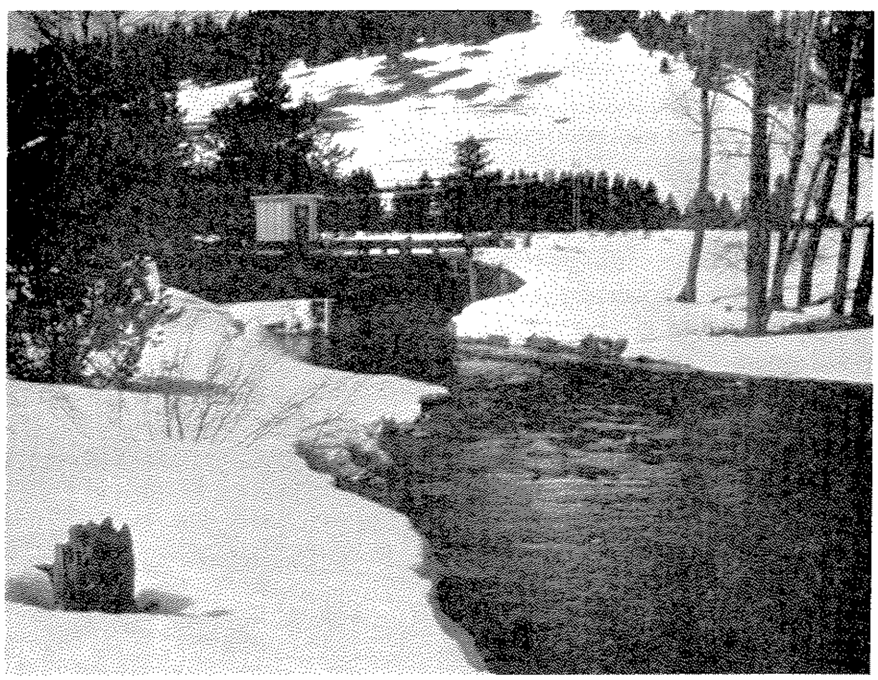


Figure 3. Location of proposed mining developments.

Analysis for "dissolved" as well as "total recoverable" heavy metals began in September 1971. This involved filtering and acidifying certain samples in the field. This practice was continued through the rest of the study. Analysis for the various forms of nitrogen and phosphorus began in March 1972 and continued until October 1972.

The USGS made periodic water quality and continuous temperature and discharge measurements at the gaging station at Pop's Place from October 1968 to September 1970 when the station was discontinued. A new station was established by USGS in October 1970 downstream at the Hogum Creek road bridge and was called "Blackfoot River below Alice Creek, near Lincoln, Montana." This station was operated until October 1975. The USGS collected continuous temperature and streamflow data, daily and monthly water quality data, and quarterly trace metals data at one or the other of these stations through September 1972. Beginning with the 1973 water year, quarterly analyses for trace metals were discontinued. Continuous streamflow and temperature measurements, and monthly water quality analyses were continued. During the 1974 water year, only continuous discharge and temperature data were collected.



USGS gaging station "Blackfoot River below Alice Creek, near Lincoln" (Hogum sample station) looking downstream. March 14, 1972.

Water quality samples were collected daily by a USGS observer at one or the other of the gaging stations through September 1972 when they were terminated. These daily samples were analyzed for specific conductance. On the basis of specific conductance, one to three samples representing extremes in total dissolved solids were selected and analyzed for common constituents.

Data from the two gaging stations are published in USGS Water Resources Data for Montana, Part 1 - Surface Water Records and Part 2 - Water Quality Records for the respective water years.

Water quality analyses not made by the USGS were performed by the State Department of Health and Environmental Sciences chemistry laboratory, Helena, Montana 59601.

BOD (Biochemical Oxygen Demand) sampling began at Canyon, Dalton and Hogum stations on the main river in February 1972. Samples were collected by the writer about every month and analyzed by the USGS in Helena. Beginning in October 1972 the USGS themselves collected and analyzed these samples monthly at the above three stations plus one additional station between Landers Fork and Lincoln (below 7-Up Pete Creek). Collections for coliform (total and fecal) determinations were also begun at these four stations by the USGS in October 1972.

In addition to irregular field determinations of DO (Dissolved Oxygen), diurnal DO measurements were made twice, once in September 1971 at six stations, and once in June 1972 at three stations. DO was determined and water temperatures were recorded every 4 hours for a 24-hour period at each station.

Intragravel DO was measured in brown and brook trout spawning redds in November 1972. Standpipes similar to those described by Terhune (1958) were placed in the spawning gravels at one location in the Blackfoot River below Poorman Creek and at the mouth of Alice Creek. Water velocities, stream discharge, surface water temperature and DO were measured, and DO and water temperatures were determined from water samples taken from within the standpipes. The approximate number of spawning redds was recorded in 1972 and 1973 in the Blackfoot River below Poorman Creek, and in 1972 in the Bartlett section on Alice Creek. Brown and brook trout were observed actively spawning over several of the redds in both places.

Measurements of turbidity were begun on a more regular basis in the spring of 1972 and continued in 1973. Sampling was intensified at the main monitoring stations during the spring runoff period, and reduced at other times of the year when the water was cleaner and fluctuated less.

Sediment samples from approximately the upper 2 inches of substrate in deposition zones of several streams and the main river were collected in 1973, stored in labeled cloth bags and analyzed for common heavy metals by the Montana Bureau of Mines and Geology laboratory in Butte.

The Anaconda Company conducted acid mine seepage surveys in the Heddleston District in 1972 and 1973. Some of their results are presented in this report.

Streamflow

Measurements of streamflow at locations other than USGS gaging stations began in March 1972. Porcelain-enameled iron staff gages were installed with assistance from USGS personnel at five locations: Canyon, Dalton and Flesher on the main river and on Poorman and Alice Creeks. In addition, a reference point was established on the Highway 200 bridge crossing Landers Fork and water height was measured with a steel tape and metal weight. The reference point was later discontinued due to channel instability at the measuring site. For the same reason there was no suitable location to install a staff gage at this site.

Bottom Fauna

Bottom fauna collections were begun in July 1968 at six Blackfoot River stations. Collections were also made in April and October 1969 at most of these same stations. These samples were collected in riffle habitat with a 2-foot-wide Needham kick screen which sampled a surface area of ± 4 square feet. One sample was collected at each station per sample period. A more intense sampling program began in March 1971. Quarterly collections were made in February, May (if water levels permitted), August and October at the following stations: Pop's Place, Flesher, Hogum, between Landers Fork and Lincoln, Dalton, Canyon and Rainbow Bend on the main river, plus Alice Creek and Poorman Creek. Periodic collections were also made on Landers Fork. A square-foot stream bottom sampler, modified after Waters and Knapp (1961) and having 38 meshes per inch (.018-inch mesh opening), was used for collection. This mesh size probably retained more insects than the U. S. Standard No. 30 sieve (.023-inch mesh size) used to define macroinvertebrates (APHA, AWWA, WPCF 1971). Three 1-square-foot samples were collected at each station in riffle habitat. The insects were preserved in glass jars containing 10 percent formalin. The samples were sorted to order. Volumes and numbers of insects in the samples were determined at the department's pollution control laboratory, Helena. The samples were then further sorted, recounted and identified to the lowest possible taxonomic group by a trained aquatic insect taxonomist working under contract with the Department of Fish and Game.

Insect collections made in 1968 and 1969 were identified to the lowest taxonomic group, but unfortunately the numbers of individuals in each group were not determined. Enumeration by lowest taxonomic group began with the March/April 1971 collections. Additional collections were made in August and October 1971, February, May, August and October 1972, and May 1973, but all of them have not been identified or enumerated below their orders.

Riffle areas were selected for sampling because they are the preferred type of habitat for bottom organisms and because life on riffles is more abundant than in pools. Riffles thus provide more information on which to base interpretation of conditions. Hard surfaces such as rocks and gravel are preferred attachment surfaces for organisms (Kittrell 1969). Also, it was felt that riffle data alone would be sufficient to show future changes in the quality or quantity of organisms due to pollution.

Needham and Usinger (1956) showed that a large number of samples was needed at a single station to give reliable (95 percent confidence) data on estimated total wet weight and estimated total numbers of bottom organisms. However, they found only two or three samples per station were needed to give 95 percent confidence that at least one member of each of the commonest genera of bottom insects would be present. It was therefore felt that three 1-square-foot samples would be adequate to establish insect diversity at the sample stations and would also be a sample size which could be managed.

Fish

Fish population estimates were made on eight sections of the Blackfoot River: Pop's Place, Flesher, below Willow Creek (Flesher), Hogum, Stemple, Poorman-Dalton and Canyon. Population estimates in one section each of Alice Creek and Poorman Creek were also made. Trout over 9 inches in total length were marked with individually numbered white Floy-T tags to determine any significant movements. All fish were captured with a Fisher-Shocker (Model FS-101) or Smith-Root backpack electrofishing equipment. The Fisher-Shocker was floated downstream in a boat rigged for electrofishing.

Additional survey shocking to establish fish species composition, their relative numbers and size was also accomplished on the following streams: Beartrap Creek - 3 sections; Pass Creek - 2 sections; Anaconda Creek - 1 section; Shoue (Shave) Gulch - 1 section; Cadotte Creek - 1 section; Willow Creek (Flesher)- 3 sections; Alice Creek - 4 additional sections; Hardscrabble Creek - 3 sections; Hogum Creek - 1 section; Copper Creek - 2 sections; Landers Fork - 2 sections.

Twenty-five fish samples were collected in 1972 by electrofishing and analyzed for the more common heavy metals by EPA (U. S. Environmental Protection Agency).

Wildlife

Wildlife data collection centered on aerial and ground observations of elk using the spring calving areas on Spencer Bar, the Alice Creek drainage, portions of Landers Fork, and winter ranges in the upper Blackfoot drainage and in the Middle Fork Dearborn River drainage east of the continental divide. Three cow elk were captured on their winter range east of the divide in April 1973 and fitted with radio transmitter collars. Their movements were followed on the ground and from aircraft during annual migrations to spring and summer range and return to winter range. Other wildlife observations were also made in the study area.

RESULTS

Water Quality

Chemical Analyses

Results of chemical analyses performed by the State Chemistry Laboratory on water samples from the 7 main river stations and 29 tributaries are given in Appendix A (pg. A-1). The location of maximum and minimum values of these chemical properties and constituents are given in Appendix B. Laboratory detection levels for the constituents are given in Appendix C. Results of laboratory analyses excluding those which had values less than the analytical detection level are given in Appendix D.

Locations of the 36 stations sampled during the study are shown in Figure 4. Numbers correspond to the station locations given in Appendix E. The system used to describe station locations is based on the system of land subdivision used by the Bureau of Land Management and is shown in Figure 5.

Average total hardness, total alkalinity, bicarbonate and calcium values increased downstream between the Pop's Place and Canyon stations (river mile 119.4 to 84.7). However, values of these constituents were less at the Rainbow Bend station (river mile 9.7) than at the Canyon station.

Average total residue increased between Pop's Place and Canyon, but these values fluctuated among the six stations in the stream reach. Total residue was also less at Rainbow Bend than at Canyon.

The lower concentrations of hardness, alkalinity, residue and calcium at Rainbow Bend may be due to the entry of waters of East and West Twin Creeks upstream and on the same side of the river as the sample station. These two streams had the lowest average values of these constituents of any of the waters sampled.

The remaining chemical constituents analyzed for did not show any particular distribution pattern in the values obtained.

Average sulfates decreased in a downstream direction, but increased again at Rainbow Bend. Sulfates were higher at Pop's Place (average 41 mg/l) than at any other station sampled. This is due to acid mine drainage from the Mike Horse area. Sulfate is commonly formed from the oxidation of sulfide minerals which are common in the Mike Horse area. The sulfur in sulfide minerals such as pyrite (FeS_2) of chalcopyrite ($CuFeS_2$) is oxidized to sulfate (SO_4^{-2}) ions in water (Coffin and Wilke 1971). The second highest average sulfate level (22 mg/l) found was at Flesher station on the main river. This station is 4.8 miles downstream from Pop's Place. Average sulfate levels in tributaries ranged from zero to a maximum of 11 mg/l at Elk Creek and Union Creek. Both streams flow through agricultural lands. Other average values were: Willow Creek (Flesher) 7.3 mg/l; Hogum Creek, 8.1 mg/l; and Poorman Creek, 9.6 mg/l - all of which flow through old mining areas; and Spring Creek, 8.8 mg/l and Willow Creek, 9.9 mg/l which flow through agricultural land.

The major cation was calcium and the major anion was bicarbonate at all 36 stations sampled. However, when sulfate levels increased, such as at Pop's Place and Flesher, bicarbonate levels were reduced accordingly.

Bicarbonate alkalinity ranged from 6-230 mg/l at all stations. West Twin, East Twin, Sandbar Creek and Pop's Place had the lowest bicarbonate levels in that order. Average bicarbonate at main river stations ranged

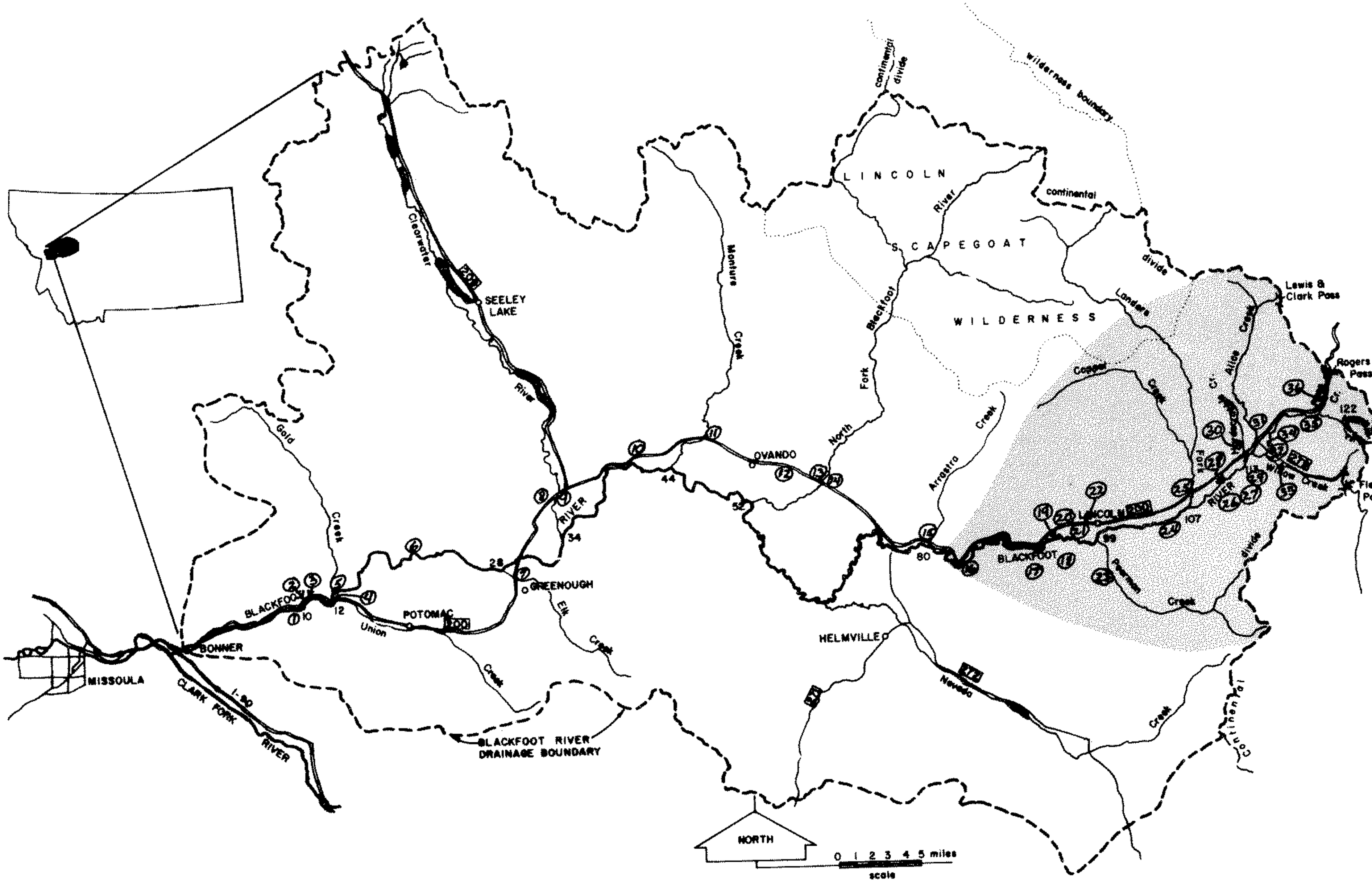


Figure 4. Location of water quality stations. Shaded portion is principal study area. See Appendix E (p. A-34) for station descriptions.

Wells, springs, water-sampling locations and stream-gaging locations are assigned numbers based on the system of land subdivision used by the U. S. Bureau of Land Management. The number consists of 12 characters and describes the location by township, range, section and position within the section. The figure below illustrates the numbering method. The first three characters of the number give the township, the next three characters the range. The next two numbers give the section number within the township, and the next three letters describe the location within the quarter section (160-acre tract), the quarter-quarter section (40-acre tract), and the quarter-quarter-quarter section (10-acre tract).

These subdivisions of the 640 acre section are designated a, b, c, and d in a counterclockwise direction, beginning in the northeast quadrant. If there is more than one feature in a 10-acre tract, consecutive digits beginning with 2 are added to the number. For example, if a water-quality sample were collected in section 21, T 9N, R 20W, it would be numbered 09N20W21DAA2. The letters DAA indicate that the well is in the NE¼ of the NE¼ of the SE¼, and the number 2 following the letters DAA indicates there is more than one water-quality sampling location in this 10-acre tract.

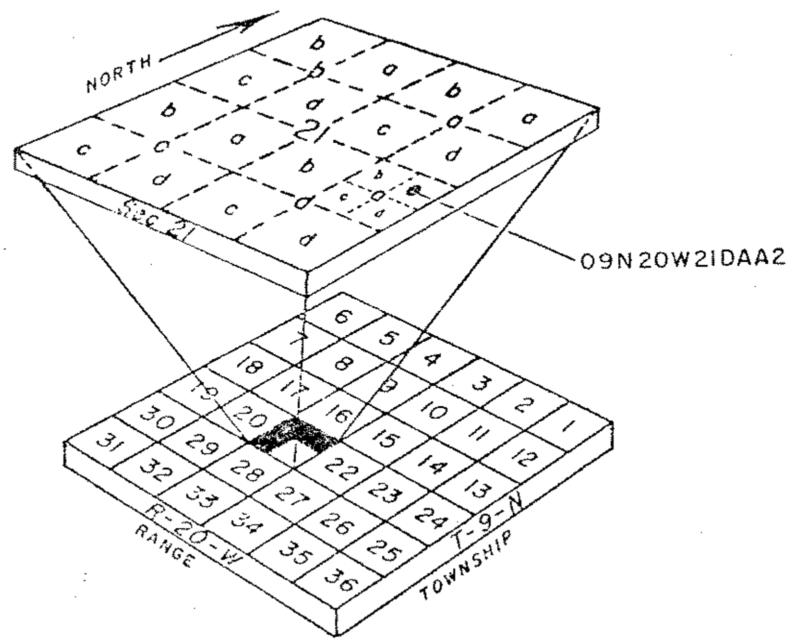
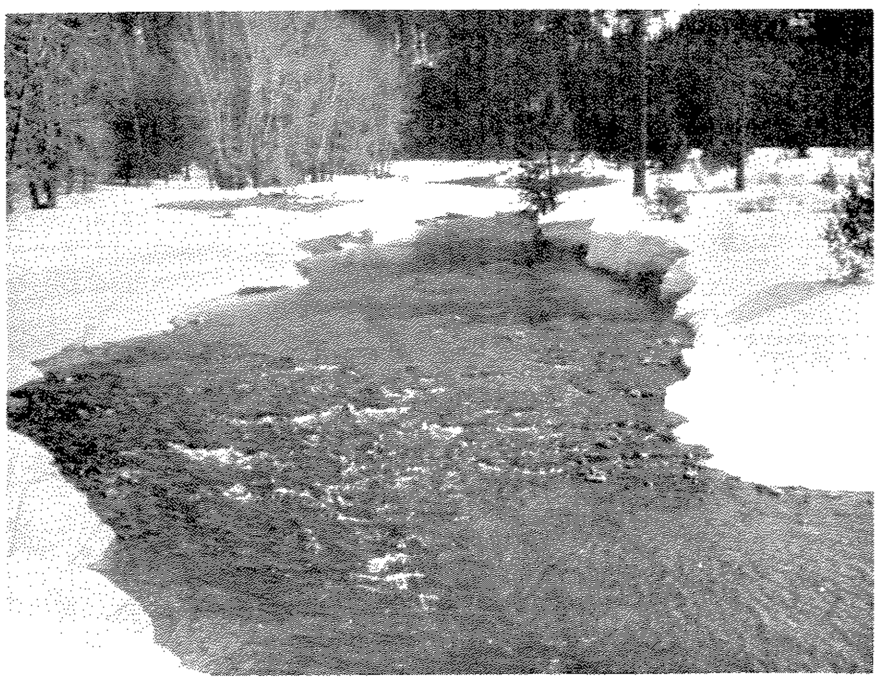


Figure 5. System for specifying water quality station locations.

from 61 at Pop's Place to 187 at Canyon. Average tributary levels ranged from 20 mg/l at West Twin Creek to 215 mg/l at Union Creek. West Twin Creek flows through boulder fill, whereas Union Creek flows through an alluvial valley and is used for irrigation of agricultural land (Weisel and Newell 1970). Union Creek does not have a good sport fish population, although other factors, such as excessive turbidity and water temperature, may be responsible.



Water quality station on Blackfoot River at Hogum Creek road, river mile 110.7. March 14, 1972.

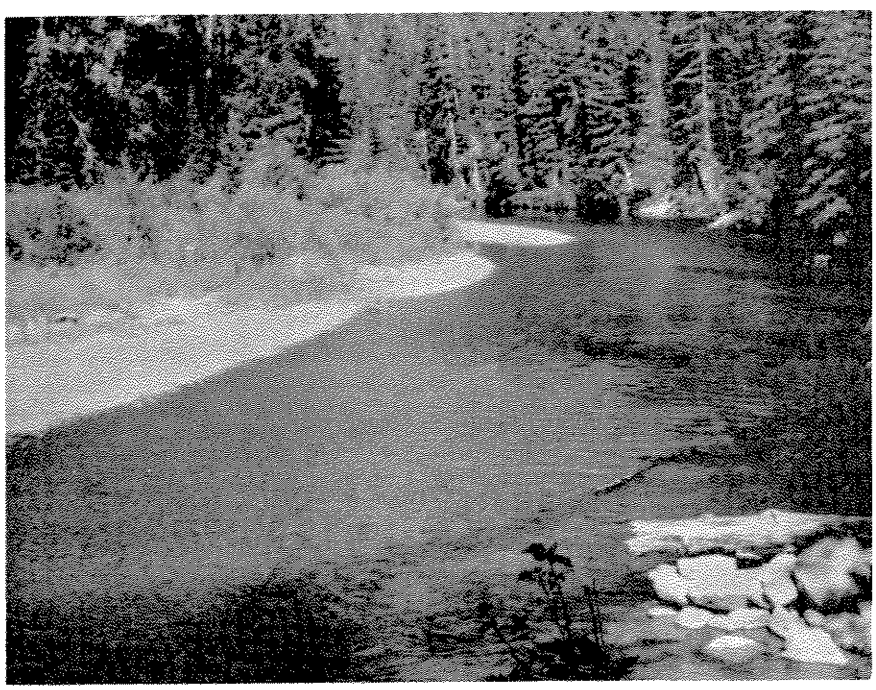
Chloride and fluoride were found in lesser quantities than any of the other major ions.1/ Average fluoride levels were almost always lower than chloride levels. Out of 36 stations sampled, only Willow Creek (Flesher), Hardscrabble Creek, Black Diamond Creek and Horsefly Creek had higher average fluoride than chloride levels (chloride was zero whereas fluoride was 0.10, 0.12, 0.20 and 0.10 mg/l, respectively). The maximum chloride levels found were 25 mg/l at Rainbow Bend and in tributaries 11 mg/l at Pass, Kleinschmidt and Union Creeks. The maximum fluoride level found on the main river was 0.50 mg/l at Pop's Place, and in tributaries 0.52 mg/l at Spring Creek.

1/ The major ions are calcium, magnesium, sodium, potassium, bicarbonate, carbonate, chloride, fluoride, sulfate.

The highest average chloride level on the main river was 4.8 mg/l at Rainbow Bend and in the tributaries 6.6 mg/l in Union Creek.

The highest average fluoride level found on the main river was 0.54 mg/l at Rainbow Bend, and in the tributaries 0.27 mg/l at East Twin Creek. Fluoride bearing rocks have a low solubility. The amount of fluorine (source of fluoride ions) in rocks is greater than the amount of chlorine; however, when all forms of both elements are considered, chlorine is much more abundant in the outer part of the earth (Hem 1970). Therefore, chloride would be expected to occur in higher concentrations than fluoride in natural water.

Total alkalinity values ranged from 35-189 mg/l on the main river and 5-226 mg/l in tributary streams. The lowest average value was found at Pop's Place (51 mg/l) on the main river. Lowest average tributary value was 17 mg/l at West Twin Creek. Average alkalinity values were over 100 mg/l at 5 of 7 main river stations (Pop's Place and Flesher were exceptions). In tributary streams, 14 of 29 stations had average alkalinity values above 100 mg/l. The remaining 15 had average values from 17-98 mg/l.



Sample station on Blackfoot River at Blackfoot Canyon Camp, river mile 84.7. August 24, 1971.

Total residue (dissolved solids) ranged from a minimum of 60 mg/l at Rainbow Bend to a maximum of 261 mg/l at Dalton on the main river and in tributary streams from 10 mg/l at West Twin Creek to 288 mg/l at

Hardscrabble Creek. Average main river values ranged from 114 mg/l at Flesher to 210 mg/l at 7-Up Pete. Average tributary values ranged from 21 mg/l at West Twin Creek to 208 mg/l at Union Creek.

Total hardness ranged from 60-340 mg/l at Pop's Place and Dalton, respectively, on the main river. Tributary values ranged from 7-310 mg/l in West Twin Creek and Union Creek, respectively. Average total hardness was lowest on the main river at Pop's Place (112 mg/l) and highest at Dalton (168 mg/l). Average tirbutary levels ranged from a low of 13 mg/l at East Twin Creek to a high of 194 mg/l at Union Creek. Hardness of water is due primarily to the presence of the cations calcium and magnesium. Water hardness is important to fish and aquatic life because toxic metals (copper, lead, zinc, etc.) are more toxic in soft water than in hard water. According to two references, the following values are used to classify water hardness (Brown, et al. 1970 and Dufor and Becker 1964).

Total Hardness (As mg/l $CaCO_3$)	Classification
0 - 60	Soft
61 -120	Moderately hard
121 -180	Hard
More than 180	Very hard

Water in the Blackfoot River drainage, therefore, ranges from soft to very hard.

Very little carbonate (CO_3) was found in any of the waters on a regular basis. Highest values were 12 mg/l at Rainbow Bend and 24 mg/l in Poorman Creek. Carbonates are less soluble in water than chlorides, sulfates and nitrates (McKee and Wolf 1963). They are not detectable when water has a pH of 8.3 or less.

Field pH levels determined with the Hach Model DR-EL field test kit showed a range of values between 6.6-8.7 for all waters sampled. The lowest values found were at Pop's Place on the main river (6.9), and in West Twin Creek (6.6), East Twin Creek (6.9) and Sandbar Creek (6.9).

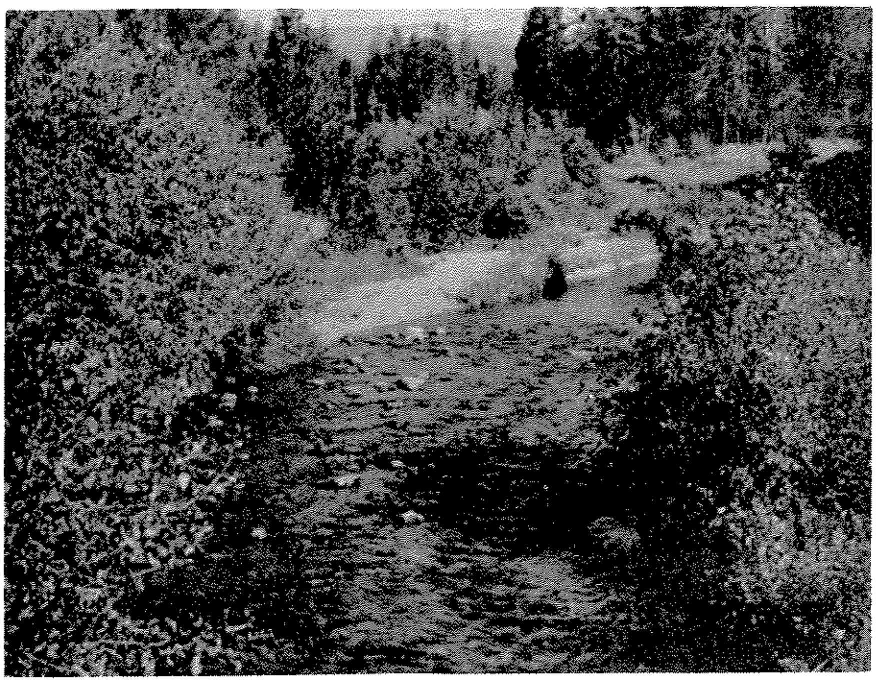
Pop's Place and Sandbar Creek receive waters from mine shafts and tailings, which account for the low pH. The two low pH values in East and West Twin Creeks were not accounted for.

The next lowest pH was 7.1 at West Twin Creek. Pass Creek and Willow Creek both had pH 7.2 as low levels. Union Creek had a low level of pH 7.3. Highest pH levels were pH 8.7 at Dalton on the main river and the same in Poorman and Elk Creeks. Fourteen of 30 stations (6 main river stations and 24 tributaries) had maximum pH levels of 8.6. Most natural waters are buffered by CO_2 reactions, and their most effective buffering action occurs between pH 6.0-8.5. Unpolluted surface water generally has a pH between 6.5-8.5 (Hem 1970).

Main river levels of calcium ranged from a minimum of 10 mg/l at Pop's Place to a maximum at Canyon of 56 mg/l. Minimum tributary values were 2 mg/l at both East and West Twin Creeks, and the maximum was 68 mg/l in Belmont Creek.

Magnesium ranged from zero at Canyon to 39 mg/l at Hogum on the main river, and in tributaries from zero at East and West Twin Creeks, Clearwater River and Pass Creek, to 51 mg/l in Union Creek. Magnesium was usually lower than calcium.

Sodium and potassium were reported together in laboratory data. Sodium + potassium values were highest on the main river at Canyon (33 mg/l) and lowest (zero) at all stations except 7-Up Pete (2.2 mg/l). In tributary streams, maximum values were 22 mg/l in Kleinschmidt and Elk Creeks and minimum values were zero in 23 of the 29 streams.



Alice Creek sample station as viewed upstream from Highway 200 bridge. August 1972.

Analyses of water samples for iron, arsenic, zinc, lead and copper revealed that in a significant number of samples these metals were not detected (Table 1).

Table 1. Number and percentage of heavy metal analyses with reported values less than the analytical detection level.

	Total Recoverable														
	Iron			Arsenic			Zinc			Lead			Copper		
	N	N<dl	%	N	N<dl	%	N	N<dl	%	N	N<dl	%	N	N<dl	%
Tributaries	198	108	54	94	80	85	204	152	74	62	54	87	202	165	82
Main River	209	91	44	81	67	83	209	102	49	53	47	89	209	162	78
Combined	407	199	49	175	147	84	413	254	62	115	101	88	411	327	80

N = total analyses
N<dl = number of analyses with reported values less than the detection level
% = percent of total analyses with reported values less than the detection level

Iron was detected more frequently than the other metals. Zinc, copper, arsenic and lead were the next most frequently detected in that order. Tributary streams, as a whole, had fewer detectable metals than did the main river. An exception was in the slightly more frequent occurrence of lead in tributary streams than in the main river. The occurrence of arsenic and lead were nearly the same in the main river and tributaries, probably because each of these metals was found infrequently and in very small amounts at all stations sampled.

By excluding the metals analyses having reported values less than the detection level, a new range and average value was calculated for each station (see Appendix D - p. A-18). The purpose is to show that heavy metals were not high at these stations, even when only those samples where the metal was detected are considered. These values are summarized in Table 2 for five selected stations in the upper 11 miles of the river. The location of these stations in the proposed mining complex (see Figures 3 and 4) makes them particularly suitable for showing any changes in water quality.

Table 2. Values (mg/l) of total recoverable heavy metals which were greater than the detection level at selected sample stations.

	B.F. @ Pop's Place (RM 119.4)	B.F. @ Flesher (RM 114.6)	Alice Cr. (RM 113.2-0.9)	Hardscrabble Cr. (RM 112.5-0.5)	B.F. @ Hogum (RM 110.7)
Iron	(7)-87%1/	(32)-67%	(14)-50%	(8)-89%	(7)-27%
Range	.02-.27	.01-.50	.01-.90	.02-.28	.08-.60
Average	.12	.12	.18	.11	.26
Arsenic		(3)-15%	(3)-20%	(1)-12%	
Range	All <dl2/	.001-.002	.001-.002	(.002)3/	All <dl
Average		.001	.002	-	
Zinc	(8)-100%	(40)-85%	(12)-40%	(4)-44%	(6)-24%
Range	.01-.44	.02-.94	.01-.72	.01-.04	.01-.03
Average	.22	.11	.11	.02	.02
Lead		(2)-13%	(4)-27%	(1)-12%	
Range	All <dl	.01-.01	.01-.01	(.01)	All <dl
Average		.01	.01	-	
Copper		(12)-25%	(9)-30%	(5)-56%	(4)-16%
Range	All <dl	.01-.18	.01-.06	.01-.02	.02-.06
Average		.03	.02	.01	.04

1/ Number and percent of total analyses showing detectable levels of the constituent.
2/ <dl = less than detection level.
3/ Number in parentheses indicates only one sample value obtained.

The highest iron value detected was .90 mg/l in Alice Creek. However, this was an extreme value as shown by the average of .18 mg/l. Arsenic, when detected, was present in very small amounts. A maximum of .002 mg/l occurred at Flesher, Alice Creek and Hardscrabble Creek. The highest zinc value (.94 mg/l) was at the Flesher station on the main river. Again, the average of .11 mg/l shows this was an extreme value. The most lead detected was .01 mg/l at Flesher, Alice Creek and Hardscrabble Creek. The maximum copper value found was .18 mg/l at Flesher; however, the average of this station was .03 mg/l.

The maximum values and the highest average values of the above metals reported at all 36 stations in the study area are given in Table 3.

Table 3. Maximum values and highest average values of metals reported at all 36 stations.

	Total Recoverable Metal	Maximum Value (mg/l)	Reported At	Highest Average Value1/ (mg/l)	Reported At
Blackfoot R.	Iron	1.5	Canyon	.24	Rainbow Bend
	Arsenic	.008	Rainbow Bend	(.008)2/	Rainbow Bend
	Zinc	.94	Flesher	.22	Pop's Place
	Lead	.01	Flesher, Dalton, Canyon	.01	Flesher, Dalton, Canyon
	Copper	.07	Dalton	.04	Hogum, Rainbow Bend
Tributaries	Iron	2.5	Sandbar Cr.	(.50)2/	North Fork
	Arsenic	.006	Beaver Cr.	(.006)2/	Beaver Cr.
	Zinc	.72	Alice Cr.	.24	Landers Fork
	Lead	.02	Poorman Cr.	.02	Poorman Cr.
	Copper	.12	E.Twin Cr.	(.12)2/	E.Twin Cr.

1/ Includes only those stations having more than one analysis performed.
2/ Numbers in parentheses indicate this was the only value greater than the detection level at this station.

Figure 6 illustrates the distribution of average concentrations of total recoverable iron, zinc and copper at the seven Blackfoot River stations based only on values greater than the detection level. Arsenic and lead

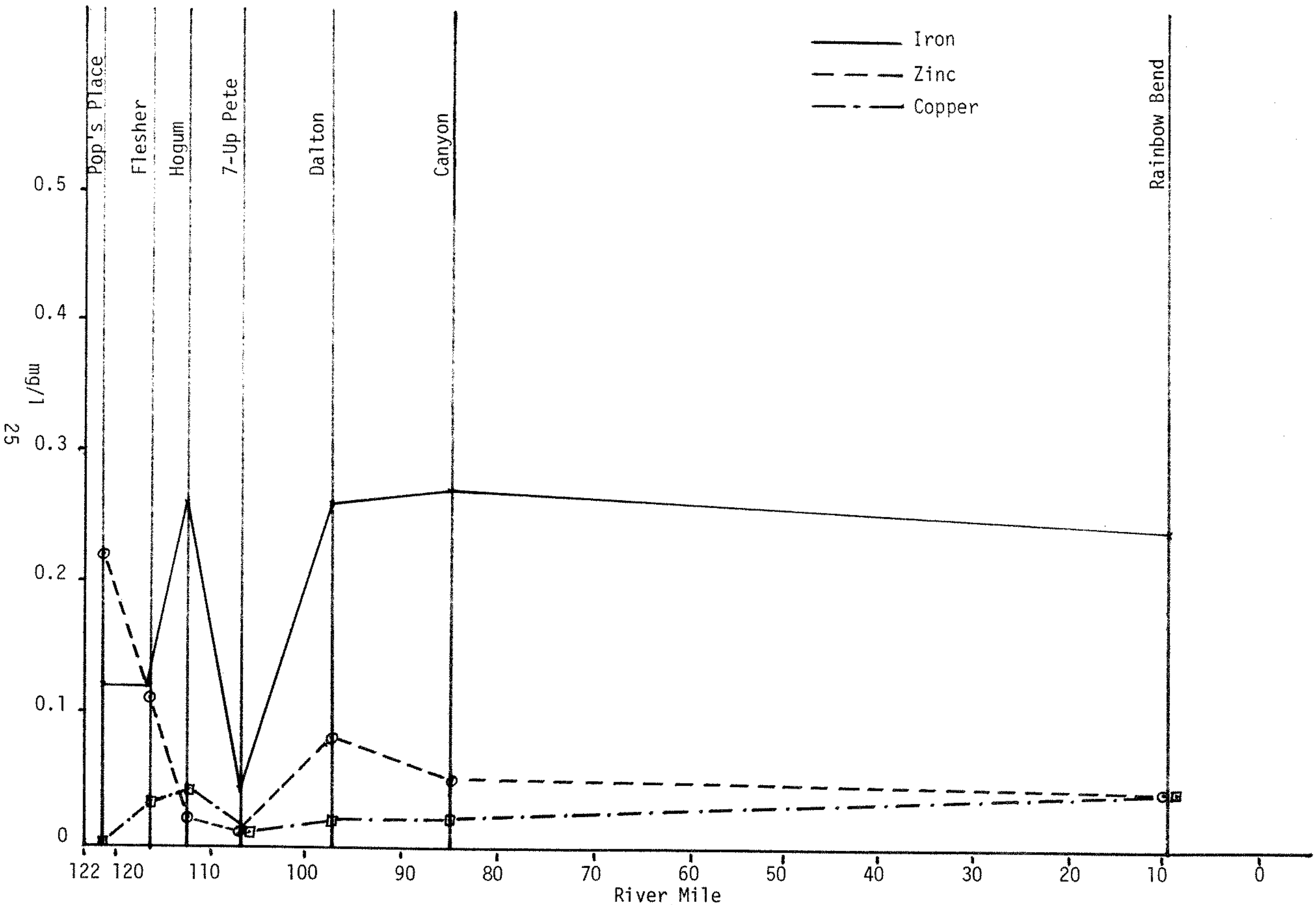


Figure 6. Average concentrations (above detection level) of total recoverable iron, zinc, and copper at the seven main Blackfoot River stations.

are not shown because they were found in very small quantities, when detected at all. If it were not for the 7-Up Pete station, average iron would be fairly level at all stations from Hogum downstream. The average of 0.4 mg/l at 7-Up Pete is based on only two samples of .03 and .06 mg/l. Further sampling would probably change this average, although Landers Fork may have an influence on metals levels at the station.

Zinc was highest at Pop's Place and Flesher, due to mine drainage from the Mike Horse area. Zinc was higher than iron at Pop's Place and almost the same at Flesher. Anaconda Company water quality data show that more zinc than iron came from the Mike Horse Mine. This tunnel also had the greatest flow into the Blackfoot River, and even though iron levels from other tunnels are higher than zinc levels, there is less water volume and these effluents do not always reach the river. Average copper fluctuated least of all and was highest at the Hogum station. No copper was detected at Pop's Place.

A bluish-gray color was always evident in the Blackfoot River near Pop's Place, giving the water a "hazy" appearance even though the water was clear. Willow Creek (Flesher) also had this appearance below (but not above) Sandbar Creek. Hogum Creek exhibited this appearance to a lesser degree. All these areas receive water from abandoned mines. This condition may be due to a colloidal hydroxide of a heavy metal. Hem (1970) states that "colloidal ferric hydroxide is commonly present in surface water, and small quantities may persist even in water that appears clean." This condition was not found in other streams sampled.

Biological Oxygen Demand (BOD)

Five-day BOD analyses were made at four main river stations: Hogum and 7-Up Pete above Lincoln and Dalton and Canyon below Lincoln. Results are given in Appendix F (p. A-35). Oxygen demand by decomposition of organic matter is very low at these stations. The highest BOD value recorded was 3.0 mg/l at Hogum on September 8, 1972. The next highest value was 2.5 mg/l at Hogum and 7-Up Pete. In no instance was zero BOD recorded, but in 25 percent of the analyses values were less than 1.0 mg/l. Sixty-one percent of the values were between 1.0-2.0 mg/l, and 14 percent were 2.0 mg/l or greater.

Coliform Bacteria

Total and fecal coliforms were determined at Hogum, 7-Up Pete, Dalton and Canyon stations during water year 1973 (Appendix G - p. A-38). Total coliform organisms reached 1700/100 ml once at Hogum and 1400/100 ml once at Canyon. Otherwise the greatest number found was 930/100 ml at Canyon. Out of 48 monthly analyses (12 at each station), 75 percent did not exceed 50/100 ml. The remaining analyses (excluding the three high values above) had coliform numbers between 0-440/100 ml. Nine percent were between 50-100/100 ml, 7 percent between 100-200/100 ml, and 4 percent were over 200/100 ml.

Fecal coliforms were much lower than total coliforms. Fecal coliforms reached a high of 15/100 ml at Dalton, followed by the next high of 14/100 ml at Canyon. Eighty-eight percent of the analyses had less than 10 fecal coliforms per 100 ml, and 73 percent were less than 5/100 ml.

Montana Water Quality Standards for B-D_1 waters, which include growth and propagation of salmonid fishes and associated aquatic life, require generally that the average number of total coliform organisms not exceed 1000/100 ml, and that fecal coliforms not exceed 200/100 ml.

It is unknown whether these coliform numbers are due to natural or domestic sources. There may be some seepage which reaches the river from septic tanks in the Lincoln area. However, from a coliform bacteria standpoint, water quality was very high at these four locations.

Dissolved Oxygen (DO)

Field analyses (Appendix H - pg. A-41) show minimum DO levels at 30 stations (DO not analyzed at 6 stations) were 7.0 mg/l. This minimum occurred at only 5 of the 30 stations (17 percent). Minimum DO was 8.0 mg/l or higher at 25 of 30 stations (83 percent), and 9 mg/l or higher at 14 stations (47 percent).

The highest DO level recorded was 14 mg/l at Kleinschmidt Creek, but this occurred only once. Lowest DO levels were found in Pass Creek, where the average was 8.0 mg/l (range 7-11 mg/l). Highest average level found was 12 mg/l in East Twin Creek (range 11-13). Three percent of the stations averaged 7 mg/l, 3 percent 8 mg/l, 7 percent 9 mg/l, 63 percent 10 mg/l, 20 percent 11 mg/l, and 3 percent 12 mg/l.

The USGS also made monthly field determinations of DO at the two gaging stations (Table 4).

Table 4. Monthly DO levels from field analyses by the USGS at Pop's Place and Hogum stations.

		Pop's Place			Hogum		
Water Year	No. of Analyses	Range	Ave.	Ave. Percent Saturation	Range	Ave.	Ave. Percent Saturation
1969	11	8.1 - 11.6	9.9	90			
1970	12	8.0 - 12.1	9.9	92			
1971	12				9.2 - 13.0	11.1	105
1972	11				8.2 - 13.4	10.8	101

The lower DO levels at Pop's Place may be due to: (1) the lack of much stream turbulence at the Pop's Place station; (2) passage of the river through a series of beaver ponds just above the Pop's Place station which may cause an increase in BOD from organic decomposition in the ponds; (3) the heavy metals from mine drainage creating a chemical oxygen demand (COD); or (4) steeper stream gradient above the Hogum station maintaining DO at higher levels by aeration.

Montana's Water Quality Standards classify the Blackfoot River and all tributaries as B-D_1, which provides for the growth and propagation of salmonid fishes and associated aquatic life. Under this classification, dissolved oxygen "is not to be reduced below 7.0 milligrams per liter." The above data show this standard is presently being met at all sample stations on the river. However, it also appears that an increase in BOD could lower DO below the recommended level at those locations where DO readings of 7.0 mg/l were found.

Diurnal Variation of Dissolved Oxygen, Temperature and pH

Field analyses were made at 1 to 4-hour intervals for a 24-hour period at Pop's Place, Flesher, Alice Creek, Poorman Creek, Dalton and Canyon (Appendix I, p. A-48). Most of the data was obtained by the USGS at the Pop's Place gage beginning in 1968. Diurnal pH was obtained only at Pop's Place in 1968 and 1969.

The maximum diurnal variation in DO was 1.5 mg/l in August 1973 at Flesher (Table 5). Other variations ranged from a maximum of 1.4 mg/l at Dalton in June 1972 to a minimum of 0.4 mg/l at Pop's Place in August 1971. The lowest saturation value was 84 percent at Flesher in August 1973 and at Dalton in September 1971. The highest saturation value found was 108 percent at Poorman Creek, Dalton and Canyon in June 1972. The highest DO concentrations occurred when water temperatures were coolest in June 1972 and October 1968. Water temperatures associated with the DO variations reached a high of 67 F at Flesher in August 1973 and a low of 41 F at Pop's Place in October 1968. The greatest pH variation was 1.3 units, but this may be inaccurate (see footnote in Appendix I). Other pH values ranged from 7.3-8.6 with variations of 0.3-0.5 pH units.

Miscellaneous Surface Water Temperatures

Surface water temperatures taken periodically during the study are given in Appendix J, (p. A-53). The highest temperature recorded was 18.9 C (66 F) on the main Blackfoot River at the Flesher station on August 17, 1973. This was a very low water period in a dry year. Minimum temperature was 0 C (32 F) at several stations during the winter months.

Turbidity

Measurements of turbidity were made at 21 locations during the study (Appendix K, p. A-57). In nearly all cases, turbidity was related to streamflow, i.e., turbidity increased with increased streamflow. The highest turbidity recorded during the study was 220 JTU (Jackson Turbidity Units) in Landers Fork at Highway 200 during high water on June 3, 1972.

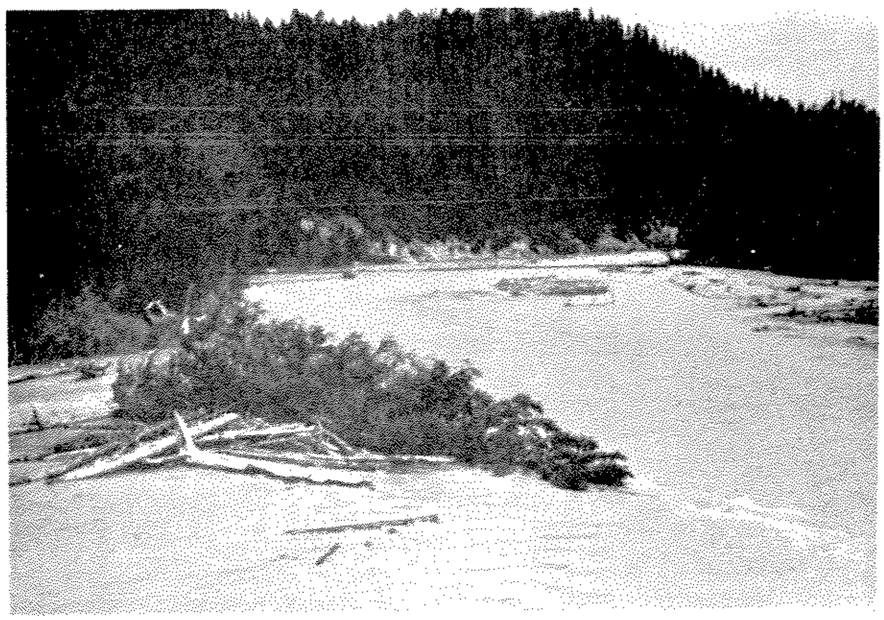
Table 5. Variation in dissolved oxygen, percent saturation, water temperature and pH over a 24-hour period at six stations, 1968-1973.

Station	Date	DO (mg/l) Max	DO (mg/l) Min	DO (mg/l) Variation	Percent Saturation Max	Percent Saturation Min	Percent Saturation Variation	Water Temp (F) Max	Water Temp (F) Min	Water Temp (F) Variation	pH Max	pH Min	pH Variation
B.F. River @ Pop's Place	9/9, 10/68	8.8	7.8	1.0	101	85	16	55	52	3	8.6	8.1	.5
	10/9, 10/68	10.4	9.8	.6	98	90	8	41	39	2	7.6	7.3	.3
	7/22, 23/69	8.4	7.9	.5	99	92	6	60	53	7	8.0	6.7*	1.3
	8/21, 22/69	8.0	7.3	.7	93	88	5	62	54.5	7.5	7.8	7.4	.4
	8/31, 9/1/71	8.1	7.7	.4	93	88	5	57	52	5			
	8/17, 18/73	8.0	7.2	.8	94	85	9	61	53	8			
B.F. River @ Flesher	8/31, 9/1/71	8.5	7.9	.6	98	88	10	58	50	8			
	8/17, 18/73	8.5	7.0	1.5	106	84	22	67	53	14			
Alice Creek	8/31, 9/1/71	8.4	7.8	.6	96	87	9	57	50	7			
	8/17, 18/73	8.8	7.6	1.2	105	86	19	64	50	14			
Poorman Cr.	9/1, 2/71	9.5	8.4	1.1	102	89	13	53	48	5			
	6/22, 23/72	10.6	9.5	1.1	108	102	6	54.5	45.5	9			
B.F. River @ Dalton	9/1, 2/71	8.9	8.0	.9	97	84	13	53	48	5			
	6/22, 23/72	10.3	8.9	1.4	108	97	11	56	47	9			
B.F. River @ Canyon	9/1, 2/71	8.9	8.4	.5	96	88	8	53	50	3			
	6/22, 23/72	9.8	8.8	1.0	108	98	10	55	49	6			

*May be in error due to improper calibration of DO meter (USGS field notation).

Nearly all the turbidity occurring in the main river below Landers Fork was due to suspended sediment from Landers Fork. The highest turbidity recorded on the main river above Landers Fork was 42 JTU at the Hogum station on May 17, 1972. In 1973, turbidity reached only 19 JTU at this station. The highest turbidity recorded at Flesher was 4.6 JTU in May 1972 and 5.2 JTU in May 1973. Highest of two values recorded at Pop's Place was 8.3 JTU.

Maximum turbidity recorded in Alice Creek was 31 JTU on May 17, 1972. A reading of 27 JTU on May 24, 1972 was due almost entirely to sediment from a mud slide washing into the stream from state land several miles upstream. The mud slide was caused by water saturation of the soil in a logged area with improperly placed roads.



Landers Fork contributes most of the suspended sediment to the upper Blackfoot River during spring runoff. Sediment originates from natural sources in the drainage. June 3, 1972.

Emphasis was placed on obtaining turbidity readings during spring runoff because this is when practically all the turbidity occurred. Sometimes the study area sustained a midwinter thaw which raised turbidity slightly. This occurred at Canyon on January 16, 1972 when a reading of 4.2 JTU was recorded. Turbidities were generally extremely low on the main river and most of its tributaries except during spring runoff. Turbidity was mainly due to suspended sediment. Higher than normal turbidity during low water periods was usually the result of man's activities in or adjacent to a stream. Rainstorms in summer and fall did not increase streamflow greatly. Practically all winter precipitation went into storage as snow which did not run off in large amounts until spring.

Streamflow

Continuous discharge data were collected by the USGS at Pop's Place and Hogum gaging stations on the main river. Streamflow data at other locations were determined from staff gage readings and periodic flow measurements (Appendix L, p. A-63). Continuous discharge data were transformed into hydrographs and are shown in Figures 7 and 8 for both USGS stations. Low flow periods were generally from August-March, while higher flows occurred from April-July, although high flows began in mid-March in Water Year 1972 at the Hogum station.

Both of the gaging stations were upstream from the confluence of Landers Fork with the main Blackfoot River and they did not show the significance of Landers Fork in the timing and amount of runoff in the drainage. Landers Fork is a relatively long drainage (about 22 miles). Runoff waters originate in high mountain country along the continental divide. Consequently, the peak runoff in the Blackfoot River below Landers Fork came later in the season than did the peak at the gaging sites, which receive runoff from lower elevations and from a much smaller drainage area. Below the mouth of Landers Fork there were two peaks on the hydrograph - one for discharge of the Blackfoot above Landers Fork and another for discharge contributed by Landers Fork. This is illustrated by a hydrograph of discharge at the Canyon station which was based on periodic staff gage readings in 1972 and 1973 (Figure 9). There was a 2-week period between peaks in 1972. In 1973 the peak caused by Landers Fork was very low and somewhat indefinite, due to below-normal snowpack in Landers Fork drainage. In addition to snowpack, precipitation and temperature conditions during May and June determined the timing and peak of runoff.

Spring snowmelt raises the Blackfoot River to bank-full stage in Lincoln canyon. June 3, 1972.

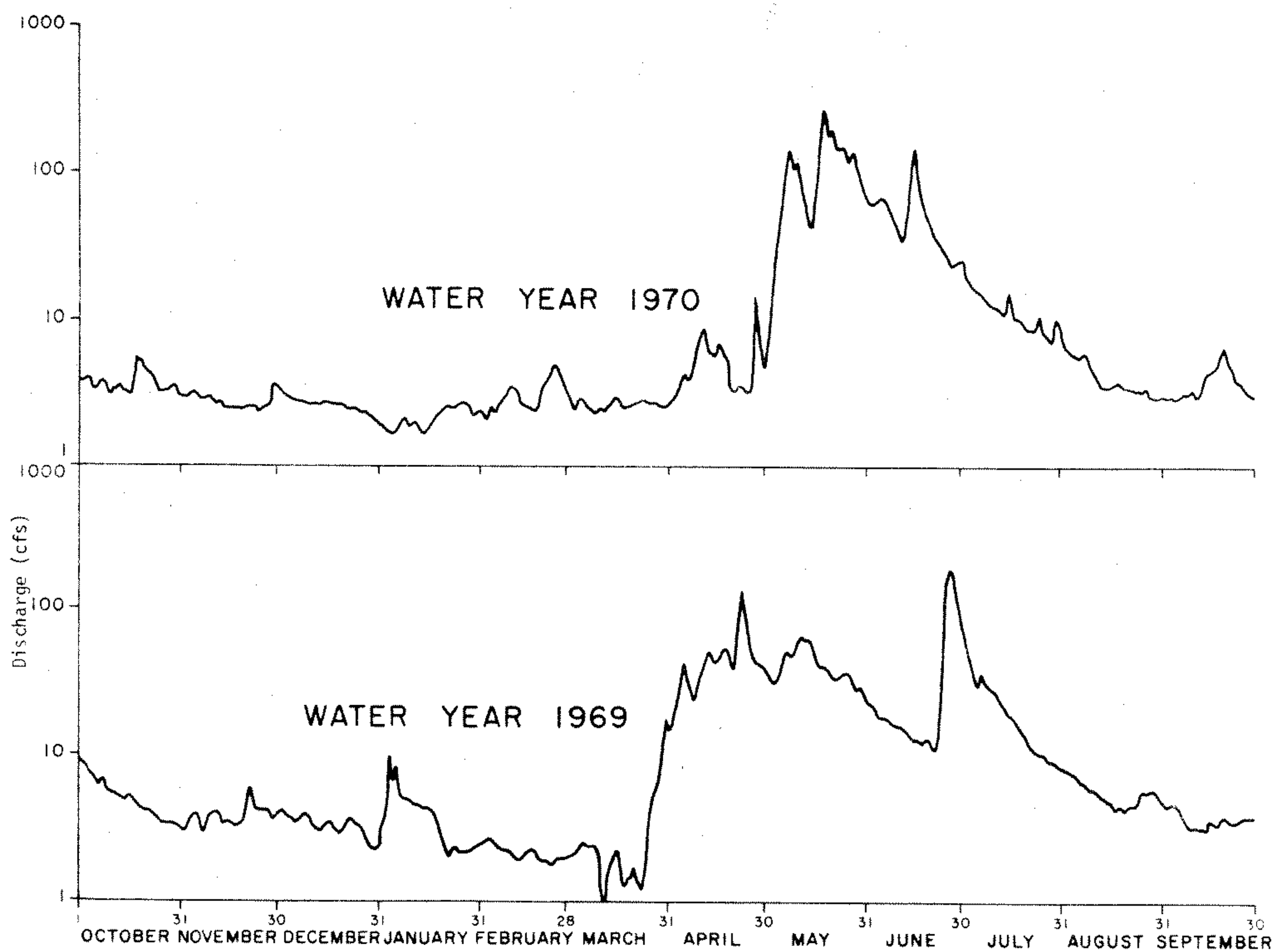


Figure 7. Hydrographs of Blackfoot River at Pop's Place for water years 1969 and 1970. From Coffin and Wilke 1971.

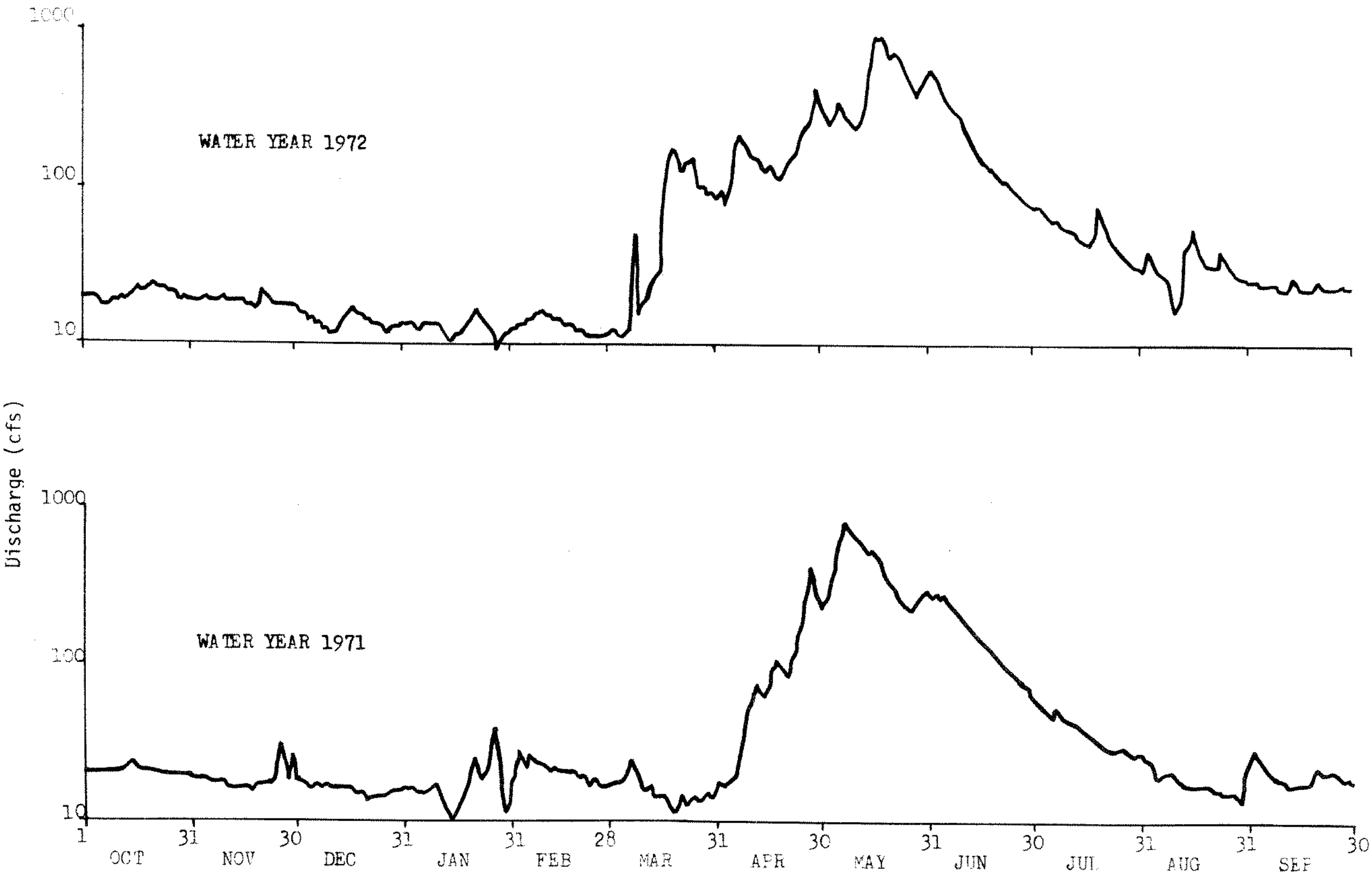


Figure 8. Hydrographs of Blackfoot River at Hogum for water years 1971 and 1972.

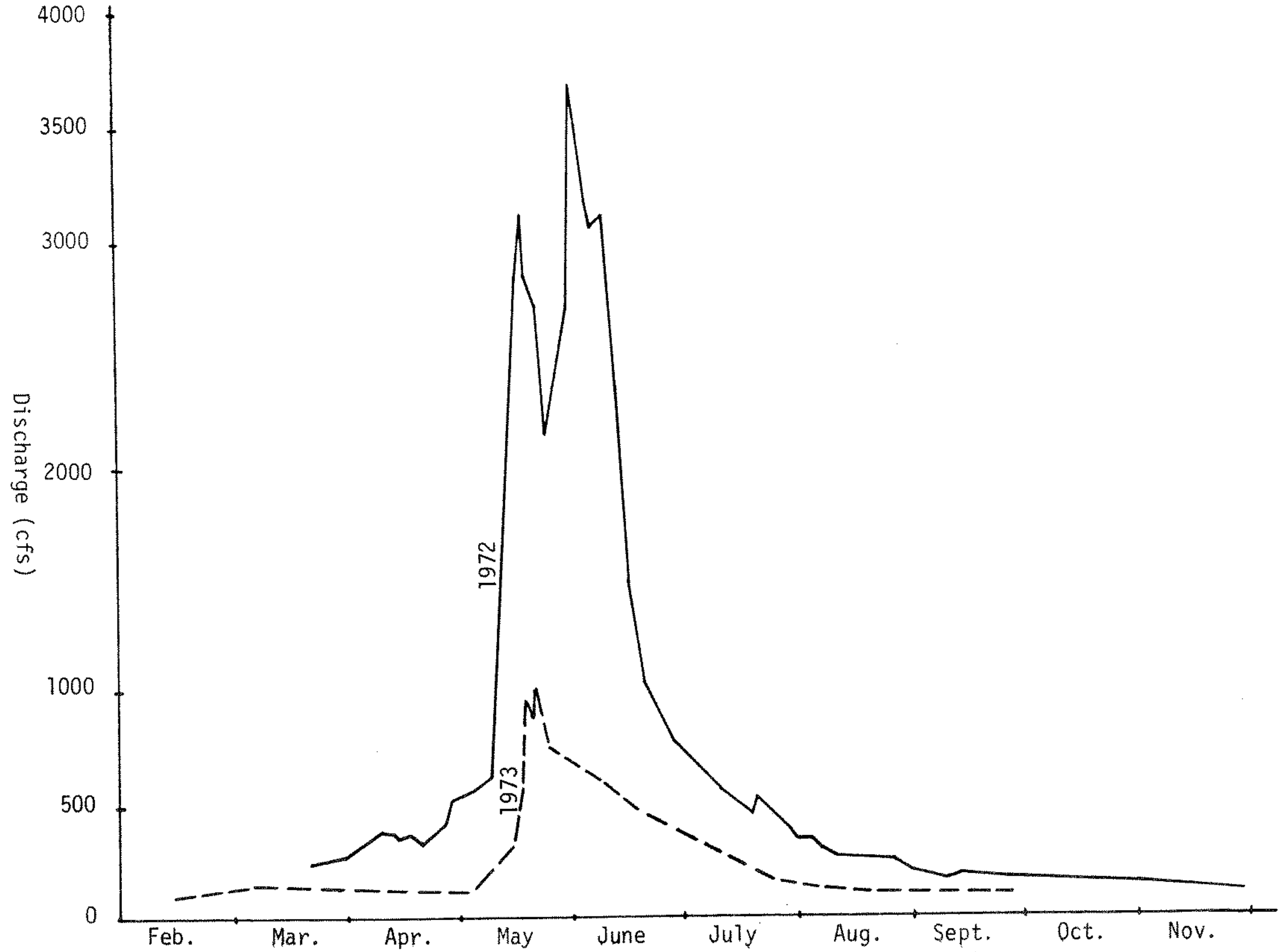


Figure 9. Hydrograph of Blackfoot River at the Canyon station, 1972 and 1973, from periodic staff gage readings.

Streamflow in the main Blackfoot River was continuous except for an intermittent stretch near Lincoln. Each fall and winter streamflow ceased in the vicinity of the Stemple road bridge in Lincoln to about 3 miles upstream. Aerial observations each year during the study revealed a dry streambed in this section. Flow recovery began below the Stemple bridge and was again normal at the mouth of Poorman Creek. Loss of streamflow was due to natural lowering of the groundwater level in the highly permeable alluvium. Coffin and Wilke (1971) discuss groundwater movement in the upper Blackfoot River.

Alice Creek also had some dry sections from late summer through winter due to fluctuating groundwater. The stream dried up beginning about 1/4 mile below the abandoned U. S. Forest Service guard station and ending about 2-1/2 miles downstream just above the mouth of Bear Creek. The exact upper and lower limits of the dry areas depended on seasonal climatic conditions. The lower end of Wildcat Gulch, a tributary in this stretch, was usually dry except during the spring runoff period. A small spring helped recharge Alice Creek in T 16N, R 7W, Sec 27 (SW¼), near the mouth of Bear Creek.

Landers fork was dry in late summer above the mouth of Copper Creek in 1973, but not in 1974. Streamflow in 1973 below Copper Creek was primarily due to flow from Copper Creek. Groundwater again came to the surface before Landers Fork reached Highway 200, since flow at the highway was greater than either Copper Creek flow or Copper Creek + Landers Fork flow (see Appendix L - p. A-63). Landers Fork has reportedly been dry at Highway 200 in past years. This was never observed during the study, although the flow did get very low. Cadotte Creek, 7-Up Pete Creek, Bartlett Creek (Alice Creek tributary), and Blanchard Creek were observed to be dry by mid-summer each year. Elk Creek was dry during one winter sampling period. Other streams reached very low water levels, but were not observed to be dry during the study.

Water Chemistry/Discharge Relationships

Certain chemical ions were plotted against stream discharge on log/log paper to determine their relationships (Figures 10-15). Data were obtained from the USGS analyses at the Pop's Place gaging station for water years 1969 and 1970, and for the Hogum gaging station for the water years 1971 through 1973. Hydrographs indicated low flows were from August to March and high flows from April to July (see Figures 7 and 8). Data were plotted accordingly.

Dissolved solids showed a definite trend toward higher concentrations during low flow periods at both stations. The major ions, bicarbonate, calcium, magnesium and sodium as well as total hardness and specific conductance followed the same trend. Sulfate, fluoride and chloride did not show a definite trend. Potassium followed the same trend as sodium, except the points were more scattered, giving a less definite relationship.

Bicarbonate showed a good inverse relationship with flow at Hogum, but a poor relationship at Pop's Place. Conversely, sulfate at Pop's Place showed a good inverse relationship with flow, while a poor relationship was found at Hogum. The ratio of sulfate to bicarbonate at Pop's Place was higher (range .79-.96) than at Hogum (range .09-.11).

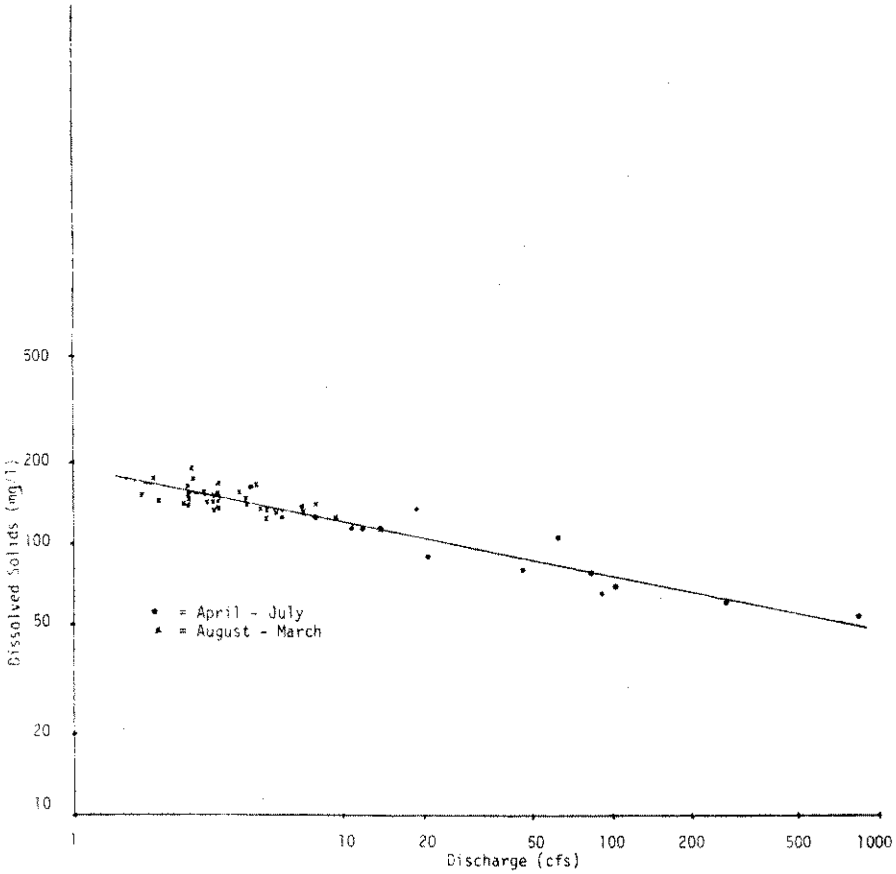


Figure 10. Relationship between discharge and dissolved solids, Blackfoot River at Pop's Place, water years 1969 and 1970.

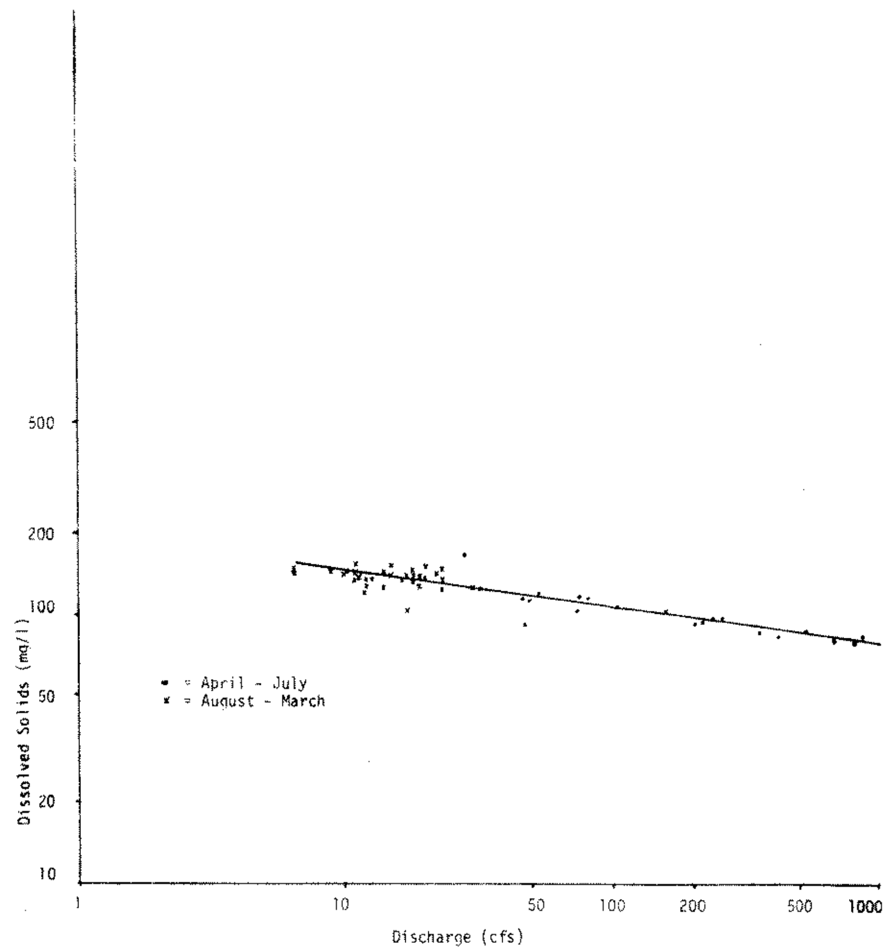


Figure 11. Relationship between discharge and dissolved solids, Blackfoot River at Hogum, water years 1971, 1972 and 1973.

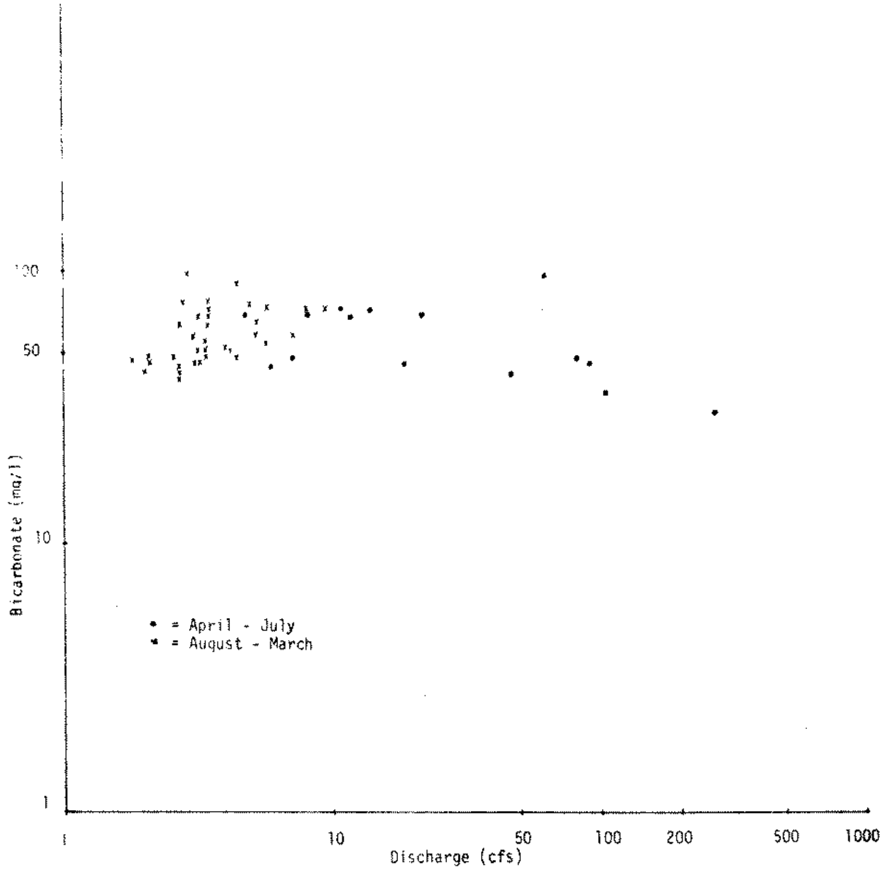


Figure 12. Relationship between discharge and bicarbonate, Blackfoot River at Pop's Place, water years 1969 and 1970.

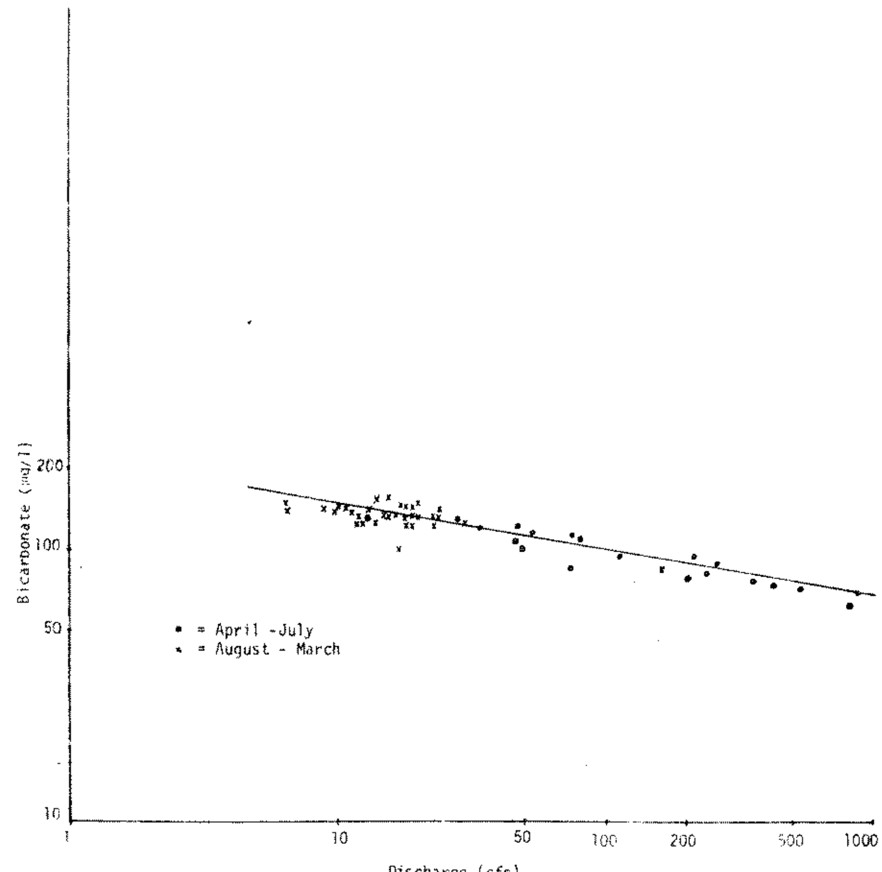


Figure 13. Relationship between discharge and bicarbonate, Blackfoot River at [illegible], water years 1971, 1972 and 1973.

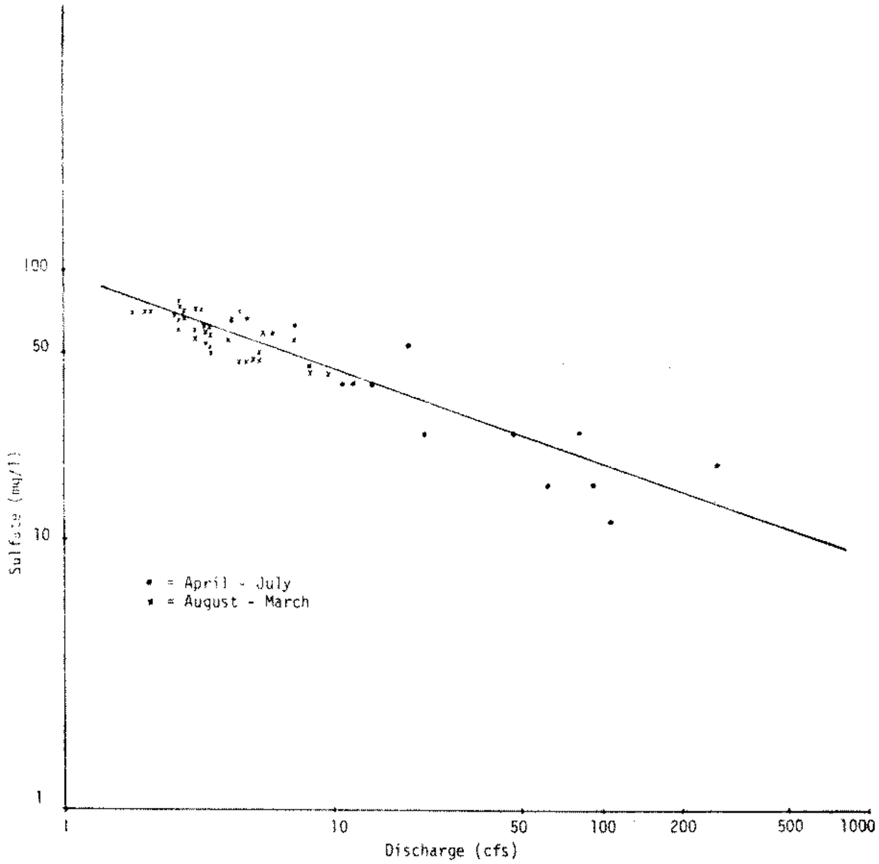


Figure 14. Relationship between discharge and sulfate, Blackfoot River at Pop's Place, water years 1969 and 1970.

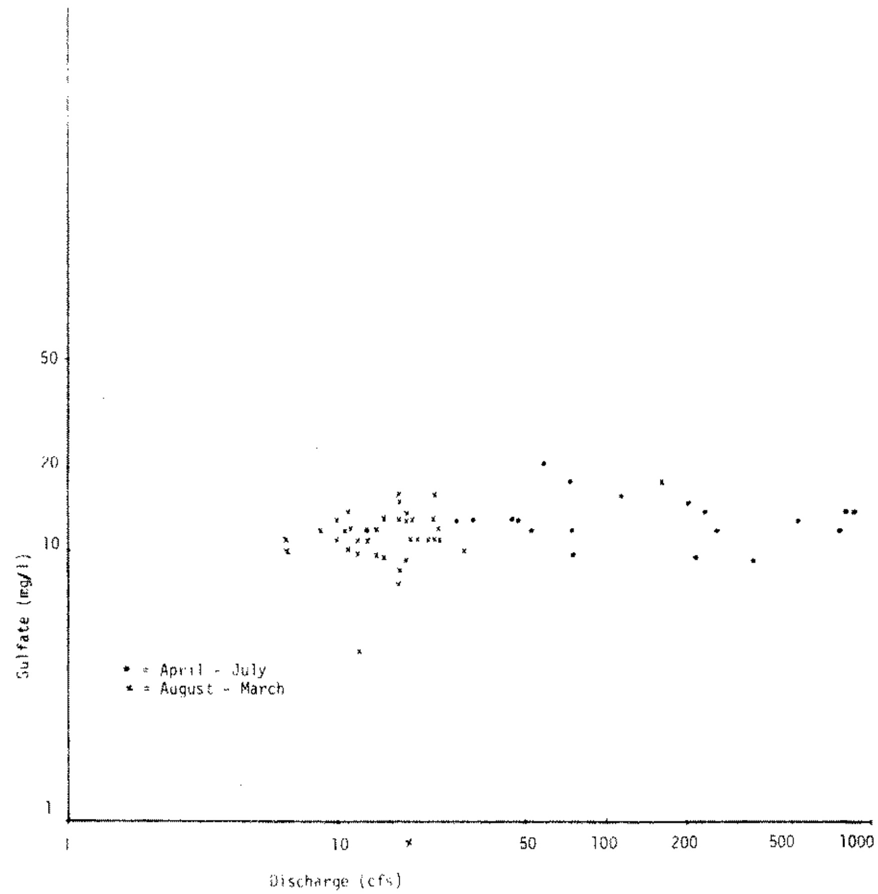


Figure 15. Relationship between discharge and sulfate, Blackfoot River at Hogum, water years 1971, 1972 and 1973.

pH at Pop's Place ranged between 7.1-8.0 over the 2-year period, whereas at Hogum the range was 6.4-8.5. A plot of pH against discharge at Hogum showed slightly higher pH levels (more basic) during low flow periods than during high flow periods.

There was no relationship between dissolved iron and discharge at either station. The highest dissolved iron levels found were during the high water period. However, the next highest values were found during low water.

The highest levels of dissolved nitrogen (NO_2+NO_3 as N) and orthophosphorous were found during the high water period, although there were also high values during low water. There was no apparent relationship between these constituents and streamflow.

U. S. Geological Survey Data

Data discussed in this section are from the two USGS gaging stations operated during the study: "Blackfoot River near Lincoln" (Pop's Place station) for water years 1969 and 1970, and "Blackfoot River below Alice Creek near Lincoln" (Hogum station) for water years 1971 through 1973. Data for these water years are published by the USGS in Water Resources Data for Montana, Part 2, Water Quality Records, for the respective water years.

Discussion of USGS data will include only continuous water temperatures, suspended sediment, and metals. Other chemical constituents have previously been discussed.

Continuous thermograph records at Pop's Place show daily water temperatures ranged from 0 C during winter months to 17 C (62.6 F) during July and August in water year 1969. The average daily maximum temperature in August was 15 C (59 F). The continuous record is incomplete for July. During water year 1970 the minimum temperature was again 0 C in winter, but reached a maximum of 18 C (64.4 F) one day each in July and August. The average daily maximum temperature in July was 15.7 C (60.3 F) and in August 15.1 C (59.2 F).

The minimum water temperature at Hogum in water year 1971 was 0 C during winter months and reached a maximum of 21 C (69.8 F) in July and 21.5 C (70.7 F) in August. The average maximum temperature in July was 17.8 C (63 F) and in August 19.2 C (66.6 F). Summer water temperatures in water year 1972 were slightly cooler than in 1971 - maximum temperature in July was 19.5 C (67.1 F) and in August 21 C (69.8 F). Average maximum temperatures in July and August were 16.6 C (61.9 F) and 17.6 C (63.7 F). A maximum temperature of 18 C (64.4 F) or above was reached each day for 14 consecutive days in July and 25 consecutive days in August 1971. In 1972 the longest period of 18 C or more was 9 days. However, during these hot spells, water temperatures cooled off 7-11 C (12.6-19.8 F) each day in both 1971 and 1972.

Instantaneous suspended sediment analyses made by the USGS show low concentrations prevail most of the year at both gaging stations. Concentrations at Pop's Place for water year 1969 ranged from 1-16 mg/l and for water year 1970 from 3-18 mg/l. The highest concentrations occurred during spring runoff. Concentrations at Hogum ranged from 1-18 mg/l in water year 1971 and from 1-249 in water year 1972. As with turbidity, the highest concentrations occurred during spring runoff. The day after the maximum concentration (249 mg/l) was recorded at Hogum, a turbidity reading of 42 JTU was recorded. Both readings were taken at a flow of 900 cfs.

Metals considered most significant are iron, zinc, lead, arsenic, copper and cadmium. From 5-28 analyses were made each year for iron, and 2-4 analyses were made for the other metals. Tables 6 and 7 show values obtained. Other metals analyses not tabulated here can be found in USGS Water Resources Data for Montana, Part 2, Water Quality Records.

Table 6. Summary of USGS analyses for metals (ug/l) at Pop's Place, water years 1969 and 1970.

Water Year		Fe	Zn	Pb	As	Cu	Cd
1969	Range	10-80	450-550	2-3	None	6-7	11-55
	Avg	28	500	2.7		6.5	39
1970	Range	29-262	None	None	None	None	None
	Avg	119					

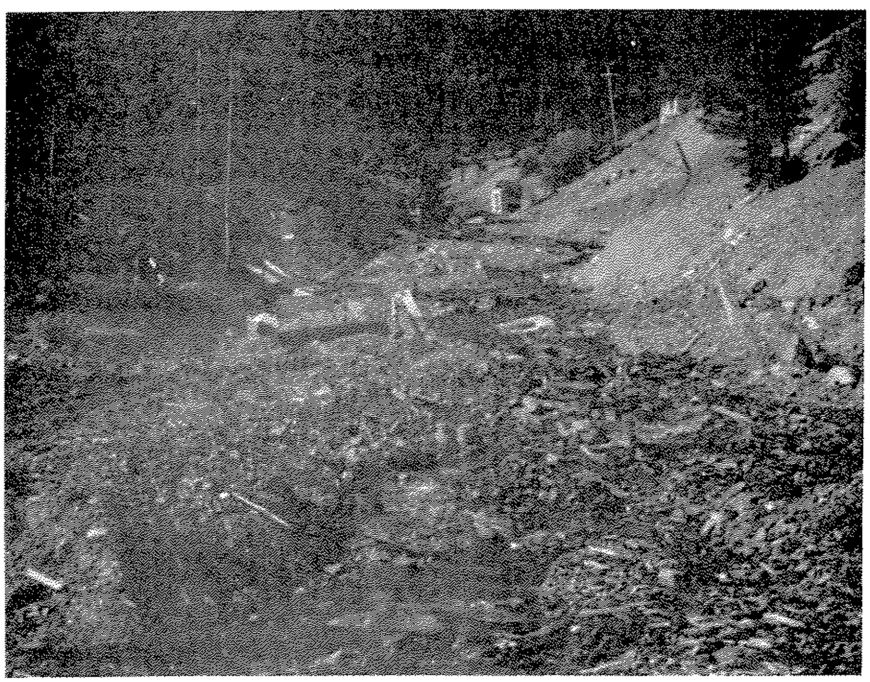
Table 7. Summary of USGS analyses for metals (ug/l) at Hogum, water years 1970-1973.

Water Year		Fe	Zn	Pb	As	Cu	Cd
1971	Range	0-110	None	None	0-4	None	0
	Avg	26			1		0
1972	Range	0-50	10-30	0-4	0	0-14	0
	Avg	19	20	1.5	0	4.8	0
1973	Range	9-150	10-20	3-3	0-2	1-8	0
	Avg	36.5	15	3	1	4.5	0

Acid Mine Seepage Surveys

Chemical surveys were made in 1972 and 1973 by the Anaconda Company to determine the location and extent of acid mine seepage from abandoned mine tunnels in the Heddleston mining district. A partial summary of the company's survey reports is given in Table 8, with original laboratory data given in Appendix M (p. A-67). This summary includes only those laboratory results for total recoverable parameters from an unfiltered water sample. The company also analyzed filtered and acidified samples for total dissolved constituents, developed acidity titration curves and made general observations of the mine tunnels. The latter data are in Anaconda Company files.

It is apparent from data in Table 8 that high concentrations of metals enter the Blackfoot River from mine tunnels and tailings. Zinc and cadmium were highest from the Mike Horse tunnel in both years. Iron was highest from the Paymaster tunnel in 1972 (Paymaster had no flow in 1973). Iron, zinc, copper, aluminum and manganese occurred in the largest concentrations. Nickel, chromium, arsenic, lead and cadmium occurred in lesser amounts.



Mine drainage from the abandoned Mike Horse Mine contributes significant amounts of heavy metals to the upper Blackfoot River. June 15, 1971.

'able 8. Partial summary of acid mine seepage water quality data obtained by the Anaconda Company in the Heddleston District, 1972 and 1973.[1/]

ource	Date	Lab pH	Tot. Alk	Tot Hard.	Calc. Tot. Res.	HCO_3	SO_4	Ca	Mg	Cl	Fe	Zn	Cd	As	Pb	Cu	Cr	Ni	Mn	Al	Est. Flow (gpm)
ike Horse Tunnel	8/ 4/72	6.33	50	1031	1352	61	928	150	158	2	20	52	.094	.006	.22	1.45	<.02	.10	26.6	.2	300
	7/12/73	6.8	85	581	964	61	652	96	83	0	9	26.5	0.55	.04	.05	.26	.005	.067	15.3	.24	300
naconda Tunnel	8/ 4/72	2.96	0	327	626	0	485	68	38	1.4	28	6.20	.028	.016	.08	4.30	<.02	.05	12.6	4.9	5
	7/12/73	2.77	0	251	582	2/	466	54	28	0	8.3	4.30	.043	<.001	.405	1.75	.003	.050	15.5	4.2	1
unnel No. 3	8/ 4/72	3.02	0	74	268	0	211	16.8	7.8	3.2	17.2	.18	<.010	.013	<.02	30.4	<.02	.06	.31	7.7	30
	7/12/73	2.84	0	28	296	2/	252	1.3	6.0	0	19	.26	.004	.04	.005	28.5	.009	.085	.43	10.0	2
dith No. 2 Tunnel	8/ 4/72	3.12	0	70	253	0	189	25	2.2	2.2	13.4	.58	.012	.005	.12	5.08	<.02	.05	.78	4.7	7
	7/12/73	2.98	0	57	238	2/	188	10.4	7.6	0	10	.61	.013	<.001	.148	3.70	.002	.056	1.00	5.7	1
aymaster Tunnel	8/ 4/72	2.62	0	174	919	0	696	48	13.3	11.2	120	3.40	.048	.021	.10	21.0	<.02	.08	4.56	15.8	5
ine drainage from Swamp Gulch	8/ 4/72	6.19	20	76	145	25	67	18.4	7.3	2.0	15.6	.16	.014	.001	.08	.23	<.02	<.02	1.6	1.4	10
near Pop's Place	4/27/73[3/]	3.80	0	50	112	0	80	12.0	4.8	0	18	1.6	.04	<.01	.21	.60	-	-	-	-	-
eartrap Cr. below	8/ 4/72	8.24	102	117	202	125	34	22	15.2	1.9	.1	.08	<.010	.008	<.02	<.02	<.02	<.02	.08	.2	
Tailings Pond	7/12/73	8.08	85	88	158	104	26	11	14.7	0	.083	.065	.002	.03	.03	.013	.001	.007		-	
rill Hole No. DZ74-135 (Flowing Hole)	8/ 4/72	-	0	58	46	2/	-	12	6.8	-	14.2	.42	<.010	.005	<.02	.25	<.02	.02	.79	2.0	5

/ Results expressed as Total Recoverable in mg/l.

/ Not given in data. However, when total alkalinity is zero, bicarbonate (HCO_3) is also zero, since alkalinity is composed almost entirely of HCO_3 and CO_3 (carbonate). CO_3 is not present below pH 8.3.

/ Fish and Game sample analyzed by State Chemistry Laboratory, Helena. (Not shown in Appendix M).

ote: Viking tunnel had no flow in 1972 or 1973. Paymaster tunnel, Drill Hole No. DZ74-135, and the mine drainage from Swamp Gulch had no flow in July 1973.

A comparison between seepage from mine tunnels and water from Beartrap Creek below the tailings pond showed a great difference in water quality. Water quality in Beartrap Creek was quite high compared with that from the tunnels, and it compared favorably with water quality at stations further downstream. It is also of interest to note that cutthroat trout lived in this short stretch of Beartrap Creek, whereas no fish lived in any of the mine seepages. No fish were found in Beartrap Creek below its confluence with the Mike Horse tunnel seepage due to the poor quality of water from this tunnel.

It is apparent that a water quality problem exists in the headwaters of the Blackfoot River. This poor quality water causes a reduction in stream biota in the main river downstream from the mining areas (see Fish and Bottom Fauna sections of this report).

Metals in Stream Sediments

Stream sediment samples weighing approximately 5 pounds each were collected at 10 stations in August 1973 and analyzed for copper, nickel, lead, cadmium, zinc and iron (Table 9). A 25-pound sample was collected at the Hogum station in 1974 and analyzed more extensively than were the 1973 samples. Results of these analyses are given in Appendix N (p. A-76). Loss of organic matter on ignition at 750 C (LOI @ 750 C) was determined for the 1973 samples, but not for the 1974 sample. Only the sediment fraction passing through a Tyler standard sieve No. 100 was analyzed in 1973, whereas 10 fractions between sieve No. +16 and -325 were analyzed in the 1974 sample.

With the exception of a higher zinc value at the Hogum station (259 ug/g), the highest levels were found at stations associated with mine drainage. The Blackfoot River at Pop's Place had the highest levels of all metals except iron, followed by Flesher, the next station downstream. Poorman Creek had a slightly higher copper level than did Flesher, which may be related to past mining activities upstream from the station. The highest iron was found in Willow Creek (Flesher). Observations of Sandbar Creek, a Willow Creek tributary upstream from the sample point, showed this stream to be the probable source of iron.

It is interesting to note the high cadmium level at Pop's Place. Cadmium usually occurs in extremely low amounts in natural water, because it occurs as the sulfide CdS in a rare mineral called greenockite. Cadmium used in industry is produced entirely from zinc ores. The ratio of zinc to cadmium in these ores is about 200 to 1 (Briscoe 1949). The high zinc levels from mine drainage in the Mike Horse area indicate that the source of the high cadmium levels at Pop's Place are from zinc ores in the Mike Horse area.

The concentration of metals in sediments at stations which did not directly receive mine drainage of some kind were generally well below those levels from locations receiving wastes.

Willow Creek (Flesher) had the highest loss on ignition of organic matter. This reinforces observations made of suspended matter during water

Table 9. Levels of heavy metals in stream sediments and loss on ignition of organic matter, August 1973.

Station	Micrograms/Gram Dry Weight Cu	Ni	Pb	Cd	Zn	Fe	LOI Percent @ 750 C
Pop's Place	700	50	400	282.5	4080	36,600	7.85
Flesher	80	30.5	83	47.5	1000	34,600	5.98
Willow Creek(Flesher)	73	18	39.5	1.2	152	40,600	10.70
Alice Creek	42	12	32.5	<1	35	31,700	5.10
Hogum1/	47	11.5	29.5	1.2	259	25,700	4.55
	47	21.5	29.5	1.0	259	Not reanalyzed	
Landers Fork	29	10.5	28	1	41.5	25,700	7.33
Below 7-Up Pete Cr.	25	12	24.5	1.0	77.5	29,700	5.90
Poorman Creek	88	20	70	1	73.5	24,700	9.40
Dalton	23	10	28	<1	53	26,700	4.55
Canyon	24	10	47.5	<1	52	25,700	4.80

1/ Same sample analyzed twice. See paragraph 5 of letter in Appendix N (pg. A-76) for explanation of variation in results.

quality sampling of this stream. Even during low water periods, a heavy yellow-brown residue was retained on the 0.45 micron filter used to filter the water samples. This residue was always more pronounced than that found at other stations sampled the same day. A portion of this residue is apparently from organic matter, which also becomes deposited in the stream sediments.

The second sediment sample collected at the Hogum station in May 1974 weighed 25 pounds, much heavier than previous samples. Analyses on the 10 different particle sizes were made to determine if metals were carried in different amounts on various sizes of sediment particles. The results showed a sharp increase in metals concentration occurred between the -200 and -230 fractions, indicating that analyzing this size sediment would give better results than analyzing only the -100 fraction in determining metals content.

Bottom Fauna

Bottom fauna collections were made at 11 stations during the study (Figure 16). The numbered station descriptions are given in Appendix O (p. A-82). Identifications were made to the lowest taxonomic group possible on samples collected in 1968 and 1969, March/April 1971, August 1971 and October 1971 (Appendix P - p. A-83). However, as was previously stated, the 1968 and 1969 samples were not enumerated by species.

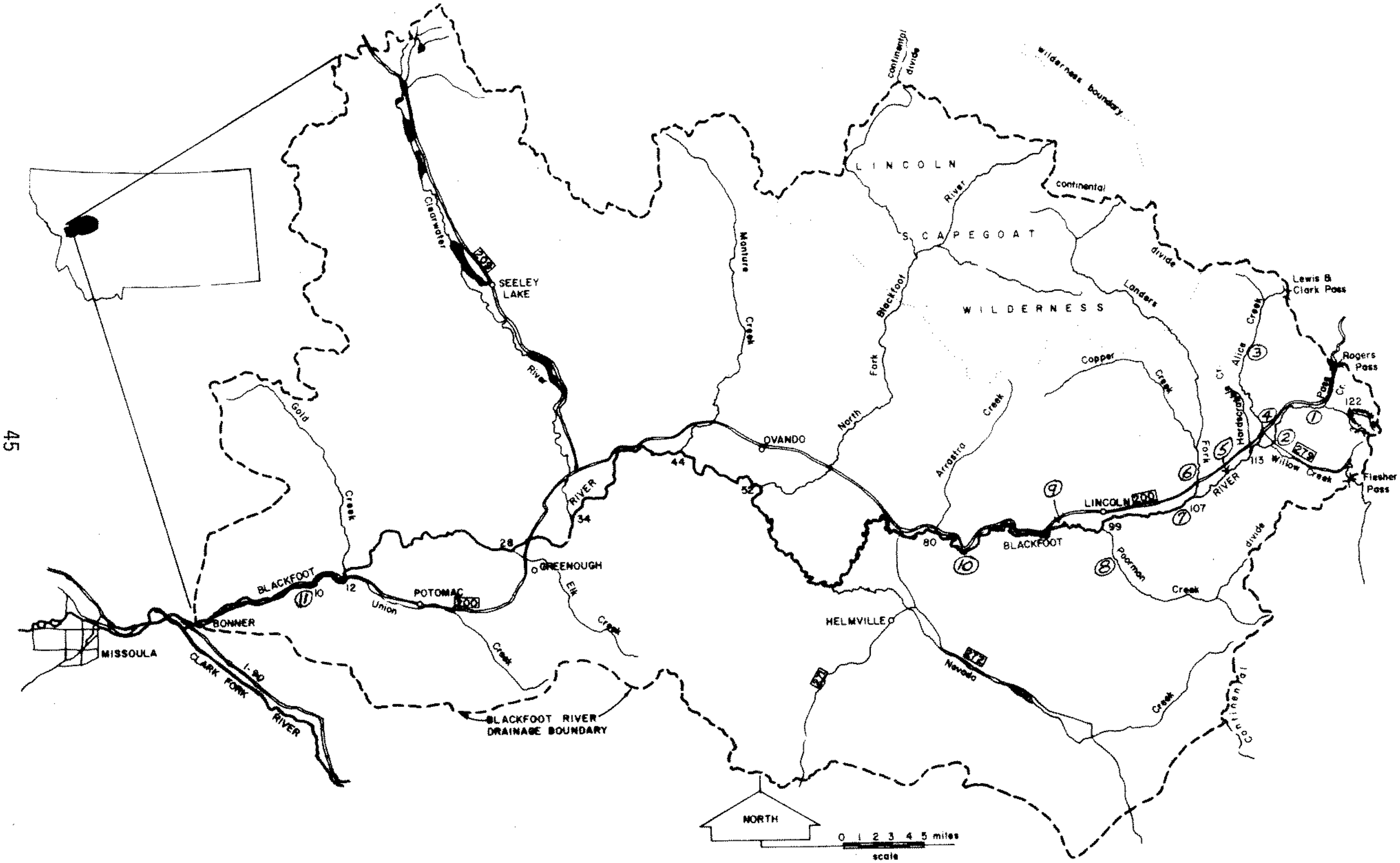


Figure 16. Location of bottom fauna collection stations.

Diversity indices were computed for these collections according to the method of Wilhm and Dorris (1968) and these indices are also given in Appendix P (p. A-83). The formulae and computer program used in their computation are given in Appendix Q (p. A-114). The basic data given in Appendix P are summarized by station in Appendix R (p. A-116). Appendix S (p. A-126) is a summary of those bottom fauna collections which were not identified below their orders.

The number of genera, number of individuals, and their diversity indices, by station, are shown in Tables 10 and 11. For the 1968 and 1969 samples, the diversity indices were computed on number of individuals in an order rather than number of individuals in a genus. When numbers in a genus were used instead of numbers in an order, the diversity index had a higher value.

Table 10. Diversity indices based on orders.1/

Station	Date	No. of Orders	No. of Indiv.	Dmin	D	Dmax	R
Pop's Place	7/16/68	4	75	0.30	1.37	2.0	0.37
	4/29/69	2	2	Dmin =	D =	Dmax	Undefined
	10/ 1/69	2	99	0.08	0.24	1.0	0.82
Flesher	7/16/68	5	179	0.20	1.93	2.32	0.18
Hogum	7/16/68	5	1653	0.03	1.79	2.32	0.23
	4/29/69	5	486	0.09	1.86	2.32	0.21
	10/ 1/69	5	574	0.07	1.49	2.32	0.37
Dalton	7/16/68	5	1502	0.03	1.26	2.32	0.46
	10/ 1/69	5	540	0.08	1.71	2.32	0.27
Canyon	7/16/68	5	589	0.07	0.90	2.32	0.63
	10/ 1/69	5	670	0.06	1.62	2.32	0.31
Rainbow Bend	7/18/68	5	209	0.17	1.80	2.32	0.24
Alice Cr. at Highway 200	8/24/71	5	427	0.09	1.98	2.32	0.15

1/ Approximate 4 sq. ft. sample collected with a Needham kick screen (mesh size = 16 meshes/inch).

Table 11. Diversity indices based on genera.[1]

Station	Date	No. of Genera	No. of Indiv.	Dmin	D	Dmax	R
Pop's Place	8/20/71	16	161	0.81	2.42	4.0	0.50
	10/19/71	12	195	0.51	2.51	3.58	0.35
Flesher	3/19/71	32	1062	0.33	3.76	5.00	0.27
	8/20/71	32	1522	0.24	3.01	5.00	0.42
Hogum	3/19/71	53	6024	0.12	4.01	5.73	0.31
	8/23/71	47	4522	0.14	3.56	5.55	0.37
Between Landers Fk. &	8/23/71	40	1808	0.26	3.57	5.32	0.35
Lincoln	10/26/71	44	2530	0.22	3.58	5.46	0.36
Dalton	3/19/71	43	1638	0.31	3.48	5.43	0.38
	8/20/71	35	1291	0.31	3.33	5.13	0.37
Canyon	3/18/71	44	2395	0.23	3.34	5.46	0.40
	8/20/71	28	922	0.33	2.24	4.81	0.57
Rainbow Bend	11/ 2/71	34	889	0.42	3.11	5.09	0.42
Alice Cr. above Nat'l. Forest boundary	8/24/71	25	1211	0.92	2.65	4.64	0.45
Alice Cr. at Highway 200	3/19/71	41	2538	0.20	4.12	5.36	0.24
	8/24/71	50	2620	0.24	4.42	5.64	0.23
Poorman Cr.	4/14/71	45	2780	0.20	4.28	5.49	0.23
	8/23/71	43	3650	0.15	3.41	5.43	0.38

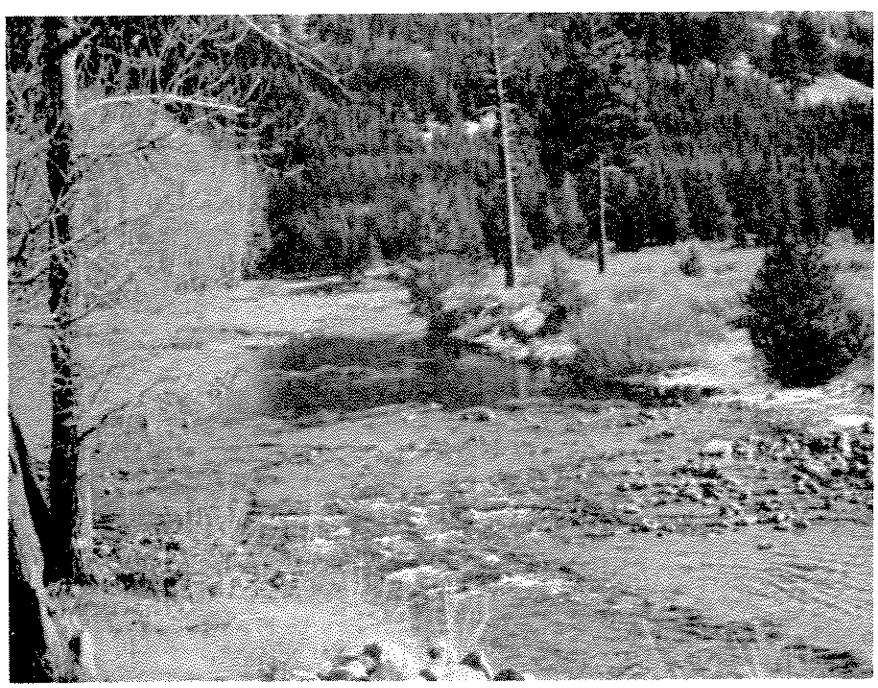
1/ Three 1 sq. ft. samples collected with a modified Waters round square foot streambottom sampler (mesh size = 38/inch). Data from all three samples combined.

Theoretical maximum diversity (Dmax) exists if each individual belongs to a different species and theoretical minimum diversity (Dmin) exists if all individuals belong to the same species. The distribution of individuals among species lies between these extremes in most communities and diversity is intermediate. Redundancy (R) is an expression of the dominance of one or more species, and is inversely proportional to the wealth of species

(Wilhm and Dorris 1968). The numerical value for diversity (D) lies between Dmax and Dmin and shows the actual diversity of the aquatic community as compared to the maximum and minimum diversities which could have occurred in the given sample. When diversity is high, redundancy is low and vice versa.

Data indicate that bottom fauna are depressed at the Pop's Place station. This is due to past and present acid mine drainage from the Mike Horse mine and other mine tunnel seepages above the station. The depression is probably due to a combination of factors, including metals in stream sediments and in surface flow. Metals in sediments may cause direct mortalities of aquatic organisms living on the streambed, and/or may interfere with their reproductive cycles. The metals may also affect the eggs laid by trout in spawning gravels.

The bottom fauna population was better at the Flesher station than at Pop's Place as a result of improved water quality. However, cadmium and zinc levels in sediments were still fairly high, suggesting that bottom fauna may still be somewhat depressed. Except for Pop's Place, Alice Creek above the national forest boundary (which goes dry each year) and Canyon stations, fewer species were found at Flesher than at other stations in 1971 (see Table 11). The reason for lower numbers at Canyon on that date may be due to a slight change in the sample site between March and August, or sampling variability.



The highest number of aquatic insect species (53) for a single sampling period was found in the Blackfoot River at Hogum section of the river. September 14, 1972.

Rainbow Bend showed the greatest volume of insects per square foot, although numbers were usually lower than at other stations sampled during the period. This was because the largest form of insect, the giant stonefly *Pteronarcys californica*, was regularly found at this station but was not regularly found at other stations. *P. californica* was found at Canyon and Dalton stations in 1968 and 1969 but not in 1971. One live adult *P. californica* was found at Dalton in June 1972. The tentative upper limit of distribution of this species is the Dalton station.

Statistical analysis of bottom fauna data can take several forms. However, because of variations between life cycles, diversity indices and other population data must be compared from samples taken at the same time of year. Since only 1 year's data have been analyzed taxonomically to date, it is not possible to compare samples on this basis, except to compare general longitudinal species distribution in the drainage. Should mining actually occur in the drainage, bottom fauna samples should be collected at the same times of year during, and for a period following, construction and operation of the mining complex. Statistical comparisons can then be made.

Fish

Fish Population Surveys

Stream surveys established species composition and relative abundance of game and nongame fish in the study area (Appendix T - p. A-129). Population estimates were made in nine stream sections (Appendix U - p. A-139). The locations of these sampling sites are shown in Figure 17. The Petersen mark-recapture method (as described by Vincent 1971 and 1974) was used for assessing fish populations.

Ten species of game and nongame fish were found in the study area (see Appendix T). Cutthroat and brook trout were the principal species found in the Blackfoot River and tributaries above Landers Fork, although whitefish were also present. Only one small brown trout was caught in the Blackfoot above Landers Fork (Hogum section). Brown trout were most abundant in the Blackfoot River below Lincoln. Mountain whitefish were probably next in abundance, although good number estimates were not obtained. Year-round populations of brown trout were found in the river only from about the mouth of Poorman Creek downstream.

For about 3 miles above Lincoln the main river went dry each year from late fall until early spring. Fish populations in this section were, therefore, intermittent. According to local residents, game fish occupied this section during the summer, but numbers or predominant species were unknown.

Poorman Creek contained cutthroat and brook trout, with cutthroat most numerous. One small brown trout was caught in Poorman Creek in the section near Circle City. A few brown trout were also observed in the mouth of Poorman Creek during the fall spawning season, probably entering from the main river. Poorman Creek flows through a series of beaver dams

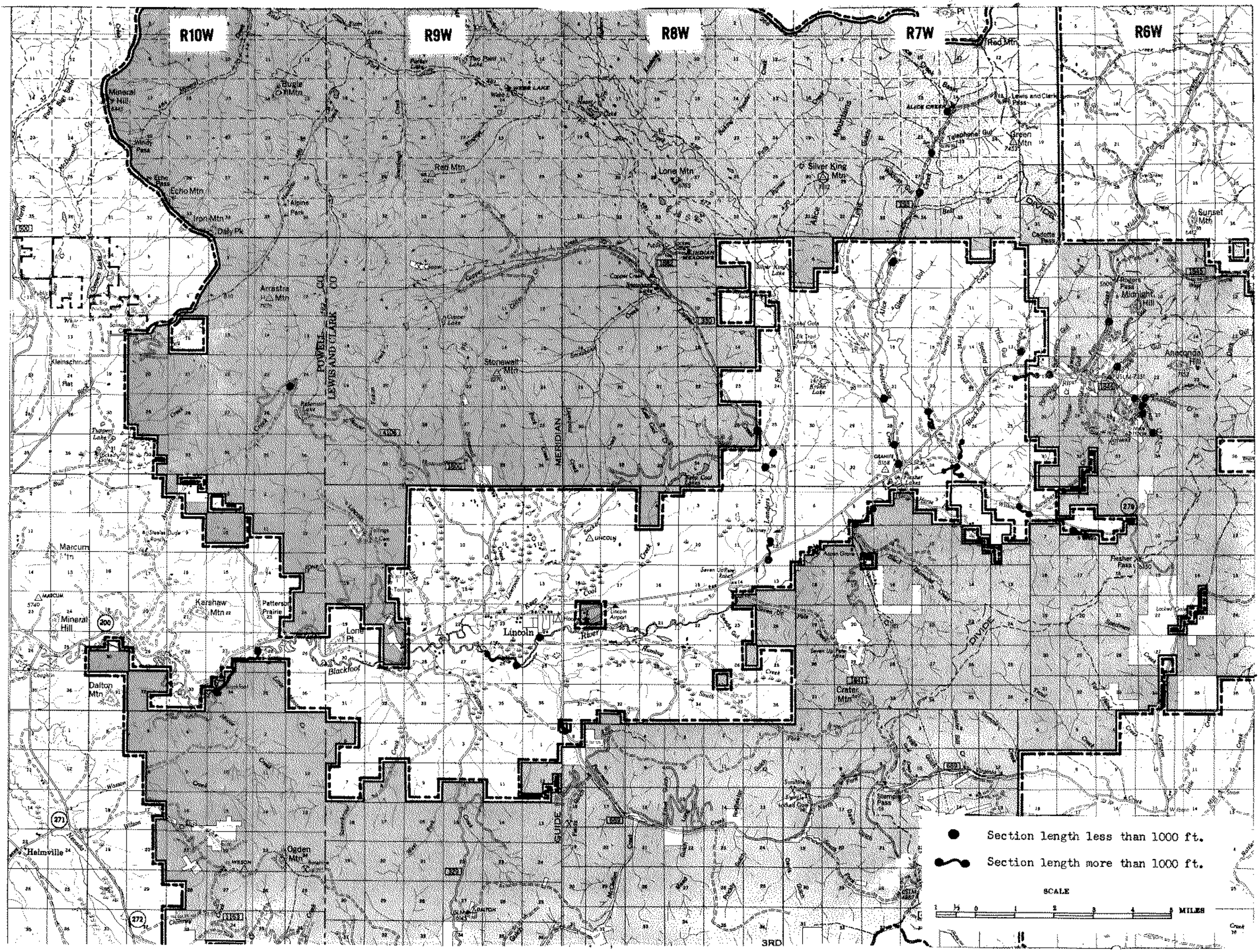
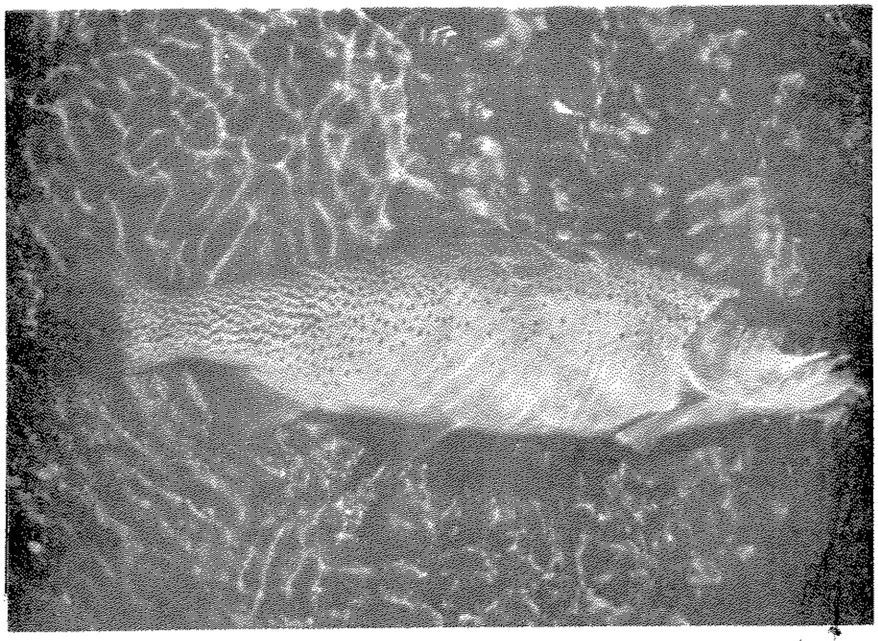
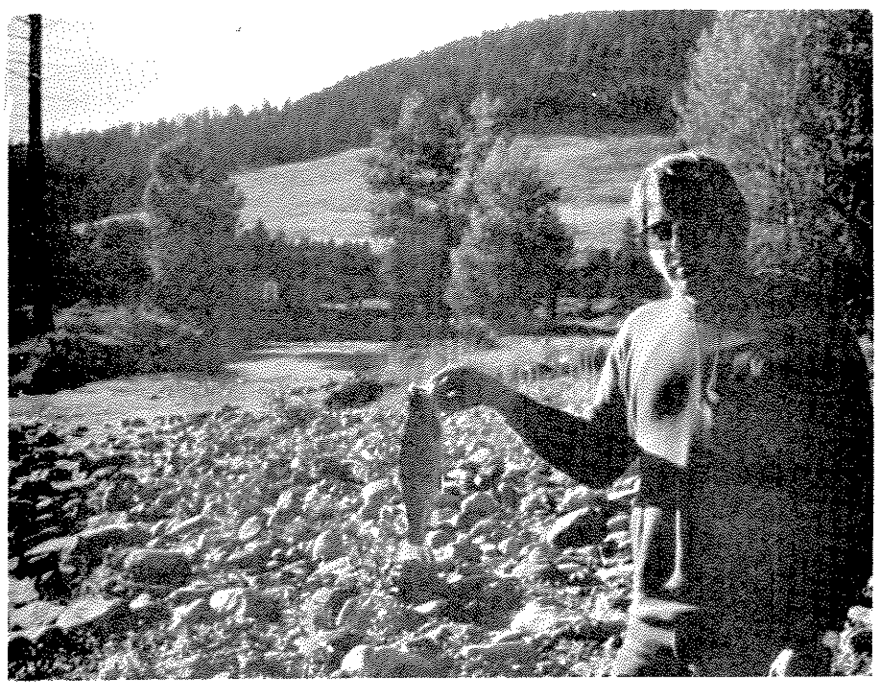


Figure 17. Fisheries stream survey and population estimate sample sites.





Cutthroat trout are an important game fish in the upper Blackfoot River. This 1-pound trout was caught in the Hogum section of the river. USGS gaging station is in the background. September 14, 1972.

just above its mouth, which may restrict movement of brown trout from the main river. Dolly Varden also inhabited Poorman Creek, but it is not known if they are migrants from the main river.

There were no fish in Beartrap Creek below its confluence with mine drainage from Mike Horse Creek, or in the main Blackfoot River below Anaconda Creek. However, there was a good cutthroat trout population in Beartrap Creek above the mine drainage (between the tailings dam and Mike Horse Creek) because of much better water quality (see Appendix M - p. A-67).

Both cutthroat and brook trout were observed in beaver ponds near Pass Creek, indicating improved water quality. The beaver ponds are in the proposed open pit area. If water quality were to be improved from the Mike Horse mine drainage, fish populations would be poor in the stretch of stream between Mike Horse Creek and Pass Creek because physical habitat is small and has been badly damaged by past mining and roadbuilding activities. Spawning would be the only potential use of this section unless habitat is improved.

Anaconda Creek contained cutthroat and brook trout. Cutthroat were most numerous. Only cutthroat were found in Shoue (Shave) Gulch. Both streams are within the Mike Horse mine area, but neither stream had obvious water quality problems.

It is apparent from water quality data collected by the Anaconda Company, and fish population data, that drainage from the Mike Horse mine is a large contributor to the degraded Blackfoot River headwaters. It also appears that high zinc levels (and possibly cadmium) are the principal cause of this water quality degradation.

The tailings pond on Beartrap Creek contained cutthroat trout which were larger than most fish found in nearby streams. The pond was not sampled, but visual observations were made of surfacing fish. Also, local fishermen verified the cutthroat species present from fish catches. Beartrap Creek above the pond also contained small cutthroat trout. Larger habitat size and better growing conditions than in small streams are factors which favor greater fish production in the pond. An attempt to reclaim polluted waters from the Mike Horse mine area should consider the possible tradeoffs involved in using the pond as part of the treatment system. Use of the pond to treat mine drainage would eliminate the trout fishery, but might improve the polluted river downstream for several miles. Mine drainage should be rehabilitated, but alternative methods which would avoid use of the tailings pond as part of the treatment system should be investigated.

Mine drainage into Willow Creek (Flesher) from Sandbar Creek appears to have some detrimental effects on the fishery. Fish shocking in Willow Creek above and below Sandbar Creek produced cutthroat and brook trout in both areas. However, the proportion of cutthroat was higher above Sandbar Creek than below (2.2:1 vs 1.4:1). More trout per 1000 feet of stream were also found above Sandbar Creek than below (233 vs 156 per 1000 feet). This was not a population estimate, but nevertheless appeared significant. Physical habitats were comparable. The appearance of Willow Creek (Flesher) below Sandbar Creek was similar to that of the main river at Pop's Place which was affected by mine drainage. This is an indication that similar causal conditions existed in both places. Since trout were found in both affected streams, it appears that reduced water quality did not have a direct killing effect on the fish, even though their numbers were below that which would normally be expected. The population depression may be related to metals in the stream and streambed which reduce optimum conditions for insect and fish reproduction, both of which are necessary to sustain a wild fish population. Physical habitat was good in both streams and this was not believed to be a limiting factor. A more detailed study should be conducted on this problem.

Fish sampling and insect data showed water quality in the Blackfoot River to be greatly improved at the Flesher sampling station. However, Willow Creek (Flesher) enters less than 1/2 mile below this station. There may be further water quality reduction from Willow Creek, since the Blackfoot River fish population estimate was higher above than below Willow Creek. Number of trout per 1000 feet of stream was also a little higher above than below, and there were almost three times more cutthroat above than below Willow Creek.

Pass Creek supported a population of small cutthroat and brook trout. Cutthroat were most abundant. Physical habitat was too small to produce very many catchable-size fish.

Cadotte Creek dried up each year about a mile before it reached the Blackfoot River. However, beaver dams above this point supported a fishable population of brook trout. No other fish species were collected in this section.

Alice Creek supported a good, fishable cutthroat/brook trout population. Streamflow was intermittent for about 2-1/2 miles above Bear Creek and fish populations were lower when streamflow <u>was</u> present. Shocking in this stretch at several locations produced some cutthroat and brook trout during the summer. However, a return visit in the late fall showed this same stream section to be dry. A year-round cutthroat population existed above the intermittent area near the abandoned U. S. Forest Service guard station. A few brook trout also inhabited this stretch of stream. Cutthroat predominated in all sampled sections of Alice Creek except in the beaver ponds on the Fickler Ranch. Here brook trout were most numerous. Dolly Varden may migrate into Alice Creek for spawning, although only a few small fish were taken in shocking samples.

Brook trout were the most abundant game fish in Hardscrabble Creek. Only two cutthroat were found in three shocking sections. There was beaver activity in Hardscrabble Basin which created pond habitat for brook trout. Sculpins were very numerous in Hardscrabble Creek below the beaver ponds.

Copper Creek contained a population of small cutthroat, brook trout and Dolly Varden. A few catchable trout were caught during this study and a 5-pound Dolly Varden was caught while sampling in 1968 (Spence 1970). Copper Creek may be a spawning and rearing stream for Dolly Varden which migrate from the main river.

Landers Fork was a poor stream for resident trout in its lower reaches. The 1964 flood destroyed portions of the stream, leaving wide, unstable sections of channel. A few deep holes contained cutthroat, brook trout, and Dolly Varden which were not readily sampled by electrofishing. Landers Fork reportedly contains a migratory Dolly Varden population which comes from the main Blackfoot River. The extent of this run is unknown. However, a natural vertical falls about 15 feet high on the Silver King Ranch (T 15N, R 8W, Sec. 12) prevents migrating fish from reaching upper Landers Fork. As previously noted, Landers Fork went dry above Copper Creek in 1973. There was a small flow here in 1974. Thus a resident fishery in this section is precluded, and flow conditions would dictate whether Dolly Varden could migrate through the area every year.

The status of the Dolly Varden is unknown in the study area. It is believed adult fish move from the Blackfoot River into Landers Fork, Copper Creek, North Fork, Monture Creek and possibly Alice Creek to spawn in the fall. They may also spawn in the main river and other tributaries. Several adult Dolly Varden were caught in the Poorman-Dalton and Hogum sections of the main river during the study. As previously mentioned, one large Dolly was caught in Copper Creek. No large Dolly Varden were caught in Landers Fork, but local fishermen are known to fish for them in the fall below the barrier falls. A complete study should be undertaken to establish the status, distribution, migratory habits and significance of the Dolly Varden in the Blackfoot River drainage.

The migratory behavior of mountain whitefish in the upper Blackfoot River is also not precisely known. There was some indication from shocking data that whitefish were more likely to be present in certain stream sections in September than earlier in the season. Schools of whitefish exhibiting spawning behavior were observed in Alice Creek and in two locations on the main Blackfoot River in the fall of the year. Population estimates for whitefish were attempted in Alice Creek in 1971, and in the Blackfoot River, Hogum section, in 1972. However, insufficient numbers of whitefish were recaptured in these sections to make an estimate.

Reproduction

Young-of-the-year trout were found in all stream sections sampled, including the main Blackfoot River. The only artificial stocking of these waters in recent years has been with hatchery-raised catchable rainbow trout. Very few of these fish were captured from areas where they were planted, and it was concluded that all waters in the study area maintained themselves by natural reproduction. The following paragraphs describe the location and characteristics of some spawning areas in the Poorman-Dalton sections of the Blackfoot River and in Alice Creek in 1972 and 1973:

On November 13, 1972, 43 trout redds were identified in the 5600-foot Poorman-Dalton shocking section of the Blackfoot River downstream from the mouth of Poorman Creek. Both brown and brook trout were observed on some of the redds. Approximately one half the redds were in the upper one-third of the section.

Two redds near the mouth of Poorman Creek had up to eight large brown trout on them at various times. One trout was marked with a white T-tag. The tag number was not seen, so the tagging location is unknown. The fish could have been tagged in the Poorman-Dalton section, or at the Stemple road bridge 1-1/4 miles upstream, since some of the 21 brown trout tagged at the latter location are known to have moved downstream after tagging (see section on tag returns).

Standpipes (Terhune 1958) were placed in the above two redds to measure intragravel DO (dissolved oxygen). Two standpipes were placed in each redd, one near the upstream end and one near the downstream end. One redd measured 5 feet wide by 13 feet long and the other was about the same size. This measurement includes the entire area of distrubed gravel which may have contained more than one egg deposition area. Standpipes were driven about 6 inches into the gravel and allowed to stabilize for 48 hours before measurements were taken.

Surface water DO and DO in water taken from inside the standpipes were determined with a Hach Model Al-36-WR test kit. Velocity and depth of surface water were made with a Price Model AA current meter. A summary of data is given in Table 12.

Table 12. Water temperature and intragravel dissolved oxygen in Blackfoot River brown trout redds, 1972.

Standpipe No.	Water Depth (ft)	Velocity (fps) @ 0.6 depth	Surface DO(ppm)	Surface Temp (°F)	Surface % Sat.	Intragravel DO	Intragravel Temp	Intragravel % Sat.
1-1[1/]	1.5	1.11	8.5	42	80	7.5	42	71
1-2	1.3	1.26	8.5	42	80	7.5	42	71
2-1	1.2	1.18	8.5	42	80	8.0	43	76
2-2	1.0	1.18	8.5	42	80	7.5	42	71

1/ 1-1 = Redd #1 upper standpipe; 1-2 = Redd #1 lower standpipe

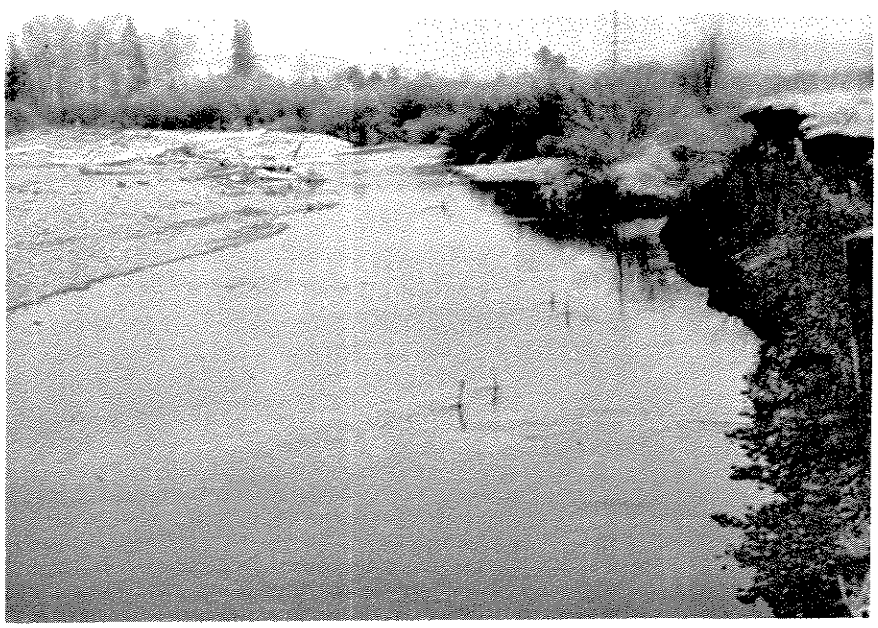
In addition to the redds seen in the main river, three redds were seen in the mouth of Poorman Creek and were believed to be brown trout redds.

Four standpipes were placed in known brook trout redds in the mouth of Alice Creek on November 14, 1972. One standpipe was placed in each redd and was allowed to stabilize for 25 hours before being sampled. Sampling techniques previously given were used here also. Sampling results are given in Table 13.

Table 13. Water temperatures and dissolved oxygen in Alice Creek brook trout redds, 1972.

Standpipe No.	Water Depth (ft)	Velocity (fps) @ 0.6 depth	Surface			Intragravel		
			DO(ppm)	Temp (°F)	% Sat.	DO	Temp	% Sat.
1	.55	.439	9.0	40.5	84	6.0	40 1/	56
2	.45	.818	9.0	40.5	84	6.5	39.5	61
3	.85	.375	9.0	40.5	84	6.5	39.5	61
4	1.6	.319	9.0	40.5	84	6.5	39.5	61

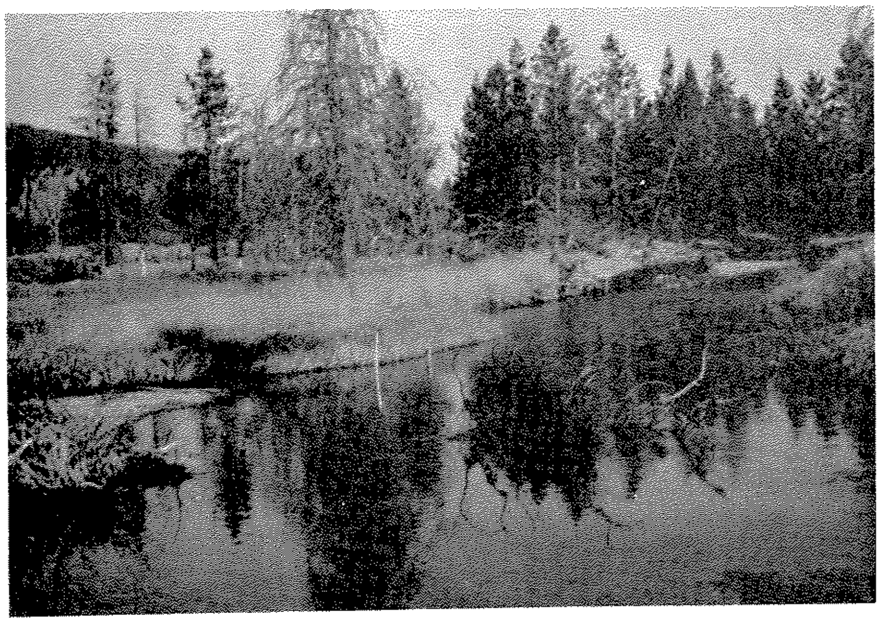
1/ A spring with slightly warmer water entered just above standpipe No. 1



Brown trout spawning sites in the Blackfoot River below Poorman Creek in which dissolved oxygen and water temperature measurements were made. Note standpipes in center of photo. November 13, 1972.

One pair of small Dolly Varden was observed in a group of brook trout about 150 yards upstream from the Alice Creek sample site. The fish showed indications of spawning activity.

The gravels in all spawning areas were loose and quite easily moved. They also contained fair amounts of silt which washed out easily when disturbed. The intragravel DO levels were, however, suitable to sustain eggs and fry during development. Water temperatures were also not limiting in this respect.



Brook trout spawning site near mouth of Alice Creek. Note standpipes at center of photo. November 14, 1972.

On November 15, 1973, 43 trout redds were again counted in the 5600-foot Poorman-Dalton section. Several pairs of brown trout were spooked off the redds. Two browns with white T-tags were observed. No brook trout were seen. In both 1972 and 1973 the distribution of redds was similar, although there were more or fewer redds in any specific area of stream.

On December 3, 1973, 36 of the above redds were measured for velocity and depth characteristics (Table 14). Measurements were taken at one point immediately upstream from any disturbed area, to obtain the approximate velocity and depth of the spawning area before digging began. There may have been more than one redd in the disturbed area, but the single measurement sufficed for all. Redds were recorded as being located in a

(1) pool, (2) pool tail, (3) riffle, (4) run, (5) riffle corner. These designations were based on depth, apparent velocity and streambed characteristics. A pool consisted of deep, slow water, usually with a smooth surface. A pool tail was where water left a pool over a riffle and usually had a "V" shape. A riffle was shallow, choppy, fast water over a rough, rocky substrate. A run was smoother than a riffle and somehwat deeper. A riffle corner comprised an area inside the main current of the riffle as it turned a corner, with some flow escaping to the inside of the curve which had less velocity than the main flow. Redds associated with pools were almost always near the pool tail, where velocity was greater and depth shallower. The streamflow at time of measurement on December 3, 1973 was 18 cfs, which was about half what it was on November 13, 1972 (37 cfs). Flow measurements were made with a Price Model AA current meter. Velocities were measured at 0.6 of total depth.

Table 14. Characteristics of redds in Blackfoot River, 1973.

Redd Location	No. of Redds	Depth (ft) Range	Depth (ft) Mean	Velocity (fps) Range	Velocity (fps) Mean
Pool	6	.9 - 1.7	1.26	.241 - 1.11	.75
Pool Tail	15	.5 - .95	.67	.539 - 2.10	1.20
Riffle	11	.45 - .6	.53	.615 - 2.29	1.20
Run	1	1.5	-	2.00	-
Riffle corner	3	.6 - .9	.73	.875 - 1.29	1.14
All areas	36	.45 - 1.7	.75	.241 - 2.29	1.18

Nineteen of the 36 redds were confined to 3 distinct areas. The rest were single redds or in pairs at different locations. Streambed materials in spawning areas were loose and composed of silt, sand, pebbles and small rocks. Spawning sites were closely associated with escape cover. No redds were found where there was a lack of nearby cover, even though these sites looked as good for spawning as the others. One stretch of several hundred yards was unused where the stream flowed over gravels with no deep pools, undercut banks or log jams (i.e., no cover).

Tag Returns

Returns of trout marked with individually numbered tags gave some indication of the extent of movement in the system. Returns also indicated that the main river is not necessarily dependent on tributary streams for recruitment. A total of 463 trout over 9 inches long was marked in 11 stream sections (Table 15).

Table 15. Tag returns from marked trout.

Stream or Main River Section	Number Tagged	Number Returned	Percent Return
Cadotte Creek	4	0	0
Flesher Section	2	0	0
Willow Creek	3	0	0
Below Willow Cr. Section	7	0	0
Alice Creek	17	1	5.9
Hogum Section	15	2	13.3
Copper Creek	2	0	0
Stemple Section	23	2	8.6
Poorman Creek	16	3	18.8
Poorman-Dalton Section	269	13	4.8
Canyon Section	105	0	0
Total	463	21	4.5

The number of tags voluntarily returned by fishermen was 21 or 4.5 percent. There was some movement out of the sections where fish were tagged, but most fish were caught within the same section where they were tagged. Those which did leave the section moved both upstream and downstream. The farthest movement was by a brown trout which traveled about 4-1/2 river miles downstream from the Stemple bridge in Lincoln to the Dalton Mountain bridge west of Lincoln. The upper part of this section became dewatered in the fall from natural causes and could account for this movement.

Of the 21 tagged fish returned, 1 was a Dolly Varden, 13 were brown trout, 6 were cutthroat trout and 1 was a brook trout. All but two of the brown trout returned were marked in the Poorman-Dalton section of the main river. The other two were marked in the Stemple section. One cutthroat and the Dolly Varden were marked in the Hogum section of the main river. Two cutthroat were from the Poorman-Dalton section, two cutthroat and the brook trout were from Poorman Creek and one cutthroat was from Alice Creek.

Sixty-two percent of the tag returns were from brown trout tagged in the Poorman-Dalton section. The majority of the 463 trout tagged were marked in this section, because more trout over 9 inches long were captured here than in any of the other stream sections sampled.

Eleven trout were recaptured by shocking in the Poorman-Dalton section and one in Alice Creek the year after tagging. All of these fish were recaptured in the same section where they were tagged. Changes in growth over the period are shown in Table 16. All but two of the trout gained in length and all but two gained in weight. One fish lost in both length and weight, one gained nothing in length and only slightly in weight, and one gained in length while losing weight. The biggest increase in length was 2.6 inches, and in weight 0.87 pounds.

Table 16. Change in size of trout recaptured a year after tagging.

Stream or River Section	Tag No.	Sp.	Date Tagged	Approx. Age	Date Recap.	Total Length (in.) at		Total Weight (lbs.) at		Change in	
						Tagging	Recap.	Tagging	Recap.	Length	Weight
Poorman-Dalton	2-1029	LL	8/26/71	4	8/15/72	14.6	14.5	1.15	.98	-0.1	- .17
"	2-1076	LL	8/26/71	4	9/ 1/72	17.5	17.5	1.71	1.73	0	+ .02
"	2-1091	LL	9/ 2/71	4	8/15/72	12.9	14.2	.78	1.06	+1.3	+ .28
"	2-1096	LL	9/ 2/71	4	8/15/72	13.3	14.3	.86	1.13	+1.0	+ .27
"	2-1101	LL	9/ 2/71	3	8/15/72*	11.8	14.0	.56	.94	+2.2	+ .38
"	2-1105	Eb	9/ 2/71	2 or 3	8/22/72	11.2	11.5	.56	.51	+0.3	- .05
"	2-1119	LL	9/ 2/71	4	8/15/72	14.8	15.3	1.26	1.42	+0.5	+ .16
"	2-1120	LL	9/ 2/71	4	8/15/72	15.0	17.5	1.23	2.10	+2.5	+ .87
"	2-1121	LL	9/ 2/71	4	8/22/72	15.0	15.6	1.27	1.43	+0.6	+ .16
"	2-1129	LL	9/ 2/71	4	8/22/72	14.1	15.6	1.09	1.44	+1.5	+ .35
"	2-1253	LL	8/15/72	2 or 3	9/13/73	10.0	12.6	.38	.75	+2.6	+ .37
Alice Cr.	2-1298	Eb	8/21/72	3	9/ 7/73	9.6	11.0	.40	.55	+1.4	+ .15

*This fish was recaptured again on 9/1/72 in the same section.

Tagging data indicate that resident brown trout in the main river near Lincoln do not undertake long migrations to spawn in tributaries. There probably are short movements within a stream section to find suitable spawning sites. If tributaries are locally accessible, some movement into them may occur. For example if Poorman Creek had been more accessible, brown trout may have used it more extensively for spawning. Spawning may also occur in the Keep Cool and Beaver Creek system. Dolly Varden and mountain whitefish may undertake longer spawning migrations, but adequate supporting data are not currently available. Observations on spring spawning cutthroat trout were limited because of the difficulty of sampling during high water conditions.

General observations of fisherman use in the Lincoln area suggest that fishing pressure is generally low on the main river and tributaries. The low number of tag returns tends to support these observations. Pressure is concentrated at the better access sites, particularly on weekends, but is greatly reduced on less accessible portions of the river.

Metals in Fish Tissues

Twenty-five fish samples from five different stream locations were collected in 1972 and analyzed by EPA for cadmium, copper, lead, mercury, nickel, zinc and arsenic. Methods and results are given in Appendix V (p. A-143). Iron was not analyzed due to a laboratory error.

Concentrations of all metals except arsenic were uniformly lowest in fish from the Blackfoot River, Poorman-Dalton section. Arsenic was no different than in samples from the other locations. However, some of the lowest cadmium, lead, mercury, and zinc levels were found in fish from the Hogum section of the main river. The highest levels of cadmium, lead, mercury and nickel were found in fish from Poorman Creek. Copper and zinc levels were highest in both Poorman Creek and Alice Creek. The metal found in the greatest quantity in all samples was zinc. Van Meter (1973) found zinc in liver tissues to be higher than other metals analyzed and suggested the higher concentrations are related to a greater need in metabolic functions. There was no apparent trend in arsenic levels at any location. The single highest level of arsenic was found in a cutthroat from Poorman Creek.

Background data on levels of metals in fish tissues from Montana streams which are unaffected by man's activities are insufficient to make valid comparisons with the data in Appendix V (p. A-143). More such data will be needed from such state waters, and it would be valuable to make additional collections in the upper Blackfoot drainage to increase the sample size for later comparison if a mining development occurs in the Mike Horse area.

Wildlife

General

Wildlife in the study area included elk, mule deer, white-tailed deer, moose, black and grizzly bears, mountain lions, bobcats, beavers and three species of mountain grouse (Franklin's, blue and ruffed). There were unconfirmed reports of bighorn sheep along the continental divide. Bald and golden eagles and ospreys were also observed. Several species of waterfowl were found on streams and beaver ponds, and in intermittent marshes in the spring.

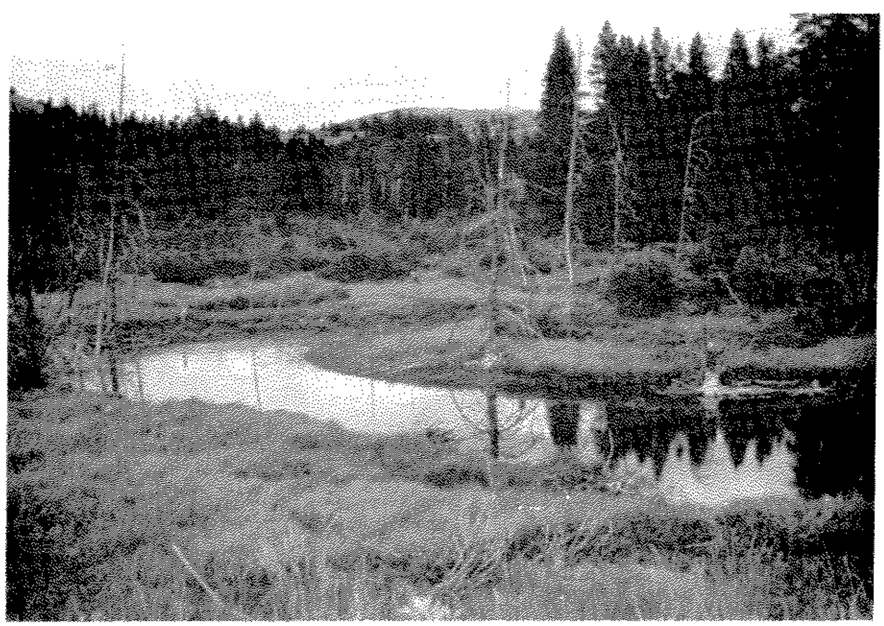
Both white-tailed and mule deer wintered in the principal study area. The main wintering area for whitetails was along the Blackfoot River in the 12-mile long canyon below Lincoln. Mule deer wintered at higher elevations in the canyon. Some white-tailed deer also wintered along lower Poorman Creek, and in scattered lowland areas in the Lincoln valley.

Small bands of elk regularly wintered at several locations in the Lincoln area (Figure 18). The same elk may have moved from one range to another, depending on the time of year and severity of the winter.

There were few moose observed in the study area. Two moose were observed wintering in Indian Meadows in February 1974, and one was seen on Highway 200 in Lincoln Canyon in June 1974. Only occasional reports of moose were received from adjacent areas.

Three grizzly bears were observed by others in the Spencer Bar calving area during the summer of 1972.

Beaver were prevalent in the upper Blackfoot River. They occupied most swampy areas created by geologic dams (see Coffin and Wilke 1971). They also built their dams across flowing streams. One of the areas beaver inhabited would be covered by the proposed clarification pond, another by the proposed open pit mine, and a third area would be covered by the proposed tailings pond in Hardscrabble Basin.



Geologic dams aid beaver in creating ponds along the upper Blackfoot River. July 23, 1973.

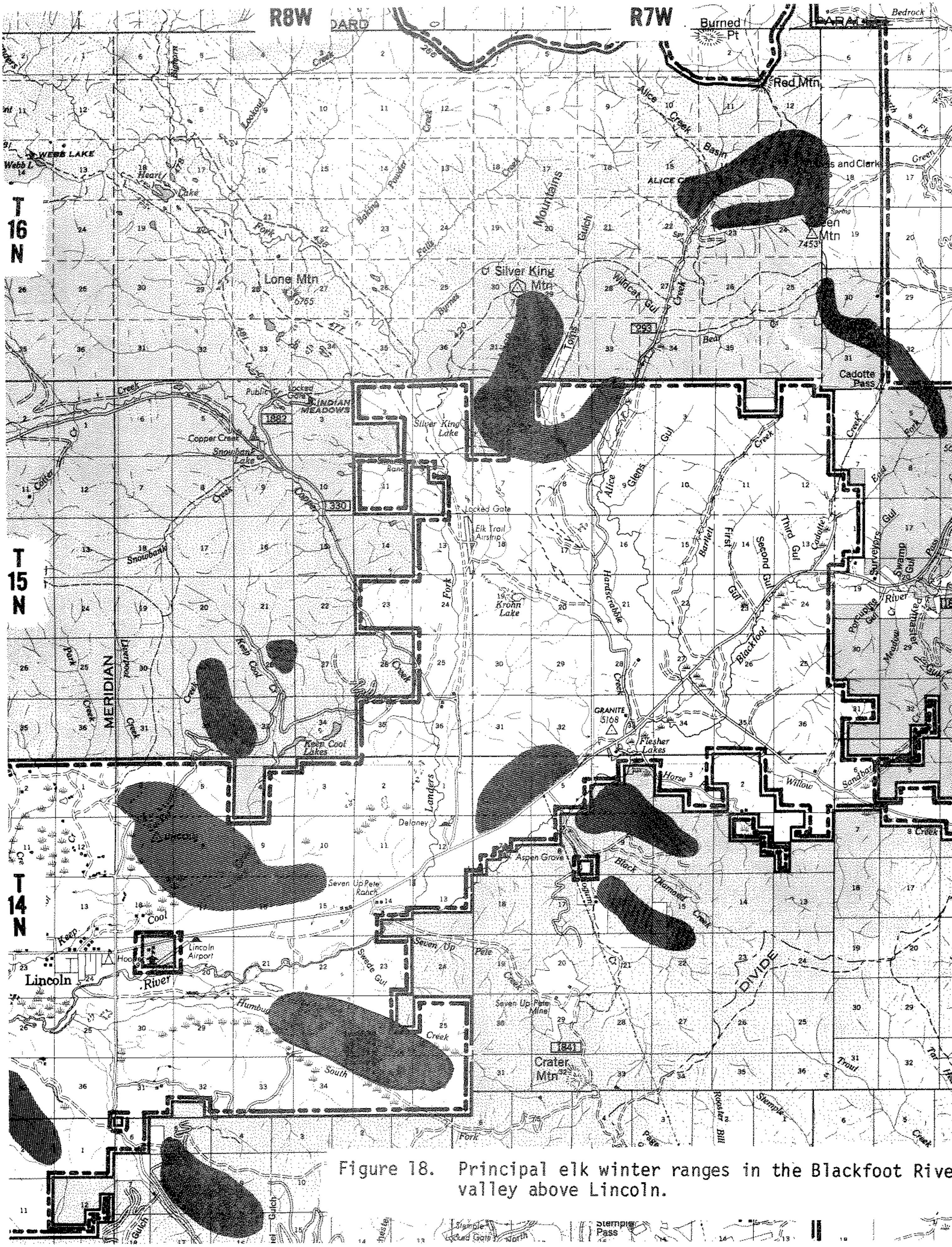


Figure 18. Principal elk winter ranges in the Blackfoot River valley above Lincoln.

Breeding and nesting waterfowl, Wilson's snipe and nongame birds occupied the proposed tailings pond site in the spring. Snowmelt created a temporary wetland in part of this grassland flat in Hardscrabble Basin. The extent of the wetland depended on the amount of spring runoff in the basin. After the wetland dried up later in the season it was grazed by domestic sheep.

Elk Distribution

Seasonal observations of elk were made by aircraft from 1971 through 1974 (Appendix W - p. A-146). These observations on winter and spring ranges were plotted to the nearest quarter section and are shown in Figure 19. Most spring flying effort was spent observing locations of elk in the Alice Creek-lower Landers Fork area. A portion of the calving area near Spencer Bar may be used for a tailings pond in the mining operation (Figure 20). Areas adjacent to Spencer Bar itself would also be influenced by the tailings pond. Newborn calves were observed for 3 years throughout this area in June and July (Figure 21). Most calving occurred on private lands (Figure 22). However, adjacent state and national forest lands were also utilized to some extent during the calving period. Delineation of primary spring ranges and calving areas, based on aerial observations and radio telemetry information, is shown in Figure 23. Surrounding areas were probably also used for calving, but the largest concentrations of elk were found in the areas shown in Figure 23.

Aerial observations made during the winter as well as in the spring months showed that only a few elk spent the entire winter in the Spencer Bar area. These elk utilized the Alice Mountains as winter range (see Figure 18). Greater numbers of elk were found in this wintering area in the fall and early winter, but observations indicated this was just a temporary early wintering area which elk used prior to migrating to winter range east of the continental divide.

Spencer Bar and vicinity was well covered by snow all winter until about mid-April when the snow began to recede. However, elk did not begin to arrive on the calving area until the last of April or first week in May. Vegetation had just begun to green up at this time. Elk continued to arrive during May and the maximum numbers occurred from mid-May to the last week in May (Table 17). By this time vegetation had usually greened up well over the entire area. "Green up" time depended on snow conditions and seasonal weather patterns.

Elk utilized the calving areas primarily during May and June. By July 1 it was difficult to find many elk, even from the air.

Fewer elk were observed on the Spencer Bar area in the spring of 1973 as compared to the other years. This may be related to the mild winter of 1972-73. Snowpack was very light, particularly east of the continental divide on critical winter range (Figure 24). Fewer elk were observed on this winter range in 1972-73 than in the previous two winters (Table 18).

Feed on Spencer Bar may provide a needed "boost" to elk who winter on an area where sufficient feed is difficult to obtain during hard winters. Since more winter range was available in 1972-73 due to the mild winter, the elk may not have required this boost quite as much because winter feed was more available.

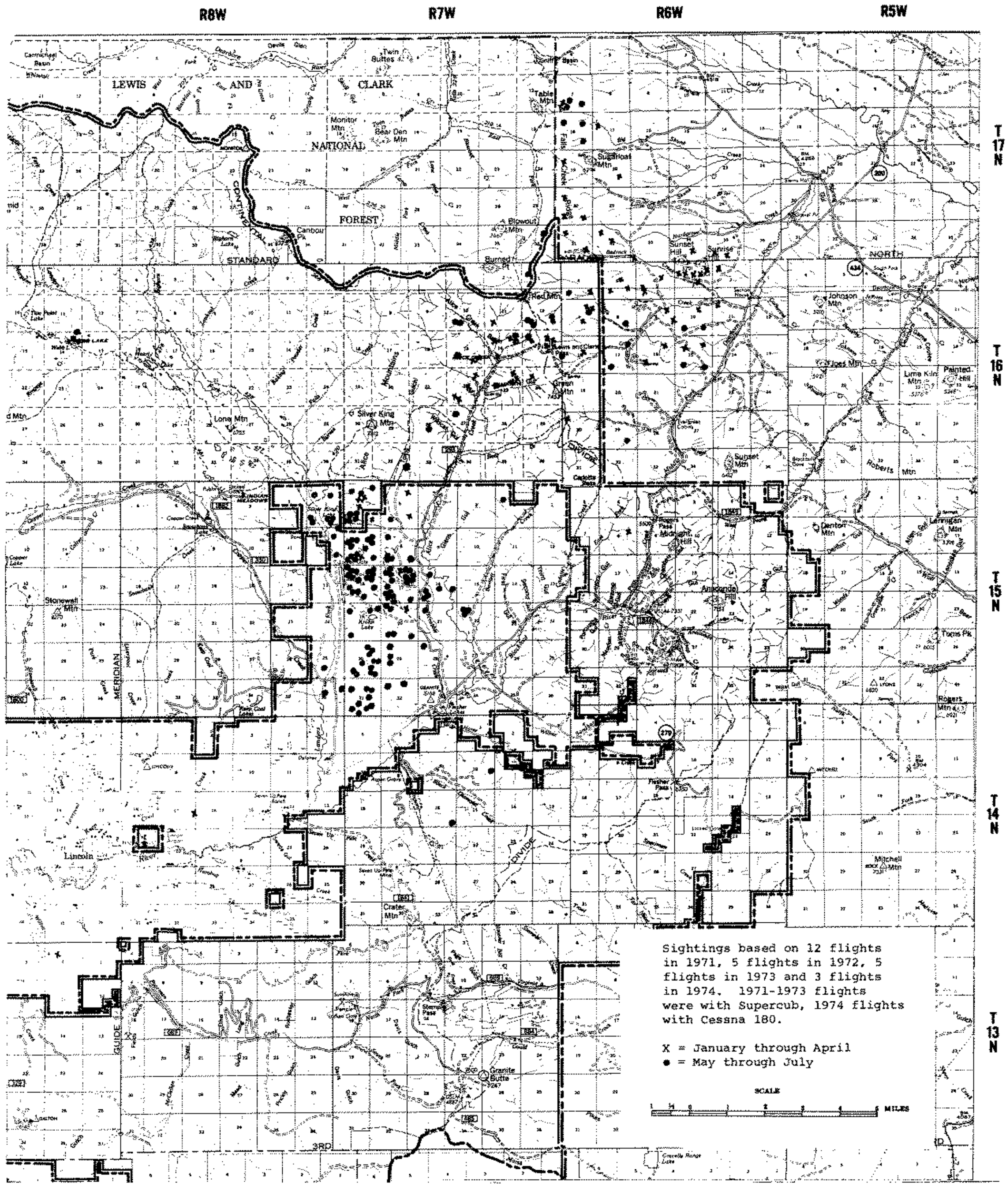


Figure 19. Aerial sightings of one or more elk on winter and spring ranges, 1971-1974.

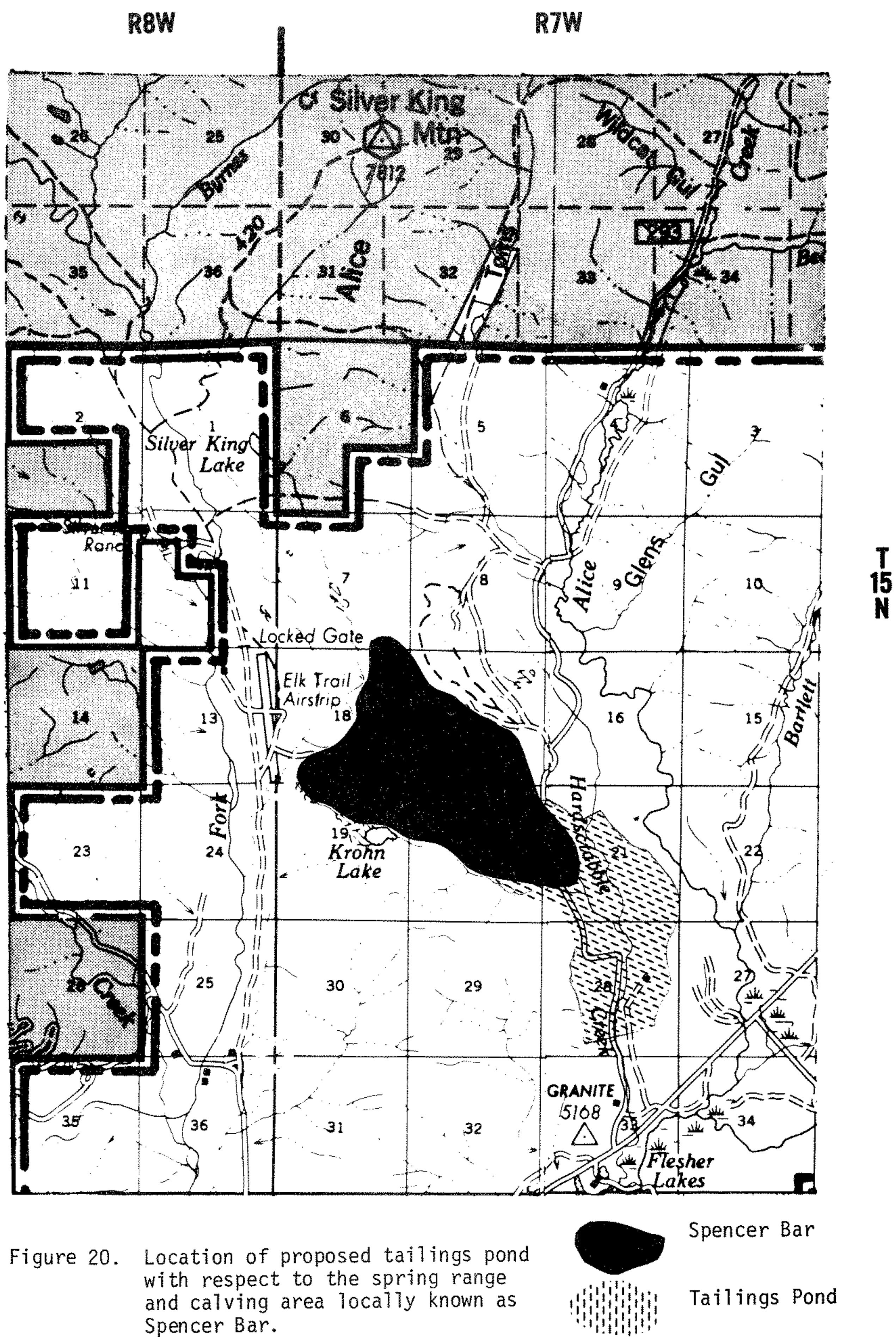


Figure 20. Location of proposed tailings pond with respect to the spring range and calving area locally known as Spencer Bar.

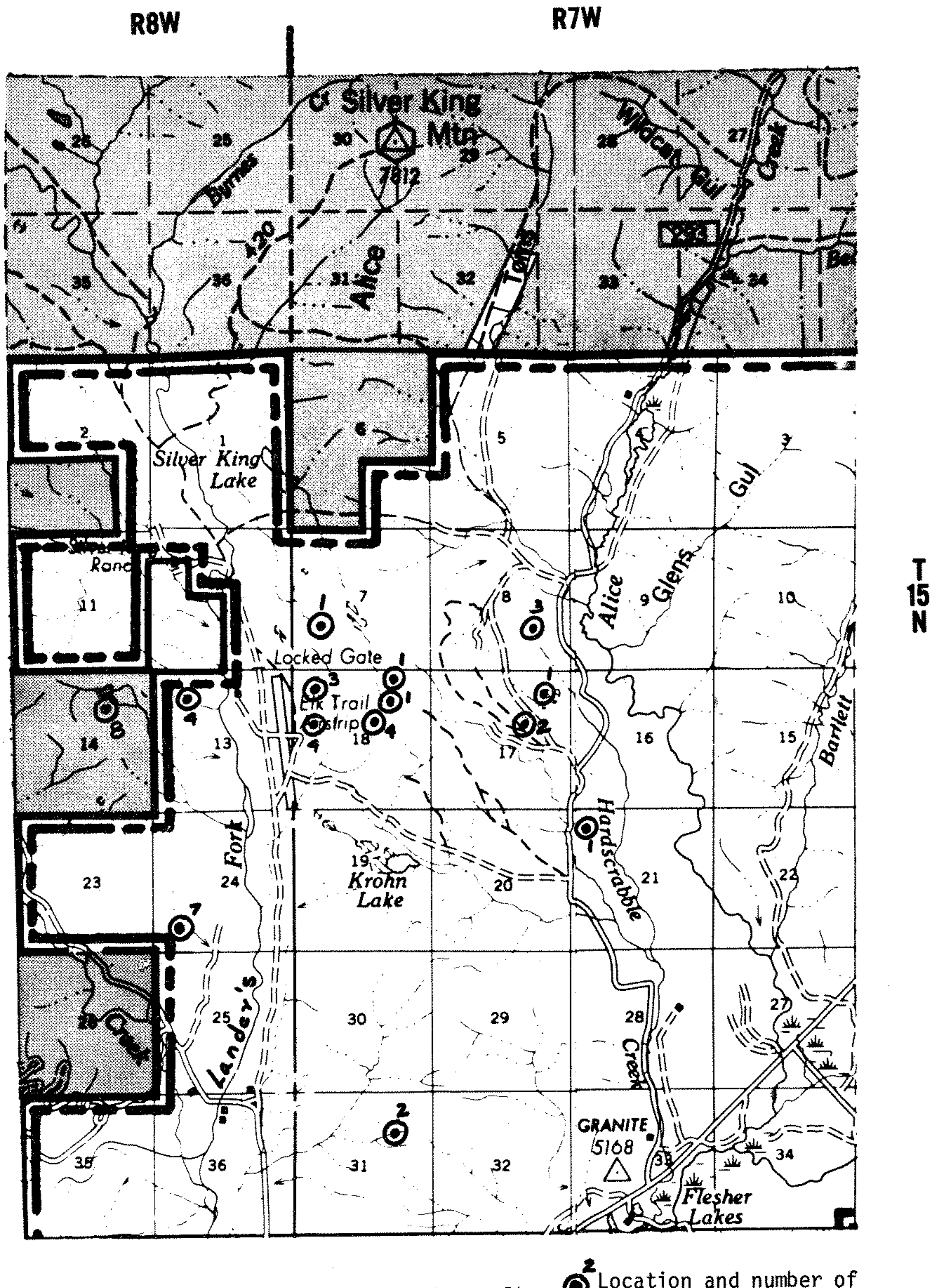


Figure 21. Aerial sightings of newborn elk calves in June and July 1971-1974.

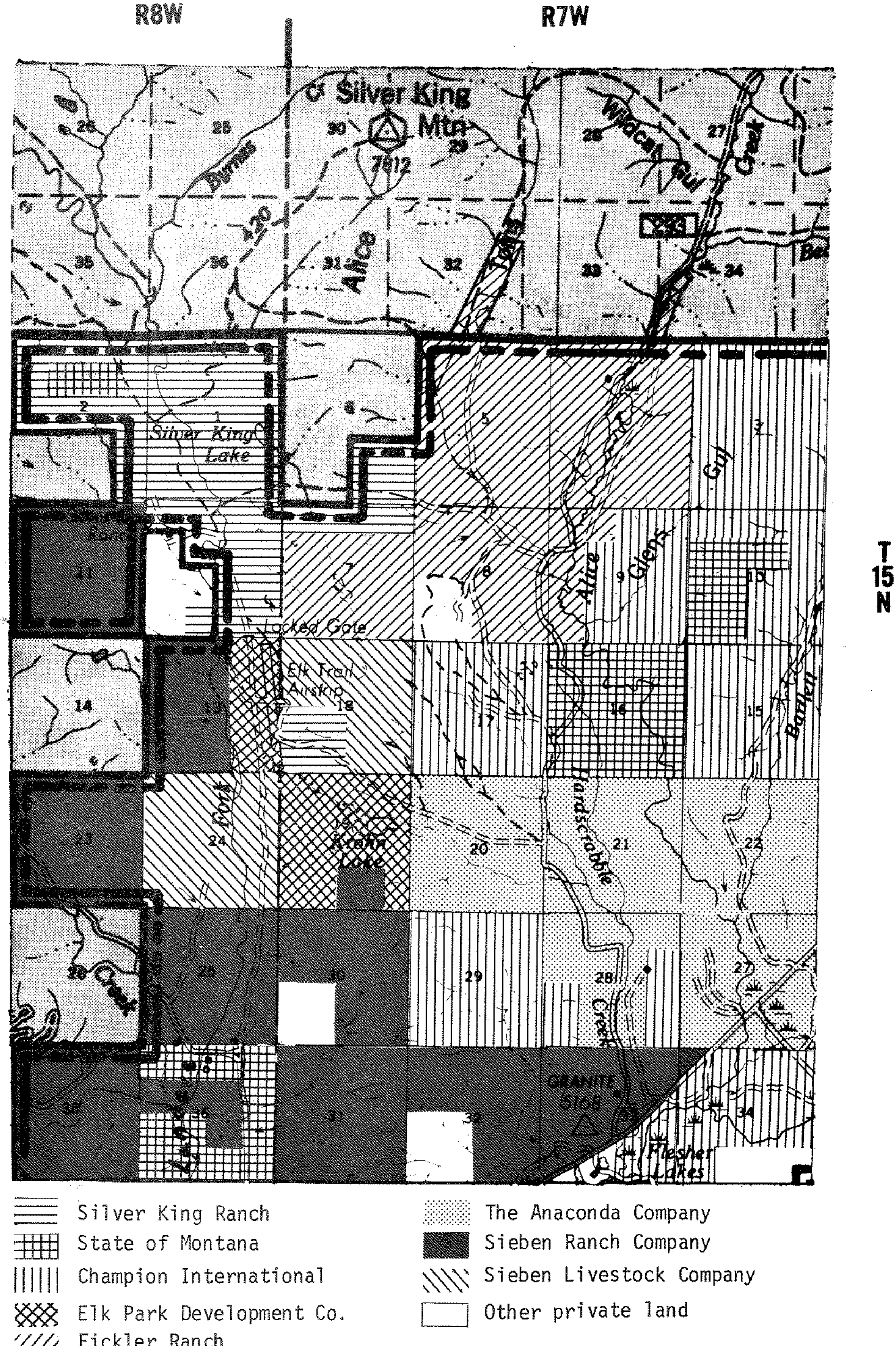


Figure 22. Land ownership of spring range and calving areas.

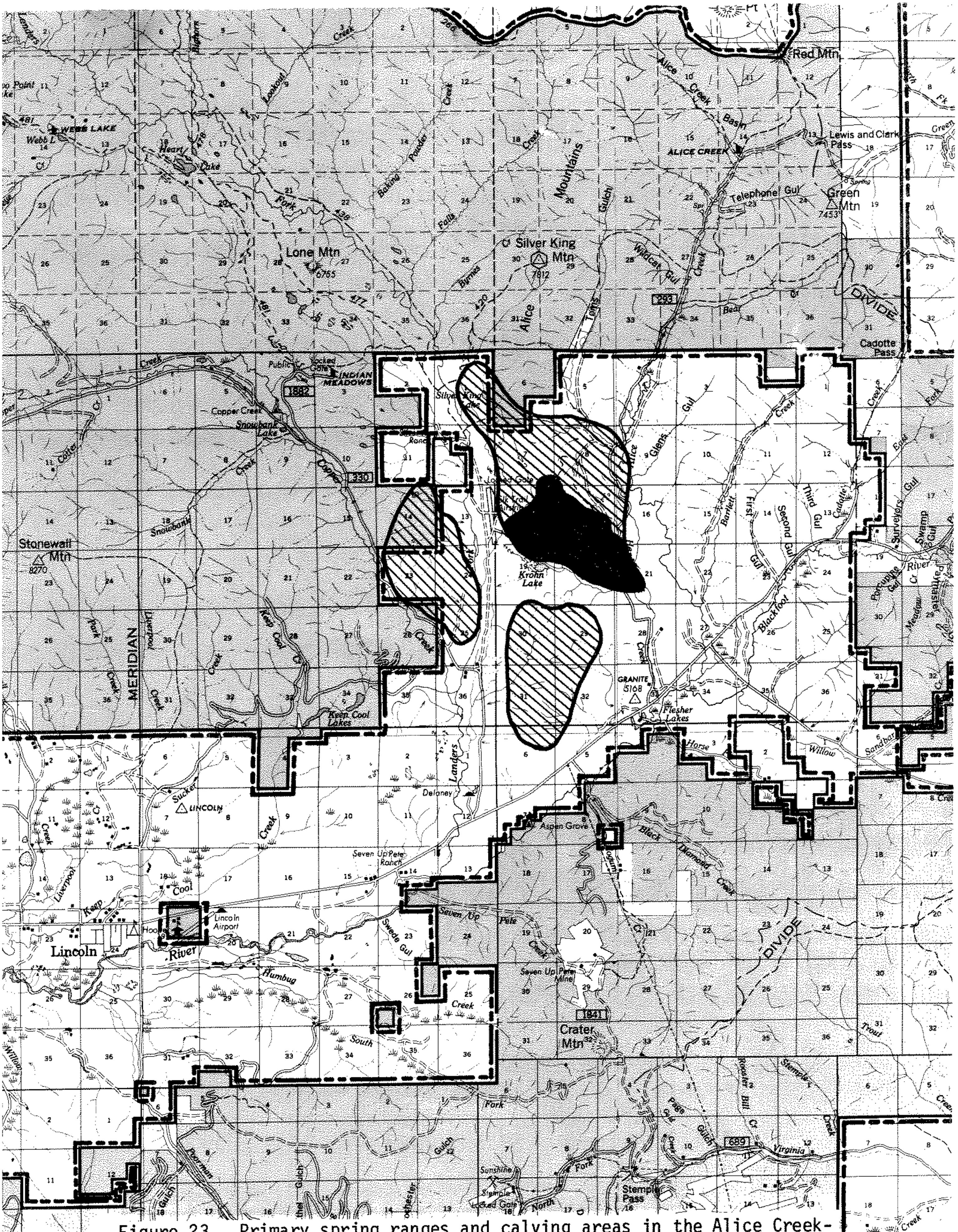


Figure 23. Primary spring ranges and calving areas in the Alice Creek-lower Landers Fork vicinity. Shaded area is Spencer Bar.

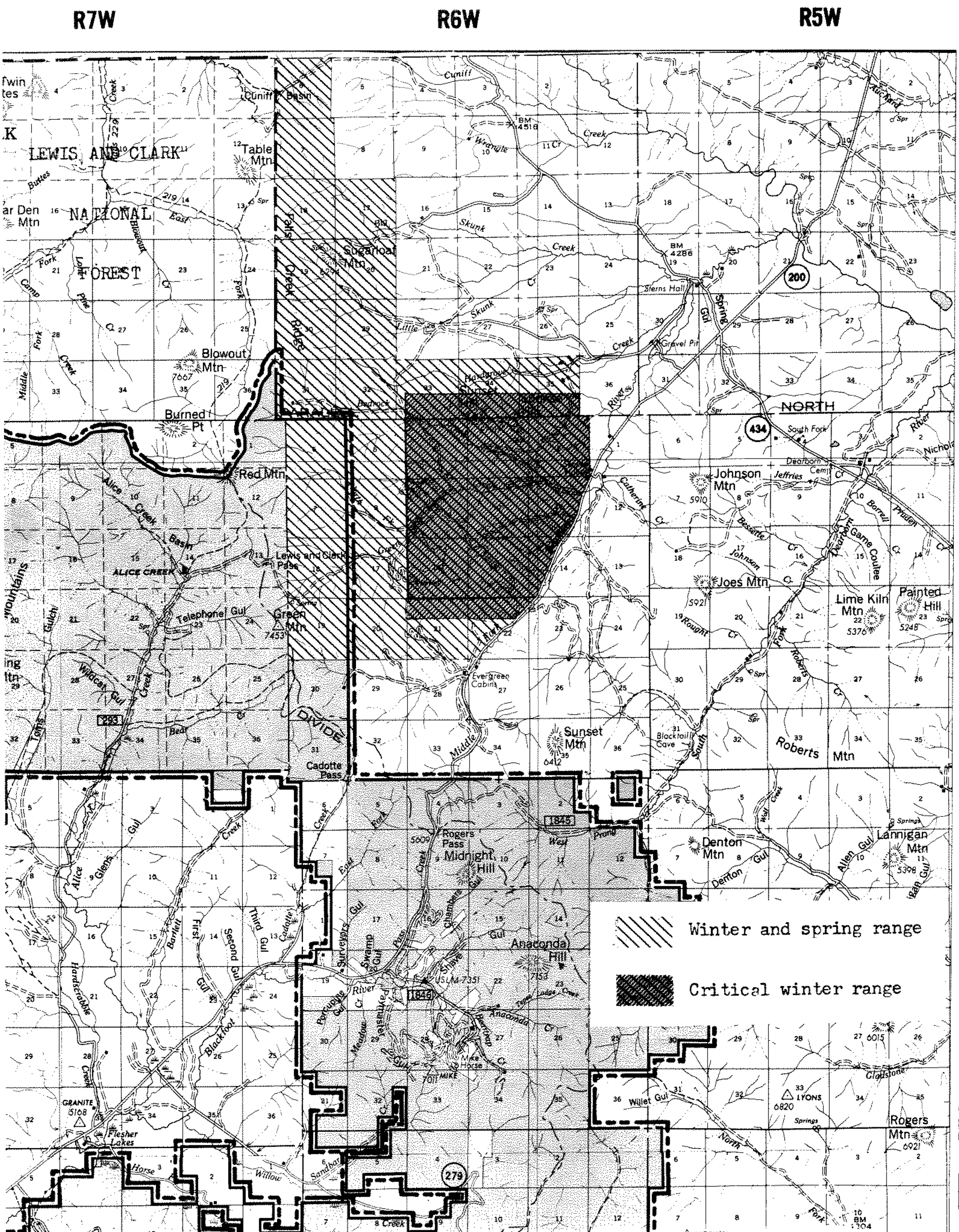


Figure 24. Winter and spring ranges used by elk on private lands east of the continental divide.

Table 17. Highest spring counts of elk observed on Spencer Bar and vicinity, 1971-74.1/

Spring of	Date	Number of Flights2/	Highest Elk Count
1971	May 24	11	93
1972	May 24	5	92
1973	May 31	5	35
1974	May 14	3	104

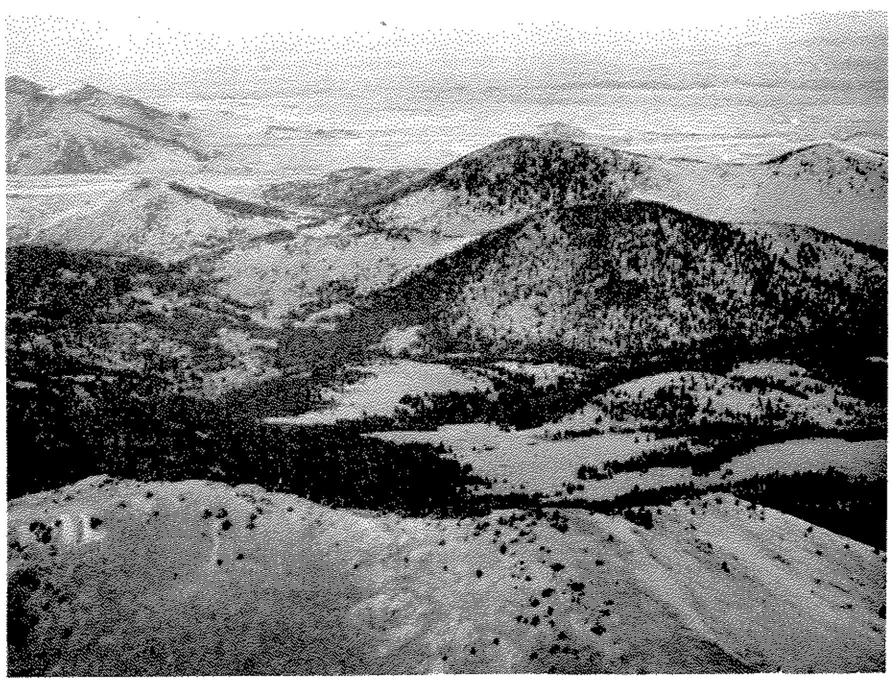
1/ Includes only the area shown on maps in Figures 20-22.
2/ Total of both winter and spring flights.

Elk begin to utilize Spencer Bar about May 1, the time of "green up."

Table 18. Highest counts of elk observed on critical winter range, 1971-74.

Winter of	Number of Flights	Highest Elk Count	Date
1970-71	5	195	February 9, 1971
1971-72	2	200	April 19, 1972
1972-73	4	142	April 19, 1973
1973-74	1 1/	146	April 30, 1974

1/ Flight made with Cessna 180 instead of Supercub.

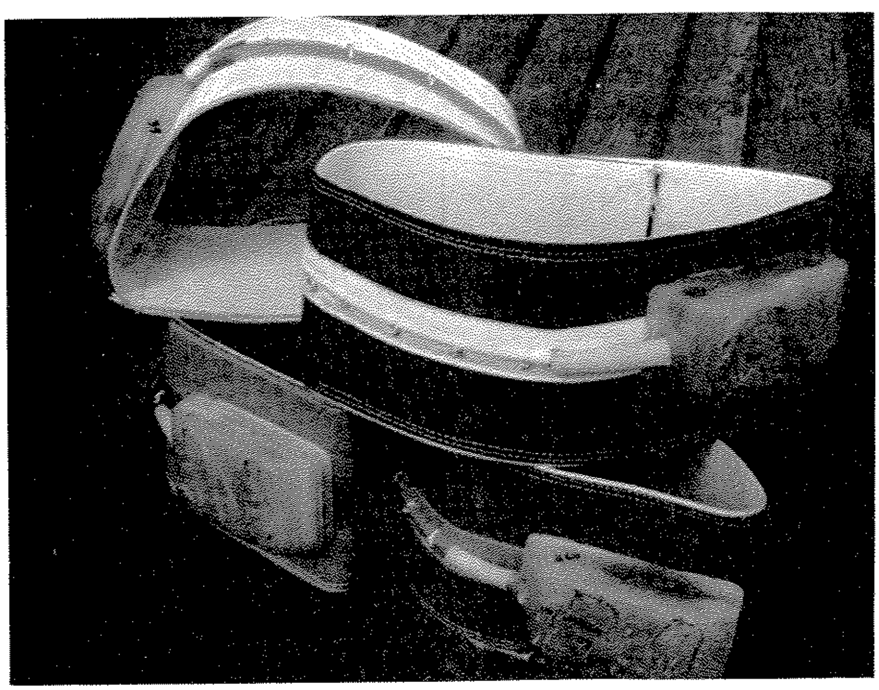


Elk and deer winter range east of continental divide.
October 29, 1974.

Elk Movement by Radio Telemetry

On April 23, 1973 two mature cow elk were trapped and banded with radio transmitter collars. These elk will be referred to as CH-6 and CH-9, which correspond to the receiver channels on which their signals were received. On April 26, 1973 a third elk, CH-2, a yearling cow was banded after being captured from a helicopter using a "Cap-Chur-Gun" and SUCOSTRIN (Succinyl choline chloride). All three elk were banded on critical winter range east of the continental divide (see Figure 24).

Radio transmitters and the receiver used in tracking were obtained from AVM Instrument Company, 810 Dennison Drive, Champaign, Illinois 61820. The receiver used was the Model LA-12 powered by eight 1.5-volt penlight batteries. The receiver also had a connection for an outside power source. Transmitters were Model SB-2 powered by four ZM12T2 mercury batteries. Activated transmitters were first sealed in beeswax, then further sealed in an acrylic compound poured into a rubber mold containing the transmitter and batteries. The completed transmitter package was attached by small brass bolts (previously sealed into the acrylic) to a 6-inch wide collar made of canvas webbing. Brightly colored nylon material made by SAFLAG (Safety Flag Company of America) was stitched to the webbing into individual color designs which could be recognized from aircraft. The designs consisted of a solid color background with a 1-1/2-inch stripe of contrasting color stitched around the center of the band. The radio antenna was placed beneath this center stripe and tied in place with nylon cord. Pertinent banding data and characteristics of the radio transmitters are shown in Tables 19 and 20.



Radio transmitter collars like these were placed on three cow elk during the study. April 1973.

Table 19. Radio transmitter data.

Elk No.	Channel	Frequency (KHz)	Beeps per Minute
CH-2	2	150.831	121
CH-6	6	150.942	74
CH-9	9	151.005	119

Table 20. Elk banding data.

Elk No.	Sex	Age	Banding Date	Ear Tag Nos. Right	Ear Tag Nos. Left	Total weight of Collar (lbs)
CH-2	F	Yearling	4/26/73	5045A	5044A	2.10
CH-6	F	Mature	4/23/73	R0928	R0927	2.20
CH-9	F	Mature	4/23/73	R0931	R0929	2.08

Radio tracking was conducted both from the ground and from aircraft. The antenna used for ground tracking was a hand-held Model 23, 3-element yagi antenna modified to the specific transmitter frequency range. The antenna was obtained from Hy-gain Electronics Corporation, 8601 N.E. Highway 6, Lincoln, Nebraska 68505.

An aircraft antenna system adapted from Craighead et al. (1971), was mounted on a Cessna 180 aircraft having a metal skin. It is a two-element driven array consisting of two 1/4-wavelength grounded whip antennas spaced 1/4-wavelength apart and attached to the underside of the fuselage. A 1/4-wavelength delay line in series with one of the antennas causes a 90-degree phase shift in one signal before it is combined with the signal from the other antenna. The delay line is a short length of coaxial cable enclosed in a small switch box. A toggle switch connects the delay line to either the right or left antenna. The system provides a stronger signal through the antenna on the side of the aircraft on which the radioed animal is located. By switching from side to side the aircraft can "home in" on the animal by a series of turns.

Flight dates, whether radioed elk were observed or not, and the number of other elk present near the radioed elk are tabulated in Appendix X (p. A-149). Maps of radioed elk movements are shown in Appendix Y (p. A-151).

By May 3, CH-6 and CH-2 were moving off the winter range. Both animals crossed the continental divide near Lewis and Clark Pass and reached spring range between lower Alice Creek and Landers Fork within 24 hours. This was the time between the aerial sighting on May 3 and the ground location on May 4. CH-9 remained east of the divide a few days longer, but arrived on the Spencer Bar area by May 7.

CH-6 eventually crossed Landers Fork and spent about 67 days in and near a burned area between Landers Fork and Copper Creek. She had a calf which was observed twice. CH-6 was always with or close by several other cows, and later in the season, cows with calves. By July 14, CH-6 had left the spring range and calving area and traveled to summer range on Red Mountain and North Fork Copper Creek in the Scapegoat Wilderness area. By November 11 she had retraced her steps to former spring range between Copper Creek and Landers Fork and by January 3 had recrossed the continental divide onto winter range. A winter range observation indicated she still had her calf by her side.

The movements of CH-2 were quite erratic during the spring of 1973. After reaching lower Landers Fork, she wandered throughout the area with other elk and then recrossed the continental divide into the East Fork Falls Creek (Dearborn River) drainage. She spent about 65 days in this area traveling widely back and forth. Finally she crossed into the West Fork and Middle Fork Falls Creek drainages and spent the remainder of the summer near the continental divide below Caribou Peak. By November 11 CH-2 had crossed the continental divide again to the Silver King Mountain area. She was still west of the divide on December 5 and by January 3, 1974 she was again on winter range east of the divide. CH-2 and CH-6, although widely separated during late spring and summer, were observed close together on their winter range.

During much of her travels, CH-2 was quite elusive and evaded visual observation. She spent much of her time in heavy timber. When she <u>was</u> seen, she was usually by herself, or at least no other animals were seen nearby.

CH-9 spent 30 days on and near Spencer Bar in company with several other cow elk and did not move as widely as did CH-2 and CH-6. However, when she finally <u>did</u> move off the spring calving area, she went in a hurry. On June 5 she was still on the calving area, but on June 6 she was located at a point up Landers Fork near Lone Mountain, having traveled about 8 airline miles overnight. The flight on June 6 was the last observation made on CH-9 due to a radio malfunction. She was searched for several times, but not found. Finally on October 17 or 18, 1973 she was killed by a hunter near Meadow Lake in T 16N, R 9W, Sec. 18 (center of south half). A bull calf, believed by the hunter's guide to belong to the dead cow was also killed at the same time and place. However, on July 11, 1973 a backpacker observed several cow elk, one wearing a "red" neckband, on the southwest side of Bugle Mountain in the Scapegoat Wilderness, west of, and across the drainage from where CH-9 was killed. CH-9 did have a bright red stripe on her blue collar which showed up readily. Previous observations of this collar showed that the red color showed up better than the blue color, and, depending on light conditions, frequently made the entire collar appear red. Since no other banded elk were known to be in this area, it is assumed that the hiker observed CH-9, and that CH-9 traveled at least as far into the Scapegoat Wilderness as Bugle Mountain.

CH-6 survived the winter of 1973-74, moving to several locations on the winter range during the period. She ranged west toward the continental divide for a short time, then returned to the main range. Between April 30 and May 4, 1974 she again crossed the continental divide on almost the same date as in 1973 and arrived on spring range. She was first found on May 4 in the same location where she spent most of her time in the spring of 1973 on the ridge between Landers Fork and Copper Creek.

On May 7 and 14 she was found about 2 miles east of there on the ridge between Landers Fork and Hardscrabble Creek in the McDonald Meadows area. She was never observed there in 1973, although she did move east of Landers Fork at least once, on June 6 of that year. She was in company with several other cows and yearlings on spring range in 1974, and observations indicated that one of the yearlings was hers. CH-6 did not have a new calf with her in 1974, as far as could be determined.

The movements of CH-6 in 1974 were quite different than in 1973. She did not move into the high country summer range as early in 1974 as she did in 1973. She stayed on the spring range until sometime between August 15 and September 3. While on the spring range she was seen with other cows and calves and also by herself. On September 3 and 14 she was in the Indian Meadows area. She was broadly located in Red Creek near Red Mountain on October 4, but the weather was too bad to determine a more exact location. Two subsequent flights on October 29 and November 14 failed to locate her signal. Finally on December 12 she was again located between Landers Fork and Copper Creek. She could not be located on January 15 and January 31, 1975, and not until February 26, 1975 was she again located, near Lewis and Clark Pass. She was still in this area on March 28, 1975, the last aerial sighting made on her prior to completion of this report. Her radio signal was practically inaudible on the last flight and it is believed the usefulness of her transmitter was about gone. However, a report of a cow elk wearing a "white" neckband was received by the game warden in Lincoln. The observation was made by a hiker in August 1975 on or near Bugle Mountain in the Scapegoat Wilderness. The neckband on CH-6 was blue with a white stripe which gave a "whitish" or "bluish-white" appearance from a distance. The hiker could have observed CH-6. No further observations of CH-6 have been made as of the date of this report.

CH-2 also made it through the 1973-74 winter. Although she did not travel as widely as CH-6, she did move to several different locations during the winter period. In the spring of 1974, in contrast to 1973, she did not cross to the west side of the continental divide, but went directly into East Fork Falls Creek, where she spent considerable time in 1973 prior to moving to higher summer range. She was observed in the East Fork on both May 7 and May 14, 1974. In 1973 she was west of the divide in the Landers Fork area between May 4 and May 11, but by May 14 had recrossed the divide and was on her way to the East Fork area.

Other movements of CH-2 in 1974 were also different than in 1973. After moving into the East Fork of Falls Creek she made her way into the West Fork and Middle Fork Falls Creek where she had spent considerable time in 1973. However, she suddenly left this area. On July 15 she was in this area but on July 19 she was observed all alone on the prairie about 4 miles east of Bean Lake, having traveled a distance of 13 air miles in 4 days. A week later she was back in the mountains with other elk and spent the rest of the summer in the Table Mountain-Falls Creek Ridge areas. Radio contact was lost between May 14 and June 27 for some unknown reason, so her whereabouts during this period are unknown. On October 4, 1974 she was still on the east slope of the continental divide, but by October 29 she had moved into the backcountry near Caribou Peak - the same area she occupied during the summer of 1973. She was still in this area on December 12. By January 15 she had moved into the Table Mountain area. She finally spent the rest of the winter of 1974-75 with other elk in the Cuniff Creek area near the Dearborn River. She did not return to the winter range where she was banded like she did in the winter of 1973-74. The last time she was observed prior to report completion was on August 24, 1975 (observations made since March 28, 1975 are not plotted on the maps in Appendix Y). Her radio was still operating, but at a significantly reduced level.

Both CH-2 and CH-6 eventually occupied the same summer range areas in 1974 as they used in 1973. The primary difference was in the time of occupancy. Both animals had similar movement behavior in 1974. They both stayed "outside" of their 1973 summer areas until late in the fall when both were observed in the areas they had occupied in 1973. Again, the exact location of CH-6 on October 4 was not determined, even though it was believed she was in the Red Mountain area. This behavioral difference may have been due to differences in climatic conditions in 1973 and 1974. The summer of 1973 was very dry, whereas 1974 was wetter. It may be that the elk did not have to move to higher summer range in 1974 because of the wetter summer conditions. However, the fall of 1974 was long and dry and may have forced the elk to higher range at a later time than was necessary in 1973.

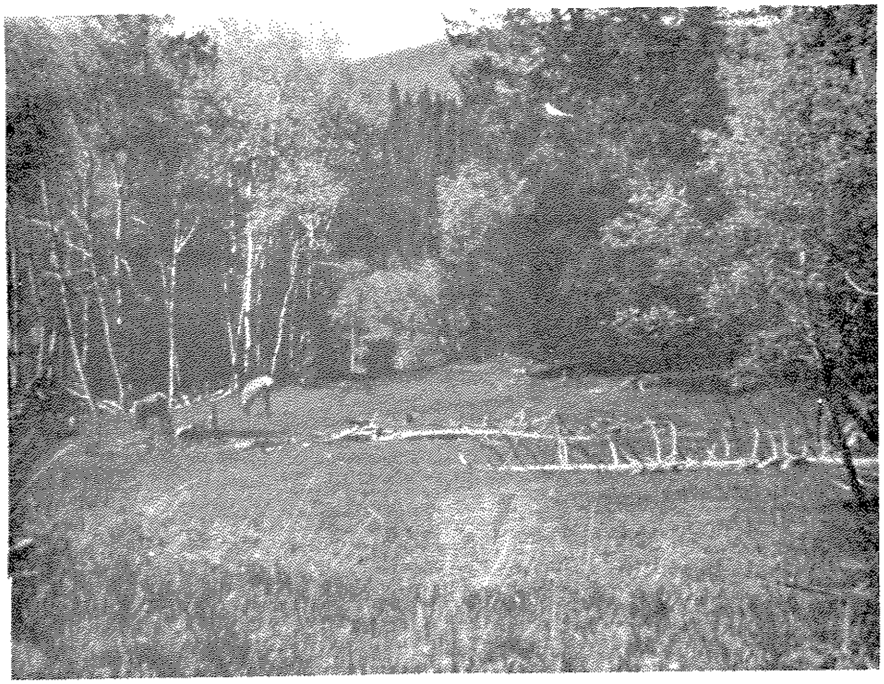
Radio telemetry data and aerial observations of elk established that Spencer Bar, Hardscrabble Basin and adjacent lands in lower Alice Creek and Landers Fork are important spring range and elk calving areas. Since only 3 elk from a wintering herd of over 100 animals were fitted with radios, and since 2 of the 3 animals migrated to and spent time on or near the Spencer Bar area, it is evident that this range is an important link in the life cycle of this herd. Elk utilizing this range are the same animals hunted in the fall in, and adjacent to, the Scapegoat Wilderness. Any decline in available spring range due to mining activities may have an adverse impact on animals in this herd.

Loss of spring range might be offset by an improvement in feed on the winter range east of the continental divide (see Figure 24). Cattle presently graze these mostly private lands heavily all summer, reducing available feed for wintering elk. Acquisition and/or improvement of critical elk winter range could provide for a healthier herd and a subsequent increase in calf production.

Cessna 180 aircraft used in tracking radioed elk. May 14, 1973.

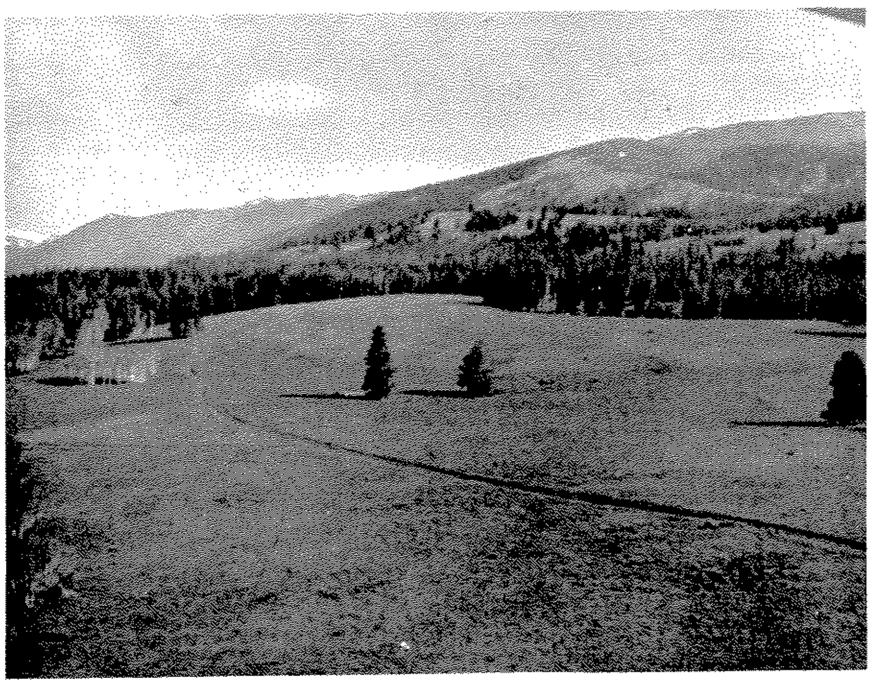
The potential increase in number of people in the Lincoln valley because of mining development could have an impact on elk utilizing the spring range. Local residents already drive into the Spencer Bar area to view the elk during the calving season. Local residents state, from their observations over many years, that the elk move farther away from roads as this public activity increases. Pickup-type campers were observed during the study to have stayed overnight in the middle of Spencer Bar during the spring period. The influx of several hundred people into the valley could increase public use of the calving area and further reduce the useful amount of area available for calving purposes. In fact, increased public use may be a significant factor as to whether the calving ground could continue to provide one of the basic needs of elk - security from harassment.

The calving areas shown in Figure 23 apparently supply basic needs for elk over and above those which can be supplied by other nearby areas. Otherwise concentrations of elk would have been found in these other areas. Thus there appears to be no alternative area(s) which can furnish these required spring needs. Any loss of the calving areas because of mining development means either greater concentrations of elk on remaining areas or a reduction in animals using the range.



Vegetated openings and adjacent timber cover provide food and security for elk on Spencer Bar. May 21 & 26, 1971.

Based on preliminary plans of the Anaconda Company, the tailings pond will cover a portion of the calving ground and eliminate elk use there. Should the proposed pond become a reality, elk use of the remaining calving area might be enhanced by controlling public or company access to it during the calving period. Should a tailings pond not be built, another consideration for improvement of the calving area is the tailings pond site itself. According to local residents and prior to the advent of increased vehicle use of the Alice Creek road, elk regularly utilized this grassland flat and adjacent hills east of the pond site. Very few elk presently use this area, possibly due to easy public access coupled with a lack of suitable escape cover. Thus there is potentially available a portion of spring range which could be used by elk if access to it were restricted during the spring. May and June are the critical months when elk occupy the area. If motorized vehicles could be controlled in Hardscrabble Basin during this period, increased elk use might be realized. Suitable agreements with private landowners would have to be made for this to be accomplished.



Easy public access to Spencer Bar and vicinity may influence successful use of this elk calving area. June 3, 1971.

Domestic sheep are grazed by the Sieben Ranch Company and/or Sieben Livestock Company on their own and other private lands in the calving area (see Figure 22). Sheep usually arrive on the area about July 1, and are removed in September. By the time the sheep arrive, most elk have left the calving area and gone to higher summer range. However, some elk spent the summer in the vicinity of the calving area. Other private lands in this area are grazed by cattle during the summer.

Suitable feed and other necessary habitat conditions on Spencer Bar and vicinity are apparently the reason the elk move there from east of the divide in the spring. Since there is more moisture west of the divide than on the east side, and competition from cattle is less, grasses and forbs are able to provide a needed "boost" for elk which usually winter on deficient feed. It is, therefore, important to maintain the productivity of the area for this purpose.

No range analysis was made in the calving area. In the spring, elk have first use of the newly growing grasses and forbs prior to sheep and cattle use. However, the extent of food competition, if any, between the elk, cattle and sheep should be investigated. Observations of the area gave the impression that overgrazing was not a major problem except at sheep-holding areas and around salt licks.

SUMMARY

With a few exceptions, water quality is high in the Blackfoot River and its tributaries. The Blackfoot River at Pop's Place and Willow Creek (Flesher) have lower water quality due to mine drainage, and Willow Creek (Flesher) may affect water quality in the main river below their confluence. Elk Creek and Union Creek, in the lower river, have lowered water quality due to agricultural activities.

All of the waters sampled had calcium and bicarbonate as the major ions. Acid mine drainage in the Mike Horse area caused an increase in sulfates at Pop's Place which were greater than in any of the other waters sampled. However, bicarbonates were still greater than sulfates at this station. Anaconda Company water quality data showed calcium, magnesium and sulfate to be the major ions in seepage water from mine tunnels. Poor quality water from mine seepage is improved by the time it reaches Pass Creek, but there are still chemical problems below this point for several miles.

The heavy metals iron, zinc, copper, arsenic and lead occur in the waters sampled, but these metals could not be detected in a significant number of the samples chemically analyzed. When metals were detected, iron occurred most frequently, followed by zinc, copper, arsenic and lead. Sediment analyses showed high concentrations of iron even in streams which have not been affected by mining activities. Thus iron occurrence in surface waters is from both natural and manmade sources.

Biological oxygen demand is low in the waters sampled. The highest BOD recorded was 3.0 mg/l at the Hogum station on the main river.

The numbers of coliform bacteria present in surface water were generally low at the sample stations. In two cases total coliforms exceeded 1000/100 ml, but 75 percent of the samples did not exceed 50/100 ml - the maximum amount recommended for Montana A-closed drinking water. Eighty-eight (88) percent of the analyses showed less than 10 fecal coliforms per 100 ml, well below the recommended maximum limit of 200/100 ml for $B\text{-}D_1$ waters.

Dissolved oxygen concentrations at all stations sampled were 7.0 mg/l or higher, and were 8.0 mg/l or higher at 83 percent of the stations sampled. These levels meet present Montana Water Quality Standards for $B\text{-}D_1$ waters. Diurnal oxygen variations over a 24-hour period ranged from 0.4-1.5 mg/l at six stations, and 56 percent of the variations were less than 1.0 mg/l.

pH ranged from 7.3-8.6 units with variations of 0.3-0.5 pH units over the 24-hour period.

Turbidity values recorded were extremely low at most stations except during spring runoff. Natural runoff from Landers Fork contributes almost all of the sediment to the Blackfoot River above Lincoln and downstream as far as Nevada Creek. Nevada Creek and the North Fork of the Blackfoot River also add to the sediment load of the main river. Most tributaries contribute some suspended sediment during high water, but are extremely clear (often less than 1.0 JTU turbidity) at other times of the year. Poor logging practices and road building on state land in Section 16, T 15N, R 7W on Alice Creek caused massive slumping of water-saturated soil into the creek, resulting in turbidity increases at the Highway 200 sample station. Corrective measures by the state of Montana should be undertaken on this problem. The turbidity of the main river at Flesher reached a maximum of 5.2 JTU in 1973 and was only 4.6 JTU in 1972. An increase in turbidity at this station will be a good indicator of man-caused sediment problems above the station.

Continuous temperature records kept by the U. S. Geological Survey at two gaging stations showed that surface water temperatures reached a maximum of 64.4 F in July and August at Pop's Place, and a maximum of 70.7 F at Hogum in August. Maximum summer temperatures may prevail for 2-3 weeks at a time, but the daily maximum temperature is cooled by 13-20 F during the night.

Hydrographs of streamflow in the main river above Landers Fork showed maximum flows occurred generally between April and July and minimum flows between August and March.

Landers Fork contributes most of the total discharge to the upper river and flows usually peak in the first week of June. The Blackfoot above Landers Fork may peak 2-3 weeks earlier, depending on air temperature and precipitation.

Bottom fauna populations were sampled at 11 stations. Populations are reduced at Pop's Place on the main river due to mine drainage upstream. Although the number of species and number of individuals was substantially reduced at Pop's Place, they had both greatly increased at the Flesher station 5 miles downstream, suggesting substantial recovery. The highest number of species found during a single sampling period was 53 at the Hogum station on the Blackfoot River. The next highest was 50 species in Alice Creek at highway 200. Samples from other stations contained from 25-45 species each. The highest number of species found at Pop's Place and Flesher was 16 and 32, respectively. The effect of Willow Creek (Flesher) on bottom fauna in the Blackfoot River is not known.

Trout populations were found in all streams sampled in the study area, except the Blackfoot River between Beartrap Creek and Pass Creek in the Mike Horse area. Catchable-sized trout are limited by physical habitat in the smaller streams, but nevertheless provided a fishery. Larger trout were found in the main river, especially below Lincoln. Indications were that natural reproduction occurred in all streams containing fish, and that resident cutthroat, brook and brown trout did not migrate long distances to spawn. Dolly Varden and mountain whitefish may move longer distances to spawn, but sufficient data to determine this were not obtained. The presence of trout in nearly all waters further indicates high water quality.

It is evident from electrofishing and bottom fauna data that fish and bottom fauna populations are depressed in the Blackfoot River near Pop's Place. Anaconda Company data established that high levels of metals, particularly zinc from the Mike Horse tunnel, flowed into the Blackfoot River from abandoned mines in the Mike Horse area.

However, the quality of water in the Blackfoot improves by the time it reaches the mouth of Pass Creek. Both cutthroat and brook trout occupied these waters. This water quality improvement is probably due to dilution and precipitation of toxic metals by surface and ground water inflow at the mouth of Pass Creek. However, chemical conditions were still not good enough below Pass Creek near Pop's Place to sustain a fishery consistent with the good physical habitat present in the stream. The exact downstream extent of the depressed biota is unknown, but it was greatly improved at the Flesher station 5 miles downstream.

Stream sediment analyses suggest that high concentrations of metals, particularly cadmium and zinc, in the stream substrate may have an indirect toxic effect on the stream biota. Immature insect forms living on the substrate may accumulate these metals in their systems from direct contact or through ingestion of other food organisms which live on the metal-laden substrate. The result could be a direct mortality of the more sensitive forms, or egg mortality during reproduction. Since trout also lay eggs in stream substrates during spawning, certain metals may have the same effect on them - increased mortality by absorption of the metals into deposited eggs. The result would be reduced recruitment of young fish to the stream population. Young-of-the-year trout were captured from the stream, indicating that reproduction was at least partially successful. Another possibility is that the lack of insect life reduced the fish food supply so that only the most competitive fish survived to adulthood.

Fish populations in the Blackfoot River below the mouth of Willow Creek (Flesher), when compared with those above, indicated some adverse influence of Willow Creek on the fishery. This would be due to mine drainage from Sandbar Creek which enters Willow Creek 3 miles upstream from its mouth.

Fish and wildlife species will be affected by the proposed mining development by direct loss of habitat. Increased pressure from a larger human population may also affect these populations.

Aerial and ground observations of elk distribution showed that Spencer Bar and adjacent lands are important elk calving areas. These areas are spring ranges for elk which winter on private land east of the continental divide and summer in or near the Scapegoat Wilderness area. This fact was documented by the use of radio collars placed on three cow elk in April 1973. The movements of two of these elk were monitored by aircraft until March 1975. The radio on the third elk stopped transmitting in June 1973, and the animal was killed by a hunter in October 1973 in the Scapegoat Wilderness.

A portion of the Spencer Bar elk calving area would be encroached upon by a proposed tailings pond and increased public use of the area during the spring calving period could have an adverse impact if development should occur.

Beaver habitat will be lost in the areas used for the proposed open pit mine, tailings pond and clarification pond. Reservoirs created by the tailings pond and clarification pond will alter existing fisheries. Metallic wastes from mill tailings may make the active tailings pond unsuitable for trout species which presently occupy waters in that area.

Present and potential subdivisions along the Blackfoot River near Lincoln will likely be more in demand than at present if the population of the valley increases. Such demand will pose an added threat to the natural meandering course of the river. Streambank stabilization projects will likely be requested by riverfront property owners. The cumulative result of such protection measures will be increased channel erosion and loss of fish habitat. Lincoln sits in a flood-prone area and any tampering with the streams could increase the flood hazard.

Proper planning by the mining company and local planning groups would greatly reduce the impact of development on the land, its fish and wildlife and the social structure of the Lincoln area. Fish and wildlife habitats which are destroyed or altered by mining development should be compensated for by purchase of other lands at the developer's expense. Lands in the Alice Creek area not actually needed for mining purposes should be turned over to the Montana Department of Fish and Game for management in accordance with the March 16, 1970 letter of agreement from the Anaconda Company to the Director, Montana Fish and Game Department.

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APPENDIX

APPENDIX A

Results of Laboratory Analyses

Laboratory analyses were conducted by the State Chemistry Laboratory, Helena. Only a partial record is given herein for those stations which had more than 12 samples analyzed. These stations are: Main River at Flesher, Hogum, Dalton, Canyon and Rainbow Bend; tributaries at Alice Creek and Poorman Creek. For these stations 12 sampling dates were selected which included the maximum, minimum and approximate average total dissolved solids for the station, with the remainder selected randomly over the sample period, but with the stipulation that each of the 12 months of the year are represented.

All values are given in mg/l except turbidity (JTU). Total hardness, alkalinity, CO_3 and HCO_3 are reported as mg/l $CaCO_3$. Alkalinity values are total and are calculated from HCO_3 and CO_3 values as follows (Hem, 1970, Pg 84):

(1) HCO_3 value X 0.8202 = bicarbonate alkalinity as $CaCO_3$

(2) CO_3 value (if any) ÷ 0.4917 X 0.8202 = carbonate alkalinity as $CaCO_3$

(3) (1) + (2) = total alkalinity as $CaCO_3$

Metals analyses are reported as total recoverable.

A zero entry means the value was less than the analytical detection level (except CO_3, which is the true value if pH was below 8.3). A blank in a column means no analysis was performed.

Prior to February, 1971 sodium and potassium values were determined by calculating the difference between the sum of the determined anions and the sum of the determined cations in milliequivalents/liter. Direct determiniations of these values by atomic absorption began in February, 1971 and resulted in increased accuracy in the cation-anion balance.

Water samples were collected in flowing water beneath the water surface in midstream whenever possible. During the period when only "total recoverable" metals were determined, a 1-liter Nalgene bottle was filled by submerging it beneath the water surface. "Dissolved" metals analyses required additional quantities of water, so a 2-quart plastic jug was filled at the same time that the 1-liter bottle was filled. The 1-liter sample was used for total recoverable metals and required no treatment. Water in the 2-quart jug was filtered through a .45 micron membrane filter into two 1-liter Nalgene bottles. One bottle received no further treatment. Three milliliters of 1:1 concentrated nitric acid (HNO_3) were added to the second bottle and the bottle shaken. Labels containing pertinent collection data were attached to each sample bottle.

Samples for nitrogen and phosphorus determination were collected in glass jars and immediately chilled in ice water to 4 C. The samples were transported to the laboratory the same day and analyses were immediately begun for those N and P compounds which are unstable.

APPENDIX A continued

BLACKFOOT RIVER AT POP'S PLACE

	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
2-17-68	0	186	90	0	73	79	3	0.0	0.3	60	28	5	26	0.08		0.40		0.00
3-17-68	0	156	110	0	49	74	3	2.2	0.50	40	20	15	5	0.14	0.00	0.44		0.00
4-21-68		76	70	0	61	10	2	0.00	0.10	50	10	11	0	0.04	0.00	0.07	0.00	0.00
5-25-68	0	80	60	0	43	29	1	.1	0	35	12	7	5	0	0	.22		0
6-20-68	0	100	65	0	61	13	1.5	0.07	0.20	50	22	2	6	0.02	0.00	0.30		0.00
7-22-68	0	142	160	0	72	37	9	0	0.04	59	13	36		0.2	0.00	.01		0.00
9-9-68	3	146	115	0	64	45	4	0		52	29	10	0	0.1		0.2		0

BLACKFOOT RIVER AT FLESHER PASS ROAD

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
2-17-68	0	124	70	0	100	21	3	0	.10	82	20	5	18	.08		.05		0
3-17-68	0	130	90	0	73	43	2	3.6	.28	60	20	10	9	0	0	.06		0
7-16-69	0	130	110	0	92	2	9	0	.10	75	20	15	12	0		.10		.18
10-7-69		124	190	0	104	39	8	0	.02	85	24	32	0	.10		0		0
1-20-70	0	90	90	0	100	3	5	0	.15	82	25	5	5	.04		.02		0
4-27-70		130	140	0	130	24	1.5	0	.20	107	30	20	0	0		.04		0
5-22-70		100	80	0	80	21	.5	.10	.10	66	12	12	6	.10		.04		0
6-23-71		110	87	0	130	0	0	.10	.30	107	20	8.6	1.5	.02		.04		0
9-21-71		80	85	0	79	0	0	.40	.20	65	20	8.5	1.5	0		.08		.01
11-22-71		110	83	0	85	37	0	.01	.20	70	20	8.2	2	.09		.12	0	.02
12-21-71		100	93	0	98	11	0	.04	.01	80	21	9.6	1.8	.02		.10	0	.02
8-17-73		152	92	0	106	11.9	1	.05	.10	87	21	9.6	2.4	.20	0	0	0	0

APPENDIX A continued

BLACKFOOT RIVER AT DALTON MTN ROAD BRIDGE

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
2-17-68	0	170	135	6	195	0	2	0	.10	170	28	16	17	.09		.02		0
4-21-68		150	105	0	200	0	4	0	.06	164	20	13	30	0	0	0	0	0
5-25-68	0	134	112	0	146	8	1	.10	0	120	29	10	3	0	0	0		0
6-20-68	8	88	102	0	140	6	4	.10	.10	115	40	1	10	.01	0	0		0
10-8-69		166	340	0	207	12	7	0	0	170	52	27	0	.10		.05		0
1-20-70	0	150	150	0	190	5	3	.10	.15	156	40	10	12	.04		0		0
7-21-70		150	190	0	210	2	0	0	.10	172	40	22	0	.10		.02		.03
8-20-70		160	240	0	200	8	0	0	.20	164	44	32	0	.10		0		.03
9-22-70		180	230	0	200	2	0	0	0	164	48	27	0	0		.06		0
11-22-71		150	110	0	200	7	0	0	.20	164	37	12	2.1	.01	0	0	0	.02
12-21-71		160	140	0	200	2.5	0	0	.10	164	39	12	2.1	0		.01	0	.02
3-5-73		261	165	0	193	7.5	0	.27	.10	158	45	13	2.5	.03	0	0	0	0

BLACKFOOT RIVER AT BLACKFOOT CANYON CAMP

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk.	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
2-17-68	0	180	130	0	210	0	1	0	.10	172	40	8	16	.06		0		0
5-25-68	0	110	112	0	122	10	1	.30	0	100	27	10		.60	0	0		0
6-20-68	9	130	103	0	140	14	2	.30	.10	115	38	1	16	.05	0	0		0
10-27-69		168	210	0	201	16	9	0	0	165	48	12	0	0		0		0
11-29-69		174	210	0	207	4	9	0	.16	170	44	32	0	0		0		0
1-20-70	0	160	155	0	195	5	3	0	.15	160	45	10	8	.06		0		0
7-21-70		150	140	0	200	2	0	0	.20	164	40	10	12	.02		.03		.06
8-20-70		160	150	0	190	8	0	.10	.20	156	44	17	0	.30		0		.03
9-22-70		150	210	0	200	6	0	0	.10	164	48	29	0	0		.03		0
4-27-71		110	110	0	140	10	1	.05	.10	115	32	7	1.4	.40		.30		.06
12-21-71		170	150	0	200	3.3	0	0	.10	164	42	12	2.2	0		0		.03
3-5-73		260	165	0	192	7.5	0	.40	.10	157	45	13	2	.02	0	0	0	0

APPENDIX A continued

BLACKFOOT RIVER AT HOGUM CREEK ROAD BRIDGE

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
2-17-68	0	130	105	0	140	0	2	0	.10	115	28	9	6	0		0		0
4-21-68		130	90	0	116	20	3	0	0	95	24	8	13	0	0	0	0	0
6-20-68	2	106	77	0	98	14	2.5	.30	.14	80	27	2	10	.14	0	.03		0
5-3-69	5	96	110	0	85	8	2	0		70	24	12	0	.20	0	0		0
7-16-69	0	108	130	0	116	9	6	0	.08	95	28	15	0	0		.02		.04
10-7-69		128	210	0	143	19	8	0	0	117	32	32	0	0		0		0
1-20-70	0	125	125	0	150	8	3	0	.15	123	30	10	10	.10		0		0
3-27-70	4	142	110	0	145	7	3	0	.30	119	26	11	10	0		0		0
8-20-70		130	180	0	150	9	0	0	.20	123	28	27	0	0		0		.03
9-22-70		130	180	0	150	10	0	0	.10	123	32	24		0		.02		0
11-22-71		130	108	0	140	14	0	0	.20	115	26	10	2.3	.02	0	.03	0	.02
12-21-71		120	110	0	140	8.6	0	.13	.10	115	28	11	2.4	0		.01		.01

BLACKFOOT RIVER BELOW 7-UP PETE CREEK

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
3-7-73		210	131	0	151	11	0	.05	.10	124	33	12	2.2	.06	0	.01	0	.01
8-20-73		210	135	2	157	0	0	.17	.10	133	36	11	2.4	.03	0	0	0	0

APPENDIX A continued

BLACKFOOT RIVER AT RAINBOW BEND

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk.	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
2-17-68	0	146	100	0	143	6	3	0.00	0.1	117	32	5	13	.09		0		0
5-25-68	0	110	80	0	98	7	1	.10	0	80	19	8	3	.50	0	0		0
6-20-68	8	60	84	0	110	6	3	.40	.10	90	31	1	9	.05	0	0		0
10-19-68	6	144	140	12	140	9	7	0	.38	135	28	17	7	0		0		0
7-16-69	0	118	130	0	140	3	6	0	.08	115	32	12	0	0		.03		0
11-29-69		140	180	0	171	2	8	0	.10	110	36	22	0	.12		0		0
1-20-70	0	135	125	0	160	7	3	.10	.15	131	30	10	13	.12		0		0
3-27-70	20	158	130	0	180	8	3	.60	.40	118	34	11	15	.20		0		0
4-21-70		170	140	0	180	3	.5	.40	.10	118	32	13	20	.01		0		0
8-20-70		150	190	0	170	6	0	0	.10	139	36	24	0	.02		0		.03
9-22-70		160	200	0	170	9	0	0	0	139	36	27	0	0		.06		0
12-17-70		170	200	0	180	7	0	.04	.10	118	44	22	0	.10		.08		0

PASS CREEK

	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
2-17-68	0	100	95	0	110	0	3	0.0	0.1	90	22	10	0	0.00		0.17		0.00
5-25-68	0	70	68	0	61	5	1	0.2	.16	50	19	5		0	0	0		0
9-9-68	1.5	98	90	0	95	2	4	0		78	26	6	0	0.0		0		0
1-2-69	0	68	80	0	84	0	5	0	0.28	69	16	10	0	0		0.0		0.0
3-28-69	15	96	130	0	91	3	11	0.6		75	24	17	0	0		0		0
6-16-69	0	86	80	0	88	0	6	0	0.40	72	32	0	1	0		.1		0
8-27-69	0	74	160	0	110	2	7	0	0	90	16.	29	0	0	0	0		0
11-29-69	-	86	90	0	110	0	8	0	0	90	28	5	6	0		0.00		0.00

SANDBAR CREEK

	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
7-16-69	27	88	150	0	55	11	7	0	0.10	45	12	29	0	2.5		0.01		0.02

APPENDIX A continued

WILLOW CREEK (FLESHER)

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
10-20-71		70	69	0	100	4.5	0	.10	.10	82	16	6.8	2	.16		0		.02
6-20-72		66	52	0	79	9.4	0	.26	.10	65	12	5.1	1.1	.27	.002	.01	.01	.01
8-31-72		70	74	0	86	0	0		.10	70	19	6.1	1.8		0	.01	0	0
9-26-72		80	75	0	83	.8	0	.13	.10	68	20	6.1	1.7		.002	0	0	0
10-31-72		88	93	0	80	3.7	.5	.13	.10	66	28	5.2	2.2	.33	0	0	0	0
3-7-73		130	78	0	81	21	0	.25	.10	66	18	8	2.3	.20	0	.01	0	0
5-14-73		92	49	0	57	11	0	.28	.05	47	11	5.2	6.8	.20		0	0	0
8-17-73		135	80	0	101	2.9	1.0	.10	.10	83	19	8	2.8	.29	0	0	0	0

ALICE CREEK

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
2-17-68	0	120	75	0	153	0	2	0	.10	125	44	4	2	0		0		0
1-2-69	0	120	140	0	140	0	5	0	0	115	24	20	0	0		0		0
6-16-69	0	126	120	0	145	0	4	0	.38	119	20	17	2	0		0		0
3-26-71		120	130	0	150	7	0	.05	.30	123	28	15	1.5	0		.03		0
4-27-71		80	90	0	100	4	0	.10	.10	82	24	7	1	.20		.72		.05
9-21-71		110	110	0	150	2.1	0	.20	.30	123	28	10	1.7	0		0		0
11-22-71		110	110	0	150	7	0	.04	.20	123	27	9.9	2	.90	0	.10	0	.03
12-21-71		100	110	0	150	0	0	.02	.10	123	27	10	1.8	0		0	0	.01
5-22-72		68	69	0	92	4	0	.36	.10	75	17	6.2	.9	.15	0	0	0	0
7-19-72		120	100	0	150	4.1	0	.20	.10	123	24	9.6	1.1	.06	.002	.02	.01	.01
10-31-72		110	110	0	140	0	0	.09	.10	115	30	8.8	2	0	0	0	0	.01
8-17-73		214	128	0	165	3.7	0	.04	.10	135	30	13	2.1	0	0	0	0	0

HARDSCRABBLE CREEK

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
10-20-71		170	150	0	210	0	0	.10	.10	172	38	14	4.2	.03		0		.01
3-23-72		130	110	0	150	0	0	.41	.10	123	28	9.7	2.8	.21	0	0	0	0
4-20-72		120	110	0	160	8.2	0	.44	.20	131	28	9.6	2.8	.09	0	0	0	.02
5-22-72		110	85	0	130	6	0	2.00	.10	107	22	7.2	2.3	.08	0	0	0	.01
7-19-72		170	140	0	210	1.6	0	.34	.10	172	34	12	3.2	.02	.002	.01	.01	.01
11-29-72		288	178	0	214	6.5	.5		.10	176	47	15	4.2	0	0	.01	0	.01
3-5-73		258	161	4	188	7	0	.09	.10	161	40	15	3.9	.11	0	.01	0	0

APPENDIX A continued

HORSEFLY CREEK

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
10-20-71		66	50	0	73	0	0	.10	.10	60	16	2.6	3.4	.08		0		.01

BLACK DIAMOND CREEK

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
10-20-71		70	68	0	100	0	0	.10	.20	82	19	4.7	3.5	.18		0		[illegible]

HOGUM CREEK

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
10-7-69		132	170	0	131	22	10	0	.18	107	28	24	0	.40		0		0
1-20-70	0	120	105	0	135	8	2	0	.20	111	30	5	13	.20		0		0
5-22-70		60	50	0	80	7	0	0	.30	66	12	5	10	.20		0		0
6-16-70		70	80	0	70	2	0	0	.30	57	20	7	0	0				
8-20-70		120	160	0	120	7	0	.20	.30	98	28	22	0	.50		0		.03
9-22-70		110	150	0	120	7	0	.20	.10	98	20	24	0	.10		.07		0
10-21-70		120	150	0	110	6	0	.10	.20	90	28	20	0	.16		.06		0
12-17-70		130	160	0	130	8	0	.06	.10	107	32	20	0	.30				
1-15-71		130	190	0	130	7	0	.04	.20	107	28	29	0	.20		.03		0
2-2-71		90	70	0	80	7	0	.10	.30	66	20	5	4.1	.30		.03		0

LANDER'S FORK

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
2-17-68	0	146	120	0	180	0	3	0	.10	148	36	9	12	0		0		0
5-25-68	0	130	100	0	122	6	1	.15	0	100	22	10	6	0	0	0		0
9-9-68	4	162	155	0	174	3	3	0		143	42	12	0	0		0		0
1-2-69	0	128	170	0	172	3	5	0	.28	141	36	15	0	0		0		0
3-28-69	0	130	150	0	152	12	4	0		125	36	15	0	0		0		0
6-16-69	0	116	130	0	151	0	4	0	.36	124	28	15	0	0		.46		0
8-27-69	0	132	210	0	177	1	6	0	0	145	36	39	0	0	0	0		0
11-29-69	0	124	190	0	85	5	9	0	0	70	40	22	0	.22		0		0
2-24-71		130	150	0	160	0	0	.10	.20	131	36	15	1	0		.03		0
3-5-73		218	139	0	163	5	0	.42	.10	134	36	12	1.5	0	0	0	0	0
5-10-73		159	86	2	116	3	0	.38	.02	98	28	8.8	1.1	.21	0	0	0	0

APPENDIX A continued

POORMAN CREEK

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
2-17-68	0	140	95	0	149	11	2	0	.20	122	30	5	19	0		0		0
5-25-68	0	100	96	0	121	12	1	.10	0	99	28	6	9	0	0	0		0
1-2-69	1	134	150	0	154	4	4	0	.02	126	36	15	0	0		0		0
3-26-71		120	110	0	150	16	0	.05	.30	123	40	2	1.3	0		.02		0
4-27-71		110	110	0	130	13	0	.05	.10	107	36	5	1	.20		.22		.02
8-23-71		140	130	0	160	1	0	.10	.20	131	37	9	2	0		.01		0
9-21-71		130	126	0	160	8	0	.20	.30	131	36	9	2.1	0		0		.02
12-21-71		150	130	0	160	9	0	0	.10	131	35	9.2	1.8	0		0	0	.01
6-20-72		130	110	0	170	12	0	.30	.10	139	31	7.2	.9	.03	.001	.01	.02	.01
7-19-72		140	120	0	160	12	0	.22	.10	131	34	8.4	1.3	.06	.002	.02	.01	.01
10-31-72		130	120	0	140	6	0	.13	.10	115	37	7.2	2	0	.001	0	0	0
11-29-72		209	126	0	146	16	.5		.10	120	37	8.4	1.5	0	0	.01	0	0

SPRING CREEK

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
2-17-68	0	180	150	0	220	0	3	0.0	0.1	180	40	12	17	0.08		0.00		0.00
5-25-68	0	180	148	0	201	4	1	.2	0	165	38	12	13	0	0	0		0
9-9-68	3	170	170	0	214	0	4	0		176	46	14	5	0.0		0		0
1-2-69	2	166	180	0	214	0	5	0.3	0.52	176	44	17	2	0		0.0		0.0
3-28-69	10	180	160	0	195	15	4	0.3	0.1	160	48	10	6	0.1		0		0
6-16-69	0	162	210	0	195	0	5	0	0.36	160	32	32	0	0		0		0
8-27-69	0	190	260	0	207	5	7	0	0	170	48	34	0	0	0	0		0
11-29-69	0	168	220	0	220	11	8	0	0.16	180	44	27	0	0.08		0.00		0.02

KEEP COOL CREEK

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
2-17-68	0	170	130	0	201	0	2	0.0	0.1	165	34	11	18	0.00		0.00		0.00
5-25-68	0	180	120	0	177	7	1	.1	0	115	35	8	16	.2	0	0		0
9-9-68	4	142	167	0	177	5	3	0		115	50	11	0	0.0		0		0
1-2-69	3	160	190	0	189	0	6	0	0.24	155	44	20	0	0.3		0.0		0.0
3-28-69	17	136	150	0	152	0	5	0		125	44	10	0	0		0		0
6-16-69	0	160	145	0	182	0	6	0	0.32	119	40	11	7	0		.02		0
8-27-69	0	164	260	0	189	3	9	0	0.02	155	44	36	0	0	0	0		0
11-29-69		164	190	0	201	1	8	0	0.08	165	48	17	0	0.10		0.00		0.00

APPENDIX A continued

BEAVER CREEK

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
2-17-68	0	150	120	0	186	0	2	0.0	0.1	152	40	5	16	0.00		0.00		0.00
5-25-68	0	110	76	0	104	8	1	.1	0	85	25	2	12	0	0	0		0
9-9-68	4	158	160	0	180	2	4	0		148	48	10	0	0.0		0		0
1-2-69	2	142	140	0	168	0	5	0	0	138	44	7	4	0		0.0		0.0
3-28-69	8	136	140	0	146	7	6	0.2		120	44	7	0	0.1		0		0
6-16-69	0	132	130	0	145	1	5	0	0.38	119	32	12	0	0		0		0
8-27-69	0	170	270	0	189	1	9	0	0	155	48	37	0	0	0.006	0		0
11-29-69		170	200	0	201	2	10	0	0.08	165	52	17	0	0.12		0.01		0.04

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WILLOW CREEK

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
3-17-68	5	100	55	0	88	11	3	3.6	0.38	72	14	5	12	0.12	0.00	0.00	0.00	0.00
6-20-68	15	100	73	0	98	6	2	0.50	0.14	80	27	1	9	0.12	0.00	0.00		0.00
10-19-68	4	104	100	0	116	8	7	0		95	28	7	7	0.1		0		0
2-8-68	6	114	110	0	112	10	5	0		92	24	12	0	0.1		0.0		0.0
5-3-68	20	78	70	0	49	8	3	0		40	16	7	0	0.5	0	0		0
7-16-68	17	88	70	0	73	17	8	0	0.10	60	20	5	9	0.4		0.01		0.02
10-7-69		138	180	0	122	15	8	0	0	100	28	27	0	0		0.02		0.0
1-20-70	0	90	75	0	90	4	3	0.1	0.15	74	25	5	0	0.14		0		0

SAUERKRAUT CREEK

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
10-20-71		50	39	0	61	0	0	.20	0	50	12	2.3	3	.C2		.01		.02

APPENDIX A continued

ARRASTRA CREEK

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
3-17-68	0	136	90	0	122	3	1	2.5	0.38	100	20	10	7	0.00	0.00	0.00	0.00	0.00
6-20-68	0	72	51	0	79	4	3.5	0.20	0.00	65	19	1	8	0.12	0.00	0.00		0.00
10-19-68	5	128	110	0	140	6	5	0		115	28	10	9	0.0		0		0
2-8-69	6	102	110	0	126	4	2	0		103	28	10	0	0.0		0.0		0.03
5-3-69	33	90	120	0	104	4	2			85	28	12	0	0	0	0		0
7-16-69	0	88	110	0	116	1	6	0	0.06	95	20	15	0	0		0.01		0.04
10=7-69		116	170	0	134	14	9	0	0.1	110	28	24	0	0.1		0.0		0.0
1-20-70	0	105	95	0	130	2	3	0	0.10	107	30	5	9	0.06		0		0

NORTH FORK BLACKFOOT RIVER

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
4-21-68		150	130	0	183	0	2	0.34	0.06	150	28	15	10	0.00	0.00	0.00	0.00	0.00
6-22-68	0	136	105	0	158	2	7	0	0.02	130	38	2	17	0.5	0.00	0		0.00
11-30-68	6	142	150	0	175	2	4	0.7		144	44	10	0	0		0		0
5-3-69	0	106	140	0	128	5	4	0		105	32	15	0	0	0	0		0
7-16-69	0	110	130	0	140	1	6	0	0.06	115	32	12	0	0		0.01		0.02
10=7-69		132	220	0	177	12	8	0	0	145	32	34	0	0		0.0		0.0
1-20-70	0	135	130	0	170	5	2	0	0.10	139	30	10	14	0		0.05		0

KLEINSCHMIDT CREEK

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
3-17-68	0	160	130	0	201	5	2	6.2	0.28	165	30	13	22	0.00	0.00	0.00	0.00	0.00
6-20-68	0	140	130	0	183	6	3	0.50	0.10	150	51	0	15	0.00	0.00	0.00		0.00
10-19-68	4	140	150	6	189	6	4	0.2		165	28	20	12	0.0		0		0
2-8-69	1	156	150	0	182	5	4	0		149	36	14	6	0.0		0.0		0.02
5-3-69	4	144	170	0	152	5	4	0		125	36	20	0	0	0.001	0		0
7-16-69	0-2	156	190	0	189	2	7	0	0.06	155	36	24	0	0		0.02		0.00
10-7-69		152	230	0	180	13	11	0	0	148	32	37	0	0		0.0		0.0
1-20-70	0	120	130	10	150	4	3	0.5	0.10	140	30	15	2	0.04		0		0.

WARREN CREEK

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
4-21-68		140	75	0	128	0	3	0.50	0.06	105	24	4	16	0.10	0.00	0.00	0.00	0.00
6-22-68	8	122	180	0	115	3	5	0	0.00	94	33	24		0.3	0.00	0.00		0.00
11-30-68	8	132	140	0	144	3	4	0.4	0.2	118	28	17	0	0.2		0		0

MONTURE CREEK

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
3-17-68	0	90	80	0	107	6	2	6.0	0.00	88	20	8	9	0.00	0.00	0.00	0.00	0.00
6-20-68	2	46	34	0	43	0	1	0.50	0.14	35	12	1	1	0.00	0.00	0.00		0.00
10-19-68	4	90	90	0	113	7	6	0	0	93	20	10	8	0.0		0.00		0.00
2-8-69	4	126	130	0	147	3	4	0		120	32	10	4	0.1		0.0		0.0
5-3-69	13	62	90	0	67	7	3	0		55	16	12	0	0.16	0	0		0
7-16-69	0	54	70	0	73	1	6	0	0.06	60	16	7	0	0		0.01		0.00
10-7-69		108	180	0	116	11	9	0	0	95	20	32	0	0		0.0		0.0
1-20-70	0	95	95	0	120	0	2	0.10	0.10	98	25	10	0	0.04		0		0

COTTONWOOD CREEK

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
4-21-68		150	125	0	127	20	3	0.50	0.00	104	28	14	20	0.00	0.00	0.00	0.00	0.00
7-22-68	0	176	180	0	187	2	6	0	0.00	153	46	16		0.0	0.00	0		0.00
11-30-68	7	154	160	0	182	2	4	0.5		149	34	18	0	0		0		0
5-3-69	7	132	140	0	128	7	7	0		105	36	12	0	0.1	0	0		0
7-16-69	0	164	170	0	177	1	6	0	0.10	145	40	15	0	0		0.02		0.00

CLEARWATER RIVER

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
3-17-68	5	86	70	0	97	3	3	8.9	0.00	80	14	9	10	0.10	0.00	0.00	0.00	0.00
6-20-68	0	60	48	0	73	0	3	0.50	0.04	60	19	0	8	0.00	0.00	0.02		0.00
10-19-68	4	90	80	0	110	4	3	0		90	20	7	6	0.0		0		0
2-8-69	6	84	80	0	98	2	4	0		80	16	10	3	0.0		0.0		0.03
5-3-69	10	80	80	0	73	4	3	0		60	20	7	0	0	0	0		0
7-16-69	0	64	90	0	85	0	6	0	0.08	70	20	10	0	0		0.01		0.00
10-7-69		90	160	0	122	7	8	0	0	100	28	22	0	0		0.0		0.0
1-20-70	0	105	95	0	125	0	1	0.10	0.15	102	30	5	5	0.06		0		0

APPENDIX A continued

BLANCHARD CREEK

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
4-21-68		60	35	0	55	0	2	0.00	0.00	45	8	4	5	0.07	0.00	0.03	0.00	0.00
7-22-68	Dry										Dry							
11-30-68	8	86	100	0	98	0	4	0.1		80	18	13	0	0		0		0

ELK CREEK

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
3-17-68	65	180	115	0	174	14	2	3.2	0.28	143	38	5	22	0.62	0.00	0.00	0.00	0.00
6-20-68	18	186	120	0	165	12	3	0.60	0.28	135	44	2	17	0.25	0.00	0.00		0.00
10-19-68	4	168	150	6	171	13	5	0		150	40	12	10	0.0		0		0
5-3-69	285	128	110	0	92	7	4	0		75	28	10	0	0.9	0	0		0
7-16-69	24	136	130	0	146	7	8	0	0.18	120	32	12	4	0		0.02		0.00
10-7-69		188	220	0	189	13	9	0	0.1	155	44	27	0	0.1		0.2		0.0

BELMONT CREEK

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
4-21-68	-	110	80	0	116	0	3	0.00	0.00	95	24	5	10	0.05	0.00	0.00	0.00	0.00
7-22-68	0	160	210	0	173	0	5	0	0.00	142	68	10		0.4	0.00	0.00		0.00
11-30-68	7	154	190	0	175	0	4	0		144	44	20	0	0		0		0

UNION CREEK

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
3-17-68	44	190	105	0	155	11	6	1.2	0.10	127	24	11	20	0.40	0.00	0.00	0.00	0.00
6-20-68	25	242	165	0	232	8	2	0.60	0.24	190	62	2	19	0.45	0.00	0.00		0.00
10-19-68	10	242	210	6	256	11	6	0		220	48	22	1	0.16		0		0
2-8-69	9	206	210	0	238	8	5	0		195	44	24	2	0.1		0.0		0.02
3-28-69	200	150	120	0	122	18	6	0		100	28	12	5	0.8		0		0
6-16-69	15	168	175	0	207	0	7	0	0.28	170	28	26	3	0.36		.06		0
8-27-69	20	242	310	0	232	11	10	0.9	0.1	190	40	51	0	0.4	.004	0		0
11-29-69		220	260	0	275	12	11	0	0.12	226	48	34	0	0.22	-	[illegible]		0.02

APPENDIX A continued

GOLD CREEK

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
4-21-68		100	95	0	104	0	2	0.00	0.00	85	20	11		0.00	0.00	0.00	0.00	0.00
7-22-68	0	110	125	0	122	4	5	0	0.00	100	32	11		0.0	0.00	0.00		0.00
11-30-68	7	100	120	0	119	0	4	0		98	28	12	0	0.4		0		0

EAST TWIN CREEK

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	No3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
3-17-68	11	44	10	0	27	8	2	2.7	0.44	22	4	0	12	0.18	0.00	0.00	0.00	0.12
6-20-68	0	24	8	0	24	0	2	0.20	0.10	20	2	1	5	0.06	0.00	0.00		0.00
10-19-68	7	50	20	0	36	5	3	0		30	8	0	9	0.0		0.01		0

WEST TWIN CREEK

Date	Turb	TDS	Hard	CO3	HCO3	SO4	Cl	NO3	F	Calc. Alk	Ca	Mg	Na&K	Fe	As	Zn	Pb	Cu
3-17-68	3	24	10	0	21	0	2	0.23	0.34	17	4	0	5	0.08	0.00	0.00	0.00	0.00
6-20-68	0	10	7	0	6	0	2	0.00	0.04	5	3	0	0	0.05	0.00	0.00		0.00
10-19-68	7	30	40	0	34	4	2	0	0.26	28	2	8	0	0.0		0		0

APPENDIX B

Minimum and Maximum Values of Chemical Constituents (mg/l) and Where the Values Occurred

Turbidity (JTU)

Main River - Minimum <dl* at all stations. Maximum 20 at Rainbow Bend.

Tributaries - Minimum <dl at Hogum Creek. Maximum 285 at Elk Creek.

(The above values are from infrequent (usually monthly) sampling and probably do not present a true turbidity picture (particularly higher values). See section on turbidity for more complete data.)

Total Residue

Main River - Minimum 60* at Rainbow Bend. Maximum 261 at Dalton.

Tributaries - Minimum 10 at West Twin Creek. Maximum 288 at Hardscrabble Creek.

Total Hardness

Main River - Minimum 60 at Pop's Place, Flesher, Canyon. Maximum 340 at Dalton.

Tributaries - Minimum 7 at West Twin Creek. Maximum 310 at Union Creek.

Total Alkalinity (Calculated)

Main River - Minimum 35 at Pop's Place. Maximum 189 at Dalton.

Tributaries - Minimum 5 at West Twin Creek. Maximum 226 at Gold Creek.

*<dl = less than analytical detection level

Carbonate, CO_3^-

Main River - Minimum <dl at all stations. Maximum 12 at Rainbow Bend.

Tributaries - Minimum <dl at all stations. Maximum 24 at Poorman Creek.

(Unpolluted, natural waters normally have extremely low amounts of CO_3 due to a buffering capacity which changes the CO_3 to HCO_3 (bicarbonate) below pH 8.3.)

Bicarbonate HCO_3^-

Main River - Minimum 43 at Pop's Place. Maximum 230 at Dalton.

Tributaries - Minimum 6 at West Twin Creek. Maximum 275 at Union Creek.

(The principal anion in all waters sampled was HCO_3.)

Sulfate, SO_4^-

Main River - Minimum <dl at Flesher, Hogum, Dalton, Canyon. Maximum 79 at Pop's Place.

(The higher values found at Pop's Place are due to acid mine drainage from sulfide ore in several old mines in the Heddleston District.)

Tributaries - Minimum <dl at 21 of 29 stations. Maximum 22 at Hogum Creek.

Cloride, Cl^-

Main River - Minimum <dl at all but Pop's Place (1.0). Maximum 25 at Rainbow Bend.

Tributaries - Minimum <dl at 8 of 29 stations. Maximum 11 at Pass Creek, Kleinschmidt Creek, and Union Creek.

(High chloride levels are usually one sign of a stream polluted by domestic sewage.)

Nitrate, NO_3^-

Main River - Minimum <dl at all stations except 7-up Pete (.05). Maximum 5.3 at Hogum.

Tributaries - Minimum <dl at 24 of 29 stations. Maximum 8.90 at Clearwater River.

Fluoride, F^-

Main River - Minimum <dl at all stations except 7-up Pete (.10). Maximum .50 at Pop's Place.

Tributaries - Minimum <dl at 17 of 29 stations. Maximum 2.0 at Hardscrabble Creek.

Calcium, Ca^+

Main River - Minimum 10 at Pop's Place. Maximum 56 at Canyon.

Tributaries - Minimum 2 at both East Twin and West Twin Creeks. Maximum 68 at Belmont Creek.

(Calcium was the most abundant cation found in the waters sampled.)

Magnesium, Mg^+

Main River - Minimum <dl at Canyon. Maximum 39 at Hogum.

Tributaries - Minimum <dl at Pass Creek, Clearwater River, East Twin Creek and West Twin Creek. Maximum 51 at Union Creek.

(Magnesium was the second most abundant cation found in the waters sampled.)

Sodium and Potassium, $Na^+ + K^+$

Main River - Minimum <dl at all stations except 7-up Pete (.03). Maximum 33 at Canyon.

Tributaries - Minimum <dl at 23 of 29 stations. Maximum 22 at Kleinschmitt and Elk Creeks.

Total Recoverable Iron, Fe

Main River - Minimum <dl at all stations except 7-Up Pete (.03). Maximum 1.5 at Canyon.

Tributaries - Minimum <dl at 20 of 29 stations. Maximum 2.5 at Sandbar Creek.

Dissolved Iron, Fe

Main River (analyzed at 3 of 6 stations only) - Minimum <dl at all stations except 7-up Pete (.03). Maximum .19 at Dalton.

Tributaries (analyzed at 7 of 29 stations only) - Minimum <dl at Alice Creek, Hardscrabble Creek, Landers Fork, and Poorman Creek. Maximum .20 at Willow Creek (Flesher).

Total Recoverable Arsenic, As

Main River - Minimum <dl at all stations. Maximum .008 at Rainbow Bend.

Tributaries - Minimum <dl at all stations. Maximum .006 at Beaver Creek.

Total Recoverable Zinc, Zn^{+}

Main River - Minimum <dl at all stations except Pop's Place (.01). Maximum 0.94 at Flesher.

Tributaries - Minimum <dl at 27 of 29 stations. Maximum 0.72 at Alice Creek.

Dissolved Zinc, Zn^{+}

Main River (analyzed at 4 of 7 stations only) - Minimum <dl at all four stations. Maximum 0.17 at Flesher.

Tributaries (analyzed at 8 of 29 stations only) - Minimum <dl at all 8 stations. Maximum 0.02 at Alice Creek and Hardscrabble Creek.

Total Recoverable Lead, Pb^{+}

Main River - Minimum <dl at all stations. Maximum 0.01 at Flesher, Dalton and Canyon.

Tributaries (analyzed at 20 of 29 stations only) - Minimum <dl at all 20 stations. Maximum of 0.02 at Poorman Creek.

Dissolved Lead, Pb^{+}

Main River (analyzed at 4 of 7 stations only) - Minimum <dl at all 4 stations. Maximum 0.01 at 3 of the 4 stations.

Tributaries (analyzed at 5 of 29 stations only) - Minimum <dl at all stations. Maximum 0.01 at 4 of 5 stations.

Total Recoverable Copper, Cu^{+}

Main River - Minimum <dl at all stations. Maximum 0.18 at Flesher.

Tributaries - Minimum <dl at 24 of 29 stations. Maximum 0.12 at East Twin Creek.

Dissolved Copper, Cu^{+}

Main River (analyzed at 4 of 7 stations only) - Minimum <dl at all 4 stations. Maximum 0.02 at all stations except 7-up Pete (<dl)

Tributaries (analyzed at 8 of 29 stations only) - Minimum <dl at 5 of 8 stations. Maximum 0.02 at 4 of 8 stations.

Nitrogen as Nitrite NO_2-N

Main River (analyzed at 3 of 7 stations only) - Minimum <dl at all stations. Maximum 0.002 at Dalton.

Tributaries (analyzed at 4 of 29 stations only) - Minimum <dl at all stations. Maximum 0.003 at Alice Creek.

Nitrogen as Ammonia, NH_3-N

Main River (analyzed at 3 of 7 stations only) - Minimum and maximum <dl at all stations.

Tributaries (analyzed at 4 of 29 stations) - Minimum and maximum <dl at all stations.

Nitrogen as Nitrate NO_3-N

Main River (analyzed at 3 of 7 stations only) - Minimum 0.01 at Flesher and Canyon. Maximum 0.60 at Canyon.

Tributaries - (analyzed at 4 of 29 stations only) - Minimum 0.01 at Alice Creek. Maximum 0.45 at Hardscrabble Creek.

Organic Nitrogen

Main River (analyzed at 3 of 7 stations only) - Minimum <dl at Flesher. Maximum 0.85 at Dalton.

Tributaries (analyzed at 4 of 29 stations only) - Minimum <dl at Willow Creek (Flesher) and Alice Creek. Maximum 1.5 at Poorman Creek.

Total Phosphate, PO_4^-

Main River (analyzed at 3 of 7 stations only) - Minimum <dl at all 3 stations. Maximum 0.19 at Canyon.

Tributaries (analyzed at 4 of 29 stations only) - Minimum 0.01 at Alice Creek and Poorman Creek. Maximum 0.10 at Poorman Creek.

Ortho Phosphate, PO_4^-

Main River (analyzed at 3 of 7 stations only) - Minimum <dl at all 3 stations. Maximum 0.04 at Canyon.

Tributaries (analyzed at 4 of 29 stations only) - Minimum <dl at Poorman Creek and Hardscrabble Creek. Maximum 0.08 at Hardscrabble Creek.

APPENDIX C

Analytical Detection levels of Chemical Constituents

Constituents		Minimum Detection Level (mg/1)	
Residue, total		10	
Hardness, total		.1	
CO_3	(above pH 8.3)	6 1.2	Prior to July 1972 since July 1972
HCO_3		6 1.2	Prior to July 1972 since July 1972
SO_4		1.0	
Cl		1.0 .5	Prior to June 1972 since June 1972
NO_3		.01	
F		.05	
Ca		.1	
Mg		.1	
Na		.1	since Feb. 1971*
Fe		.01	
As		.001	
Zn		.01	
Pb		.01	
Cu		.01	
NO_2-N		.001	
NH_3-N		.01	
NO_3-N		.01	
Org. N		.01	
PO_4, total		.01	
PO_4, Ortho		.01	

*Prior to February 1971, Na was calculated. Since then it has been measured directly by atomic absorption.

Note: In all cases except NO_2-N and Arsenic (As), results are reported to two significant figures. NO_2-N and As are reported to three significant figures.

Summary of Laboratory Analyses with Chemical Results Less Than and Greater Than the Analytical Detection Level

Samples collected during the period February 1968 through August 1973. Main river stations are given in descending order downstream followed by tributaries in descending order downstream.

RM	=	River Mile
N	=	Sample size, or total number of laboratory analyses made during the period.
dl	=	Analytical detection level of chemical constituent (see Appendix C).
N $<$ dl	=	Number of analyses with chemical results less than the detection level.
% $<$ dl	=	Percent of analyses with chemical results less than the detection level.
Range $>$ dl	=	Lowest (L) and highest (H) chemical results which were greater than the detection level.
$\bar{X} >$ dl	=	Average value of chemical results which were greater than the detection level

All values in mg/liter except turbidity (JTU).

A blank space in a column means all values were less than the detection level. Numbers in parentheses indicate only one value was greater than the detection level. A dash (-) indicates no data were collected. When all spaces below a dash (-) are blank, this indicates no data were collected.

Analyses were done in accordance with Standard Methods for the Examination of Water and Wastewater, current edition.

APPENDIX D continued

	Turbidity (JTU)	Total Residue	Total Hardness	Total Alkalinity (Calc.)	CO_3	HCO_3	SO_4	Cl	NO_3	F	Ca	Mg	Na	Total Recoverable Fe	As	Zn	Pb	Cu	Dissolved Fe	Zn	Pb	Cu
Blackfoot River at Pop's Place (RM 119.4)																						
N	6	8	8	8	8	8	8	8	8	8	8	8	7	8	6	8	2	8	-	-	-	-
N < dl	5	0	0	0	0	0	0	0	4	1	0	0	2	1	6	0	2	8				
% < dl	83	0	0	0	0	0	0	0	50	13	0	0	29	13	100	0	100	100				
Range > dl L	(3)	76	60	35	0	43	10	1	.07	.04	10	2	5	.02		.01						
Range > dl H		186	160	62	0	76	79	9	2.2	.50	29	36	26	.27		.44						
$\bar{X}$ > dl	(3)	130	96	51	0	62	41	3.4	.60	.18	20	12	8.8	.12		.22						
Blackfoot River at Flesher Road (RM 114.6)																						
N	-	41	41	41	41	41	41	41	41	36	41	41	39	48	20	48	15	48	13	15	14	15
N < dl	-	0	0	0	0	0	2	19	20	3	0	0	13	16	17	8	13	36	3	3	13	9
% < dl	-	0	0	0	0	0	5	46	49	8	0	0	33	33	85	15	87	75	23	20	87	60
Range > dl L	-	80	60	55	0	67	2	.5	.01	.01	12	2	1	.01	.001	.02	.01	.01	.01	.03	(.01)	.01
Range > dl H	-	152	220	125	0	152	43	9	3.6	.34	32	37	18	.5	.002	.94	.01	.18	.11	.17		.02
$\bar{X}$ > dl	-	115	111	80	0	98	22	4.2	.29	.15	22	14	4.8	.12	.001	.11	.01	.03	.04	.09	.01	.01
Blackfoot River at Hogum Road (RM 110.7)																						
N	15	26	26	26	26	26	26	26	26	21	26	26	25	26	7	25	2	25				
N < dl	9	0	0	0	0	0	1	4	20	5	0	0	11	19	7	19	2	21				
% < dl	67	0	0	0	0	0	4	15	77	24	0	0	44	73	100	76	100	84				
Range > dl L	2	96	76	65	0	79	2	.5	.1	.08	14	2	1	.08		.01		.02				
Range > dl H	9	142	230	125	0	152	20	8	5.3	.36	32	39	21	.6		.03		.06				
$\bar{X}$ > dl	4.7	124	128	107	0	131	9.3	3.7	1.0	.20	27	16	8.5	.26		.02		.04				

APPENDIX D continued

Blackfoot River Below 7-Up Pete Creek (RM 106.2)

		Turbidity (JTU)	Total Residue	Total Hardness	Total Alkalinity (Calc.)	CO_3	HCO_3	SO_4	Cl	NO_3	F	Ca	Mg	Na	Total Recoverable Fe	Total Recoverable As	Total Recoverable Zn	Total Recoverable Pb	Total Recoverable Cu	Dissolved Fe	Dissolved Zn	Dissolved Pb	Dissolved Cu
N		-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
N < dl		-	0	0	0	0	0	1	2	0	0	0	0	0	0	2	1	2	1	0	1	2	2
% < dl		-	0	0	0	0	0	50	100	0	0	0	0	0	0	100	50	100	50	0	50	100	100
Range > dl	L	-	210	131	124	0	151	(11)		.05	.1	33	11	2.2	.03		(.01)		(.01)	.03	(.01)		
	H	-	210	135	133	2	157			.17	.1	36	12	2.4	.06					.06			
$\bar{X}$ > dl		-	210	133	129	1	154	(11)		.11	.1	34	12	2.3	.04		(.01)		(.01)	.04	(.01)		

Blackfoot River at Dalton Mountain Road Bridge (RM 95.9)

		Turbidity (JTU)	Total Residue	Total Hardness	Total Alkalinity (Calc.)	CO_3	HCO_3	SO_4	Cl	NO_3	F	Ca	Mg	Na	Total Recoverable Fe	Total Recoverable As	Total Recoverable Zn	Total Recoverable Pb	Total Recoverable Cu	Dissolved Fe	Dissolved Zn	Dissolved Pb	Dissolved Cu
N		17	42	41	42	41	42	42	41	41	36	41	41	41	48	20	50	15	50	12	14	13	14
N < dl		9	0	0	0	0	0	9	15	24	6	0	0	16	24	15	29	13	37	7	12	11	9
% < dl		53	0	0	0	0	0	21	37	59	17	0	0	39	50	75	58	87	74	58	86	85	64
Range > dl	L	1	88	102	110	0	134	1.6	.5	.03	.06	20	1	1.3	.01	.002	.01	.01	.01	.01	.01	.01	.01
	H	9	261	340	189	6	230	12	7	2.8	.3	52	37	30	1.3	.002	.59	.01	.07	.19	.01	.01	.02
$\bar{X}$ > dl		2.1	161	167	154	.24	187	5.8	3.7	.29	.16	39	16	6.8	.26	.002	.08	.01	.02	.06	.02	.01	.01

Blackfoot River at Blackfoot Canyon Camp (RM 84.7)

		Turbidity (JTU)	Total Residue	Total Hardness	Total Alkalinity (Calc.)	CO_3	HCO_3	SO_4	Cl	NO_3	F	Ca	Mg	Na	Total Recoverable Fe	Total Recoverable As	Total Recoverable Zn	Total Recoverable Pb	Total Recoverable Cu	Dissolved Fe	Dissolved Zn	Dissolved Pb	Dissolved Cu
N		14	40	40	40	40	40	40	40	40	36	40	40	38	47	19	47	15	47	11	14	13	14
N < dl		7	0	0	0	0	0	8	17	20	4	0	1	17	21	14	26	13	34	7	10	11	7
% < dl		50	0	0	0	0	0	20	43	50	11	0	3	45	45	74	55	87	72	64	71	85	50
Range > dl	L	1.5	110	60	100	0	122	.4	.5	.01	.02	24	1	1.2	.02	.001	.01	.01	.01	.01	.01	.01	.01
	H	10	260	250	180	6	220	16	9	1.4	.4	56	32	33	1.5	.007	.30	.01	.06	.06	.01	.01	.02
$\bar{X}$ > dl		4.6	166	166	154	.2	187	5.5	3.0	.26	.17	41	16	8.5	.27	.003	.05	.01	.02	.04	.01	.01	.01

APPENDIX D continued

	Turbidity (JTU)	Total Residue	Total Hardness	Total Alkalinity (Calc.)	CO_3	HCO_3	SO_4	Cl	NO_3	F	Ca	Mg	Na	Total Recoverable Fe	As	Zn	Pb	Cu	Dissolved Fe	Zn	Pb	Cu

Blackfoot River at Rainbow Bend (RM 9.7)

	Turbidity (JTU)	Total Residue	Total Hardness	Total Alkalinity (Calc.)	CO_3	HCO_3	SO_4	Cl	NO_3	F	Ca	Mg	Na	TR Fe	As	Zn	Pb	Cu	Diss. Fe	Zn	Pb	Cu
N	17	30	30	30	30	30	30	30	30	26	30	30	30	30	7	29	2	29	-	-	-	-
N < dl	7	0	0	0	0	0	3	8	16	5	0	0	16	10	6	19	2	25				
% < dl	41	0	0	0	0	0	10	27	53	19	0	0	53	33	86	66	100	14				
Range > dl L	2	60	80	85	0	98	.4	.5	.04	.02	19	1	1	.01	(.008)	.01		.02				
H	20	170	230	148	12	180	10	31	4.0	.44	46	34	20	1.0		.08		.06				
$\bar{X}$ > dl	8	137	148	128	.4	155	5.8	4.8	.54	.17	33	16	7.5	.24	(.008)	.04		.04				

Pass Creek (RM 120.4-0.8)

	Turbidity (JTU)	Total Residue	Total Hardness	Total Alkalinity (Calc.)	CO_3	HCO_3	SO_4	Cl	NO_3	F	Ca	Mg	Na	TR Fe	As	Zn	Pb	Cu	Diss. Fe	Zn	Pb	Cu
N	7	8	8	8	8	8	8	8	8	6	8	8	7	8	2	8	-	8	-	-	-	-
N < dl	5	0	0	0	0	0	4	0	6	2	0	1	5	8	2	6	-	8				
% < dl	71	0	0	0	0	0	50	0	75	33	0	13	71	100	100	75	-	100				
Range > dl L	1.5	68	68	50	0	61	2	1	.2	.10	16	5	1			.10	-					
H	15	100	160	90	0	110	5	11	.6	.40	32	29	6			.17	-					
$\bar{X}$ > dl	8.1	85	99	77	0	94	3	5.6	.40	.24	.23	12	3.5			.14	-					

Sandbar Creek (RM 114.3-2.8-0.1)

	Turbidity (JTU)	Total Residue	Total Hardness	Total Alkalinity (Calc.)	CO_3	HCO_3	SO_4	Cl	NO_3	F	Ca	Mg	Na	TR Fe	As	Zn	Pb	Cu	Diss. Fe	Zn	Pb	Cu
N	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-	1	-	1				
N < dl	0	0	0	0	0	0	0	0	1	0	0	0	1	0	-	0	-	0				
% < dl	0	0	0	0	0	0	0	0	100	0	0	0	100	0	-	0	-	0				
Range > dl L	(27)	(88)	(150)	(45)	(0)	(55)	(11)	(7)		(.10)	(12)	(29)		(2.5)	-	(.01)	-	(.02)				
H																						
$\bar{X}$ > dl	Same as Range > dl																					

APPENDIX D continued

	Turbidity (JTU)	Total Residue	Total Hardness	Total Alkalinity (Calc.)	CO_3	HCO_3	SO_4	Cl	NO_3	F	Ca	Mg	Na	Total Recoverable Fe	As	Zn	Pb	Cu	Dissolved Fe	Zn	Pb	Cu
Willow Creek (Flesher) (RM 114.3-0.0)																						
N	-	8	8	8	8	8	8	8	6	8	8	8	8	6	6	8	7	8	6	8	7	8
N < dl	-	0	0	0	0	0	1	6	0	0	0	0	0	0	4	5	6	6	0	7	6	6
% < dl	-	0	0	0	0	0	13	75	0	0	0	0	0	0	57	63	86	75	0	88	86	75
Range > dl L	-	66	49	47	0	57	.8	.5	.10	.05	11	5.2	1.1	.16	.002	.01	(.01)	.01	.07	(.01)	(.01)	.01
Range > dl H	-	135	93	83	0	101	21	1.0	.28	.10	28	8.0	6.8	.33	.002	.01		.02	.20			.01
$\bar{X}$ > dl	-	91	71	68	0	83	7.6	.8	.19	.09	18	6.4	2.6	.24	.002	.01	(.01)	.02	.17	(.01)	(.01)	.01
Alice Creek at Highway 200 (RM 113.2-0.9)																						
N	7	30	30	30	30	30	30	30	29	28	30	30	30	28	15	30	15	30	13	15	14	15
N < dl	5	0	0	0	0	0	13	21	8	4	0	0	5	14	12	18	11	21	8	13	12	11
% < dl	71	0	0	0	0	0	43	70	28	14	0	0	17	50	80	60	73	70	62	87	86	73
Range > dl L	3	68	69	61	0	74	1	.5	.02	.03	16	4	.9	.01	.001	.01	.01	.01	.02	.01	.01	.01
Range > dl H	9	214	240	135	0	165	11	7	.36	.38	44	39	5.2	.90	.002	.72	.01	.06	.07	.02	.01	.01
$\bar{X}$ > dl	6	120	116	110	0	135	5.7	3.9	.15	.15	27	13	1.6	.18	.002	.11	.01	.02	.05	.02	.01	.01
Hardscrabble Creek (RM 112.5-0.5)																						
N	-	9	9	9	9	9	9	9	9	9	9	9	9	9	8	9	8	9	9	9	8	9
N < dl	-	0	0	0	0	0	3	7	0	0	0	0	0	1	7	5	7	4	2	8	7	6
% < dl	-	0	0	0	0	0	33	78	0	0	0	0	0	11	88	56	88	44	78	11	13	33
Range > dl L	-	110	85	107	0	130	1.6	.5	.09	.07	22	7.2	2.3	.02	(.002)	.01	(.01)	.01	.02	(.02)	(.01)	.01
Range > dl H	-	288	178	181	6	214	8.2	1.0	2.0	.20	47	16	7.2	.28		.04		.02	.16			.02
$\bar{X}$ > dl	-	198	140	154	1.6	184	5.6	.75	.37	.11	35	12	3.9	.11	.002	.02	.01	.01	.06	.02	.01	.01

APPENDIX D continued

Horsefly Creek (RM 112.2-0.5)

		Turbidity (JTU)	Total Residue	Total Hardness	Total Alkalinity (Calc.)	CO_3	HCO_3	SO_4	Cl	NO_3	F	Ca	Mg	Na	Total Recoverable Fe	Total Recoverable As	Total Recoverable Zn	Total Recoverable Pb	Total Recoverable Cu	Dissolved Fe	Dissolved Zn	Dissolved Pb	Dissolved Cu
N		-	1	1	1	1	1	1	1	1	1	1	1	1	1	-	1	-	1	1	1	-	1
N < dl			0	0	0	0	1	1	0	0	0	0	0	0	0		1		0	0	1		0
% < dl			0	0	0	0	0	100	100	0	0	0	0	0	0		100		0	0	100		0
Range > dl	L		(66)	(50)	(60)	(0)	(73)			(0.1)	(0.1)	(16)	(2.6)	(3.4)	(.08)				(.01)	(.04)			(.02)
	H																						
$\bar{X}$ > dl		Same as Range > dl																					

Black Diamond Creek (RM 110.3-1.2-0.0)

		Turbidity (JTU)	Total Residue	Total Hardness	Total Alkalinity (Calc.)	CO_3	HCO_3	SO_4	Cl	NO_3	F	Ca	Mg	Na	Total Recoverable Fe	Total Recoverable As	Total Recoverable Zn	Total Recoverable Pb	Total Recoverable Cu	Dissolved Fe	Dissolved Zn	Dissolved Pb	Dissolved Cu
N		-	1	1	1	1	1	1	1	1	1	1	1	1	1	-	1	-	1	1	1	-	1
N < dl			0	0	0	0	0	1	1	0	0	0	0	0	0		1		0	0	1		0
% < dl			0	0	0	0	0	100	100	0	0	0	0	0	0		100		0	0	100		0
Range > dl	L		(70)	(68)	(82)	(0)	(100)			(0.1)	(.20)	(19)	(4.7)	(3.5)	(.18)				(.02)	(.14)			(.01)
	H																						
$\bar{X}$ > dl		Same as Range > dl																					

Hogum Creek (RM 110.3-0.2)

		Turbidity (JTU)	Total Residue	Total Hardness	Total Alkalinity (Calc.)	CO_3	HCO_3	SO_4	Cl	NO_3	F	Ca	Mg	Na	Total Recoverable Fe	Total Recoverable As	Total Recoverable Zn	Total Recoverable Pb	Total Recoverable Cu	Dissolved Fe	Dissolved Zn	Dissolved Pb	Dissolved Cu
N		-	10	10	10	10	10	10	10	10	10	10	10	10	10	-	8	-	8	-	-	-	-
N < dl			0	0	0	0	0	0	8	4	0	0	0	7	1		4		7				
% < dl			0	0	0	0	0	0	80	40	0	0	0	70	10		50		88				
Range > dl	L		60	70	57	0	70	2	2	.04	.08	12	5	4.1	.10		.03		(.03)				
	H		132	190	111	0	135	22	10	.20	.30	32	29	13	.50		.07						
$\bar{X}$ > dl			108	128	91	0	111	8.1	6.0	.12	.21	25	16	9.0	.26		.05		(.03)				

APPENDIX D continued

Landers Fork (RM 107.2-0.8)

		Turbidity (JTU)	Total Residue	Total Hardness	Total Alkalinity (Calc.)	CO_3	HCO_3	SO_4	Cl	NO_3	F	Ca	Mg	Na	Total Recoverable Fe	Total Recoverable As	Total Recoverable Zn	Total Recoverable Pb	Total Recoverable Cu	Dissolved Fe	Dissolved Zn	Dissolved Pb	Dissolved Cu
N		8	12	12	12	12	12	12	12	12	10	12	12	12	12	5	12	3	12	3	3	3	3
N < dl		7	0	0	0	0	0	2	4	7	3	0	0	6	10	5	10	3	12	2	3	3	3
% < dl		88	0	0	0	0	0	17	33	58	30	0	0	50	83	100	83	100	100	67	100	100	100
Range > dl	L	(4)	116	96	70	0	85	1	1	.15	.02	22	8.8	1.0	.22		.03			(.10)			
	H		225	210	148	2	180	12	9	.42	.36	42	39	12	.31		.46						
X̄ > dl		(4)	150	146	125	.17	152	4.3	4.4	.24	.16	34	16	4.4	.27		.24			(.10)			

Poorman Creek (RM 99.4-2.2)

		Turbidity (JTU)	Total Residue	Total Hardness	Total Alkalinity (Calc.)	CO_3	HCO_3	SO_4	Cl	NO_3	F	Ca	Mg	Na	Total Recoverable Fe	Total Recoverable As	Total Recoverable Zn	Total Recoverable Pb	Total Recoverable Cu	Dissolved Fe	Dissolved Zn	Dissolved Pb	Dissolved Cu
N		7	28	28	28	28	28	28	28	24	26	27	27	27	26	14	28	13	26	12	14	13	14
N < dl		4	0	0	0	0	0	1	18	9	1	0	0	6	17	9	18	11	18	9	11	11	9
% < dl		57	0	0	0	0	0	4	64	38	4	0	0	22	65	64	64	85	69	75	79	85	64
Range > dl	L	1	100	95	70	0	86	1.0	.5	.01	.02	20	2	.9	.03	.001	.01	.01	.01	.01	.01	.01	.01
	H	10	209	230	172	24	210	18	8	.63	.36	60	20	19	.37	.002	.32	.02	.03	.06	.01	.01	.02
X̄ > dl		5	137	128	121	1.2	145	9.6	3.6	.20	.16	36	9.1	2.8	.12	.002	.08	.02	.02	.03	.01	.01	.01

Spring Creek (RM 96.6-0.5-1.3)

		Turbidity (JTU)	Total Residue	Total Hardness	Total Alkalinity (Calc.)	CO_3	HCO_3	SO_4	Cl	NO_3	F	Ca	Mg	Na	Total Recoverable Fe	Total Recoverable As	Total Recoverable Zn	Total Recoverable Pb	Total Recoverable Cu	Dissolved Fe	Dissolved Zn	Dissolved Pb	Dissolved Cu
N		8	8	8	8	8	8	8	8	8	7	8	8	8	8	2	8	-	8	-	-	-	-
N < dl		5	0	0	0	0	0	4	0	5	2	0	0	3	5	2	8	-	7				
% < dl		33	0	0	0	0	0	50	0	63	29	0	0	38	63	100	100	-	86				
Range > dl	L	2	162	148	160	0	195	4	1	.20	.10	32	10	2	.08			-	(.02)				
	H	10	190	260	180	0	220	15	8	.30	.52	48	34	17	.10			-					
X̄ > dl		5	175	187	171	0	208	8.8	4.6	.27	.25	42	20	8.6	.09				(.02)				

APPENDIX D continued

	Turbidity (JTU)	Total Residue	Total Hardness	Total Alkalinity (Calc.)	CO_3	HCO_3	SO_4	Cl	NO_3	F	Ca	Mg	Na	Total Recoverable Fe	As	Zn	Pb	Cu	Dissolved Fe	Zn	Pb	Cu
Keep Cool Creek (RM 96.6-1.0)																						
N	7	8	8	8	8	8	8	8	8	6	8	8	8	8	2	8	-	8	-	-	-	-
N < dl	4	0	0	0	0	0	4	0	7	1	0	0	5	5	2	7	-	8				
% < dl	57	0	0	0	0	0	50	0	87	17	0	0	63	63	100	87	-	100				
Range > dl L	3	136	120	125	0	152	1	1	(.10)	.02	34	8	7	.10		(.02)	-					
H	17	180	260	165	0	201	7	9		.34	50	36	18	.30			-					
$\bar{X}$ > dl	8	160	169	150	0	184	4	5	(.10)	.17	42	16	14	.20		(.02)	-					
Beaver Creek (RM 96.6-0.7-0.2)																						
N	7	8	8	8	8	8	8	8	8	6	8	8	8	8	2	8	-	8	-	-	-	-
N < dl	4	0	0	0	0	0	2	0	6	3	0	0	5	6	1	7	-	7				
% < dl	57	0	0	0	0	0	25	0	75	50	0	0	63	75	50	87	-	87				
Range > dl L	2	110	76	85	0	104	1	1	.10	.08	25	2	4	.10	(.006)	(.01)	-	(.04)				
H	8	170	270	165	0	201	8	10	.20	.38	52	37	16	.12			-					
$\bar{X}$ > dl	5	146	155	135	0	165	3.5	5.2	.15	.19	42	12	11	.11	(.006)	(.01)	-	(.04)				
Willow Creek (RM 94.2-1.2)																						
N	7	8	8	8	8	8	8	8	8	5	8	8	8	8	3	8	1	8	-	-	-	-
N < dl	1	0	0	0	0	0	0	0	5	1	0	0	4	1	3	6	1	7				
% < dl	14	0	0	0	0	0	0	0	63	20	0	0	50	13	100	75	100	88				
Range > dl L	4	78	55	40	0	49	4	2	.10	.10	14	1	7	.10		.01		(.02)				
H	20	138	180	100	0	122	17	8	3.6	.38	28	27	12	.50		.02						
$\bar{X}$ > dl	11	102	92	77	0	94	9.9	4.9	1.4	.19	23	8.6	9.2	.21		.02		(.02)				

APPENDIX D continued

Sauerkraut Creek (RM 93.7-0.2)

	Turbidity (JTU)	Total Residue	Total Hardness	Total Alkalinity (Calc.)	CO_3	HCO_3	SO_4	Cl	NO_3	F	Ca	Mg	Na	Total Recoverable Fe	Total Recoverable As	Total Recoverable Zn	Total Recoverable Pb	Total Recoverable Cu	Dissolved Fe	Dissolved Zn	Dissolved Pb	Dissolved Cu
N	-	1	1	1	1	1	1	1	1	1	1	1	1	1	-	1	-	1	1	1	-	1
N < dl	-	0	0	0	0	0	0	0	0	0	0	0	0	0	-	0	-	0	0	1	-	0
% < dl	-	0	0	0	0	0	0	0	0	0	0	0	0	0	-	0	-	0	0	100	-	0
Range > dl L	-																					
Range > dl H	-	One Sample Only																				
$\bar{X}$ > dl	-	(50)	(39)	(50)	(0)	(61)	(0)	(0)	(.2)	(0)	(12)	(2.3)	(3)	(.02)	-	(.01)	-	(.02)	(.02)		-	(.01)

Arrastra Creek (RM 79.9-0.1)

	Turbidity (JTU)	Total Residue	Total Hardness	Total Alkalinity (Calc.)	CO_3	HCO_3	SO_4	Cl	NO_3	F	Ca	Mg	Na	Total Recoverable Fe	Total Recoverable As	Total Recoverable Zn	Total Recoverable Pb	Total Recoverable Cu	Dissolved Fe	Dissolved Zn	Dissolved Pb	Dissolved Cu
N	7	8	8	8	8	8	8	8	7	5	8	8	8	8	3	8	1	8				
N < dl	4	0	0	0	0	0	0	0	5	1	0	0	4	5	3	7	1	6				
% < dl	57	0	0	0	0	0	0	0	71	20	0	0	50	63	100	88	100	75				
Range > dl L	5	72	51	65	0	79	1	1	.20	.06	19	1	7	.06		(.01)		.03				
Range > dl H	33	136	170	115	0	140	14	9	2.5	.38	30	24	9	.12				.04				
$\bar{X}$ > dl	2	105	107	98	0	119	4.8	3.9	1.4	.16	25	11	8.2	.09		(.01)		.04				

Kleinschmidt Creek (RM 51.8-5.6-0.1)

	Turbidity (JTU)	Total Residue	Total Hardness	Total Alkalinity (Calc.)	CO_3	HCO_3	SO_4	Cl	NO_3	F	Ca	Mg	Na	Total Recoverable Fe	Total Recoverable As	Total Recoverable Zn	Total Recoverable Pb	Total Recoverable Cu	Dissolved Fe	Dissolved Zn	Dissolved Pb	Dissolved Cu
N	7	8	8	8	8	8	8	8	8	5	8	8	8	8	3	8	1	8				
N < dl	3	0	0	0	0	0	0	0	4	1	0	1	3	7	2	7	1	7				
% < dl	43	0	0	0	0	0	0	0	50	20	0	13	38	88	67	88	100	88				
Range > dl L	1	120	130	125	6	150	2	2	.20	.06	28	13	2	(.04)	(.001)	(.02)		(.02)				
Range > dl H	4	160	230	165	10	201	13	11	6.2	.28	51	37	22									
$\bar{X}$ > dl	3	146	160	150	2	178	5.8	4.8	1.8	.14	35	20	11	(.04)	(.001)	(.02)		(.02)				

APPENDIX D continued

		Turbidity (JTU)	Total Residue	Total Hardness	Total Alkalinity (Calc.)	CO_3	HCO_3	SO_4	Cl	NO_3	F	Ca	Mg	Na	Total Recoverable Fe	Total Recoverable As	Total Recoverable Zn	Total Recoverable Pb	Total Recoverable Cu	Dissolved Fe	Dissolved Zn	Dissolved Pb	Dissolved Cu
North Fork Blackfoot River (RM 51.8-5.6)																							
N		5	7	7	7	7	7	7	7	7	5	7	7	7	7	3	7	1	7				
N < dl		4	0	0	0	0	0	1	0	5	1	0	0	4	6	3	5	1	6				
% < dl		67	0	0	0	0	0	14	0	71	20	0	0	57	86	100	71	100	86				
Range > dl	L	(6)	106	105	105	0	140	1	2	.34	.02	28	2	10	(.50)		.01		(.02)				
	H		150	220	150	0	183	12	8	.70	.10	44	34	17			.05						
$\bar{X}$ > dl		(6)	130	144	132	0	162	4.5	4.7	.52	.06	34	14	14	(.50)		.03		(.02)				
Warren Creek (RM 48.2-4.4)																							
N		2	3	3	3	3	3	3	3	3	3	3	3	2	3	2	3	1	3				
N < dl		0	0	0	0	0	0	1	0	1	1	0	0	1	0	2	3	1	3				
% < dl		0	0	0	0	0	0	33	0	33	33	0	0	50	0	100	100	100	100				
Range > dl	L	8	122	75	94	0	115	3	3	.40	.06	24	4	(16)	.10								
	H	8	140	180	118	0	144	3	5	.50	.20	33	24		.30								
$\bar{X}$ > dl		8	131	132	106	0	129	3	4	.45	.13	29	15	(16)	.20								
Monture Creek (RM 44.2-3.0)																							
N		7	8	8	8	8	8	8	8	8	6	8	8	8	8	3	8	1	5				
N < dl		3	0	0	0	0	0	2	0	5	2	0	0	4	5	3	7	1	5				
% < dl		43	0	0	0	0	0	25	0	63	33	0	0	50	63	100	88	100	100				
Range > dl	L	2	46	34	35	0	43	1	1	.10	.06	12	1	1	.04		(.01)						
	H	13	126	180	120	0	147	11	9	6.0	.14	32	32	9	.16								
$\bar{X}$ > dl		6	84	96	80	0	98	5.8	4.1	2.2	.08	20	11	5.5	.07		(.01)						

APPENDIX D continued

		Turbidity (JTU)	Total Residue	Total Hardness	Total Alkalinity (Calc.)	CO_3	HCO_3	SO_4	Cl	NO_3	F	Ca	Mg	Na	Total Recoverable Fe	Total Recoverable As	Total Recoverable Zn	Total Recoverable Pb	Total Recoverable Cu	Dissolved Fe	Dissolved Zn	Dissolved Pb	Dissolved Cu
Cottonwood Creek (RM 41.6-0.6)																							
N		4	5	5	5	5	5	5	5	5	3	5	5	4	5	3	5	1	5				
N < dl		2	0	0	0	0	0	0	0	3	2	0	0	3	4	3	4	1	5				
% < dl		50	0	0	0	0	0	0	0	60	67	0	0	75	80	100	80	100	100				
Range > dl	L	7	132	125	104	0	127	1	3	.5	(.1)	28	12	(20)	(.10)		(.02)						
	H	7	176	180	153	0	187	20	7	.5		40	18										
$\bar{X}$ > dl		7	155	155	131	0	160	6.4	5.2	.50	(.1)	37	15	(20)	(.1)		(.02)						
Clearwater River (RM 33.8-3.0)																							
N		7	8	8	8	8	8	8	8	8	5	8	8	8	8	3	8	1	8				
N < dl		3	0	0	0	0	0	3	0	5	2	0	1	3	6	3	6	1	7				
% < dl		43	0	0	0	0	0	38	0	63	40	0	13	38	75	100	75	100	88				
Range > dl	L	4	60	70	60	0	73	2	1	.10	.04	14	5	3	.06		.01		(.03)				
	H	10	105	160	102	0	125	7	8	8.9	.15	30	22	10	.10		.02						
$\bar{X}$ > dl		6	82	88	80	0	98	4	3.9	3.2	.09	21	10	6.4	.08		.02		(.03)				
Blanchard Creek (RM 33.8-2.6-0.2)																							
N		1	2	2	2	2	2	2	2	2	1	2	2	2	2	1	2	2	2				
N < dl		0	0	0	0	0	0	2	0	1	1	0	0	1	1	1	1	2	2				
% < dl		0	0	0	0	0	0	100	0	50	100	0	0	50	50	100	50	100	100				
Range > dl	L	(8)	60	35	45	0	55		2	(.1)		8	4	(5)	(.07)		(.03)						
	H		86	100	80	0	98		4			18	13										
$\bar{X}$ > dl		(8)	73	68	62	0	77		3	(.1)		13	9	(5)	(.07)		(.03)						

APPENDIX D continued

		Turbidity (JTU)	Total Residue	Total Hardness	Total Alkalinity (Calc.)	CO_3	HCO_3	SO_4	Cl	NO_3	F	Ca	Mg	Na	Total Recoverable Fe	Total Recoverable As	Total Recoverable Zn	Total Recoverable Pb	Total Recoverable Cu	Dissolved Fe	Dissolved Zn	Dissolved Pb	Dissolved Cu
Elk Creek (RM 27.9-1.0)																							
N		5	6	6	6	6	6	6	6	6	4	6	6	6	6	3	6	1	6				
N < dl		0	0	0	0	0	0	0	0	4	0	0	0	2	2	3	4	1	6				
% < dl		0	0	0	0	0	0	0	0	67	0	0	0	33	33	100	67	100	100				
Range > dl	L	4	128	110	75	0	92	7	2	.60	.10	28	2	4	.10		.02						
	H	285	188	220	155	6	189	14	9	3.2	.28	44	27	22	.90		.20						
$\bar{X}$ > dl		79	164	141	130	1	156	11	5.2	1.9	.21	38	11	13	.47		.11						
Belmont Creek (RM 21.2-0.1)																							
N		2	3	3	3	3	3	3	3	3	2	3	3	2	3	2	3	1	3				
N < dl		1	0	0	0	0	0	3	0	3	2	0	0	1	1	2	3	1	3				
% < dl		50	0	0	0	0	0	100	0	100	100	0	0	50	33	100	100	100	100				
Range > dl	L	(7)	110	80	95	0	116		3			24	5	(10)	.05								
	H		160	210	144	0	175		5			68	20		.40								
$\bar{X}$ > dl		4	141	160	127	0	155		4			45	12	10	.23								
Gold Creek (RM 13.0-0.0)																							
N		2	3	3	3	3	3	3	3	3	2	3	3	1	3	2	3	1	3				
N < dl		1	0	0	0	0	0	2	0	3	2	0	0	1	2	2	3	1	3				
% < dl		50	0	0	0	0	0	67	0	100	100	0	0	100	67	100	100	100	100				
Range > dl	L	(7)	100	95	85	0	104	(4)	2			20	11		(.40)								
	H		110	125	100	0	122		5			32	12										
$\bar{X}$ > dl		(7)	103	113	94	0	115	(4)	3.7			27	11		(.40)								

APPENDIX D continued

		Turbidity (JTU)	Total Residue	Total Hardness	Total Alkalinity (Calc.)	CO_3	HCO_3	SO_4	Cl	NO_3	F	Ca	Mg	Na	Total Recoverable Fe	As	Zn	Pb	Cu	Dissolved Fe	Zn	Pb	Cu
Union Creek (RM 12.3-0.0)																							
N		7	8	8	8	8	8	8	8	8	5	8	8	8	8	3	8	1	8				
N < dl		0	0	0	0	0	0	1	0	5	0	0	0	2	0	2	7	1	6				
% < dl		0	0	0	0	0	0	13	0	63	0	0	0	25	0	67	88	100	75				
Range > dl	L	9	150	105	100	0	122	8	2	.60	.10	24	2	1	.10	(.004)	(.06)		.02				
	H	200	242	310	226	0	275	18	11	1.2	.28	62	51	20	.80				.02				
X̄ > dl		46	208	194	177	0	215	11	6.6	.90	.17	40	23	8.3	.36	(.004)	(.06)		.02				
East Twin Creek (RM 10.3-0.0)																							
N		3	3	3	3	3	3	3	3	3	2	3	3	3	3	2	3	1	3				
N < dl		1	0	0	0	0	0	1	0	1	0	0	2	0	1	2	2	1	2				
% < dl		33	0	0	0	0	0	33	0	33	0	0	67	0	33	100	67	100	67				
Range > dl	L	7	24	8	20	0	24	5	2	.20	.10	2	(1)	5	.06		(.01)		(.12)				
	H	11	50	20	30	0	36	8	3	2.7	.44	8		12	.18								
X̄ > dl		9	39	13	24	0	29	6.5	2.3	1.4	.27	4.7	1	8.7	.12		(.01)		(.12)				
West Twin Creek (Rm 10.0-0.0)																							
N		3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	1	3				
N < dl		1	0	0	0	0	0	2	0	2	0	0	2	2	1	2	3	1	3				
% < dl		33	0	0	0	0	0	67	0	67	0	0	67	67	33	100	100	100	100				
Range > dl	L	3	10	7	5	0	6	(4)	2	(.23)	.04	2	(8)	(5)	.05								
	H	7	30	40	28	0	34		2		.34	4			.08								
X̄ > dl		5	21	19	17	0	20	(4)	2	(.23)	.21	3	(8)	(5)	.06								

APPENDIX D continued

Summary of Laboratory Analyses for N + P Compounds with Chemical Results Less Than and Greater Than the Analytical Detection Level

Blackfoot River at Flesher Road (Rm 114.6)

		NO_2-N	NH_3-N	NO_3-N	Org. N	Total PO_4	Ortho PO_4
N		6	6	6	6	7	6
N < dl		5	6	0	1	3	4
% < dl		83	100	0	17	43	67
Range > dl	L	(.001)		.01	.08	.01	.01
	H			.08	.39	.03	.01
$\bar{X}$ > dl		(.001)		.03	.28	.02	.01

Blackfoot River at Blackfoot Canyon Camp (Rm 84.7)

		NO_2-N	NH_3-N	NO_3-N	Org. N	Total PO_4	Ortho PO_4
N		7	7	7	7	7	6
N < dl		7	7	0	0	2	3
% < dl		100	100	0	0	29	50
Range > dl	L			.01	.20	.01	.01
	H			.60	.75	.19	.04
$\bar{X}$ > dl				.17	.38	.06	.02

Blackfoot River at Dalton Mountain Road (Rm 95.9)

		NO_2-N	NH_3-N	NO_3-N	Org. N	Total PO_4	Ortho PO_4
N		7	7	8	7	7	7
N < dl		6	7	0	0	2	3
% < dl		86	100	0	0	29	43
Range > dl	L	.002		.02	.18	.01	.01
	H	.002		.16	.85	.17	.03
$\bar{X}$ > dl		.002		.06	.44	.05	.02

Willow Creek (Flesher) (Rm 114.3 - 0.0)

		NO_2-N	NH_3-N	NO_3-N	Org. N	Total PO_4	Ortho PO_4
N		2	2	2	2	2	2
N < dl		2	2	0	1	0	0
% < dl		100	100	0	50	0	0
Range > dl	L			.03	(.39)	.02	.01
	H			.03		.02	.02
$\bar{X}$ > dl				.03	(.39)	.02	.02

APPENDIX D continued

<u>Alice Creek at Highway 200 (Rm 113.2 - 0.9)</u>

		NO_2-N	NH_3-N	NO_3-N	Org. N	Total PO_4	Ortho PO_4
N		7	7	7	7	7	7
N < dl		6	7	0	1	1	2
% < dl		86	100	0	14	14	29
Range > dl	L	(.003)		.01	.03	.01	.01
	H			.14	.50	.06	.02
$\bar{X}$ > dl		(.003)		.05	.30	.02	.02

<u>Hardscrabble Creek (Rm 112.5 - 0.5)</u>

		NO_2-N	NH_3-N	NO_3-N	Org. N	Total PO_4	Ortho PO_4
N		5	5	4	5	5	5
N < dl		5	5	0	0	0	1
% < dl		100	100	0	0	0	20
Range > dl	L			.03	.27	.03	.02
	H			.45	.50	.08	.08
$\bar{X}$ > dl				.16	.42	.06	.05

<u>Poorman Creek (Rm 99.4 - 2.2)</u>

		NO_2-N	NH_3-N	NO_3-N	Org. N	Total PO_4	Ortho PO_4
N		7	7	5	7	7	7
N < dl		4	7	0	0	0	1
% < dl		57	100	0	0	0	14
Range > dl	L	.001		.02	.20	.01	.01
	H	.002		.07	1.5	.10	.03
$\bar{X}$ > dl		.002		.51	.12	.02	.03

APPENDIX E

Water Quality Station Locations and River Mileages

Station No.	Name	Location 1/	River Miles Above Mouth 2/
1	Blackfoot River at Rainbow Bend	13N 17W 2 cca	9.7
2	West Twin Creek	13N 17W 2 cad	10.0 - 0.0
3	East Twin Creek	13N 17W 2 dba	10.3 - 0.0
4	Union Creek	13N 16W 6 dac	12.3 - 0.0
5	Gold Creek	13N 17W 6 bbd	13.0 - 0.0
6	Belmont Creek	14N 16W 24 bcd	21.2 - 0.1
7	Elk Creek	14N 15W 36 acd	27.9 - 1.0
8	Blanchard Creek	14N 14W 5 daa	33.8 - 2.6 - 0.2
9	Clearwater River	14N 14W 4 bdb	33.8 - 3.0
10	Cottonwood Creek	15N 13W 29 cbb	41.6 - 0.6
11	Monture Creek	15N 13W 24 bdb	44.2 - 3.0
12	Warren Creek	15N 12W 35 ada	48.2 - 4.4
13	North Fork Blackfoot River	14N 11W 6 acb	51.8 - 5.6
14	Kleinschmidt Creek	14N 11W 6 acd	51.8 - 5.6 - 0.1
15	Arrastra Creek	14N 10W 30 aab	79.9 - 0.1
16	Blackfoot River at Blackfoot Canyon Camp	14N 10W 34 bdc	84.7
17	Sauerkraut Creek	14N 9W 29 cad	93.7 - 0.1
18	Willow Creek	14N 9W 28 adc	94.2 - 1.2
19	Blackfoot River at Dalton Mountain Road	14N 9W 28 aba	95.9
20	Beaver Creek	14N 9W 22 bda	96.6 - 0.7 - 0.2
21	Keep Cool Creek	14 N 9W 22 abc	96.6 - 1.0
22	Spring Creek	14N 9W 23 bcb	96.6 - 0.5 - 1.3
23	Poorman Creek	14N 9W 36 ddd	99.4 - 2.2
24	Blackfoot River below 7-up Pete Creek	14N 8W 14 cdd	106.2
25	Landers Fork	14N 8W 12 cac	107.2 - 0.8
26	Hogum Creek	14N 7W 8 acb	110.3 - 0.2
27	Black Diamond Creek	14N 7W 8 dda	110.3 - 1.2 - 0.0
28	Blackfoot River at Hogum Creek Road	14N 7W 5 cdd	110.7
29	Horsefly Creek	14N 7W 4 ada	112.2 - 0.5
30	Hardscrabble Creek	15N 7W 33 acd	112.5 - 0.5
31	Alice Creek	15N 7W 27 dbc	113.2 - 0.9
32	Willow Creek (Flesher)	15N 7W 34 daa	114.3 - 0.0
33	Sandbar Creek	14N 6W 6 cbd	114.3 - 2.8 - 0.1
34	Blackfoot River at Flesher Road	15N 7W 35 bca	114.6
35	Blackfoot River at Pop's Place	15N 6W 19 acc	119.4
36	Pass Creek	15N 6W 17 ddd	120.4 - 0.8
	Source (junction of Anaconda Creek and Beartrap Creek	15N 6W 27 bbb	122.0

1/ Location method given in Figure 5.

2/ Mileages obtained from the following sources: Mouth to Willow Creek from USGS map "Plan and Profile of Blackfoot River, to Mile 95, and Tributaries, Montana, Miscellaneous Dam Sites", dated 1937. Willow Creek to Source, measured from the following USGS 7½ minute quadrangle maps: Moose Creek, 1968; Lincoln, 1968; Swede Gulch, 1968; Stemple Pass, 1968; Cadotte Creek, 1963; Rogers Pass, 1963.

APPENDIX F

Results of BOD Analyses

Samples were collected by the writer from February 1972 through September 1972 and analyses were made by the USGS, Helena. Collections and analyses were both made by the USGS during water year 1973 (October 1972 - September 1973).

A 1 liter water sample was collected and supersaturated with oxygen. Dissolved oxygen was then measured. Five days later dissolved oxygen content was again measured. The difference between the first and second dissolved oxygen levels was the five day BOD.

APPENDIX F continued

Blackfoot River at Hogum Road Bridge
(USGS gage "below Alice Creek near Lincoln")

	Date	Time	5-day BOD (mg/1)
1972	2-2	1330	1.8
	3-23	1200	1.1
	4-14	1010	1.2
	5-19	1050	1.8
	8-2	1020	1.1
	9-8	1010	3.0
	10-25	1130	1.3
	11-28	1500	2.3
	12-27	1330	1.1
1973	1-23	1130	0.6
	2-27	1330	1.2
	3-28	1330	0.6
	4-25	1400	1.4
	5-21	1800	0.9
	6-18	1620	2.5
	7-16	1200	1.8
	8-13	1500	1.0
	9-11	1600	0.6

Blackfoot River below 7-up Pete Creek

	Date	Time	5-day BOD (mg/1
1972	10-26	1010	1.0
	11-28	1115	2.5
	12-27	1140	1.4
1973	1-23	1615	1.1
	2-27	1010	0.8
	3-28	0935	1.1
	4-25	1100	1.5
	5-21	1300	0.8
	6-18	1200	2.0
	7-16	1115	1.8
	8-13	1145	0.7
	9-11	1230	0.5

Blackfoot River at Dalton Mountain Road Bridge

	Date	Time	5-day BOD (mg/1)
1972	2-2	0945	1.3
	3-23	0945	1.6
	4-14	0935	1.3
	5-19	0945	1.8
	8-2	0935	1.3
	9-8	0945	2.0
	10-26	0900	1.4
	11-28	1015	1.9
	12-27	1040	1.6
1973	1-23	Invalid - analytical error	
	2-27	0900	1.6
	3-28	0900	0.8
	4-25	1000	0.8
	5-21	1120	1.2
	6-18	1040	2.0
	7-16	1000	1.4
	8-13	1020	0.8
	9-11	1040	0.6

Blackfoot River at Blackfoot Canyon Camp

	Date	Time	5-day BOD (mg/1)
1972	2-2	no sample collected	
	3-23	0815	1.2
	4-14	0915	1.5
	5-19	0915	1.6
	8-2	0920	1.0
	9-8	0925	1.9
	10-26	0800	1.4
	11-28	0920	2.4
	12-27	0945	1.3
1973	1-23	1420	1.4
	2-27	0745	0.9
	3-28	0815	0.9
	4-25	0900	1.3
	5-21	0930	1.2
	6-16	0915	2.2
	7-16	0900	1.4
	8-13	0930	0.6
	9-11	0935	0.4

APPENDIX G

Results of Coliform Bacteria Analyses

Collection and analysis of water samples were performed by the USGS, Helena, Montana. Sample preparation and incubation was done in the field using a portable test kit. The membrane filter technique was used to prepare the water sample for incubation. Results are reported in total coliforms per 100 ml and fecal coliforms per 100 ml of water sample.

APPENDIX G continued

Blackfoot River at Hogum Road Bridge
(USGS gage below Alice Creek near Lincoln)

Year	Date	Time	Temp (°C) Air	Temp (°C) Water	Total Coliforms per 100 ml	Fecal Coliforms per 100 ml
1972	10-26	1130	10.5	3.5	1	0
	11-28	1500	-1.5	0.0	6	0
	12-27	1550	5.5	1.5	7	0*
1973	1-23	1130	-5.0	0.0	1	0
	2-27	1330	8.0	2.5	0	0
	3-28	1130	4.0	3.5	0	0
	4-25	1400	7.5	5.5	0	0
	5-21	1800	14.0	11.0	28	2*
	6-18	1620	11.0	9.0	12	0*
	7-16	1200	25.5	15.0	136	0
	8-13	1500	30.5	15.5	8	11
	9-11	1600	25.0	15.5	1700	1

*Reported values based on non-ideal count of colonies.

Blackfoot River below 7-up Pete Creek

Year	Date	Time	Temp (°C) Air	Temp (°C) Water	Total Coliforms per 100 ml	Fecal Coliforms per 100 ml
1972	10-26	1010	2.0	3.5	12	0
	11-28	1115	-4.5	0.0	10	1
	12-27	1140	4.5	3.0	0	0*
1973	1-23	1615	---	1.0	2	0
	2-27	1010	5.5	3.0	6	4
	3-28	0935	3.5	0.5	2	0
	4-25	1100	7.5	5.0	12	0
	5-21	1300	11.0	7.0	13	0
	6-18	1200	7.5	5.5	10	2
	7-16	1115	24.0	11.5	28	1
	8-13	1145	25.5	12.0	75	6
	9-11	1230	24.0	11.0	170	2

*Reported value based on non-ideal count of colonies.

APPENDIX G continued

Blackfoot River at Dalton Mtn Road Bridge

	Date	Time	Temp (°C) Air	Temp (°C) Water	Total Coliforms per 100 ml	Fecal Coliforms per 100 ml
1972	10-26	0900	0.5	5.5	32	4
	11-28	1015	-12.0	1.5	49	3
	12-27	1040	5.5	4.5	23	6*
1973	1-23	1500	---	5.0	2	0
	2-27	0900	8.0	4.0	120	15
	3-28	0900	2.0	3.5	3	0
	4-25	1000	8.0	6.0	11	6
	5-21	1120	10.0	7.0	74	4
	6-18	1040	6.0	6.5	24	6
	7-16	1000	19.0	10.5	48	13
	8-13	1020	20.5	10.5	84	10
	9-11	1040	20.5	9.5	440	10

*Reported value based on non-ideal count of colonies.

Blackfoot River at Blackfoot Canyon Camp

	Date	Time	Temp (°C) Air	Temp (°C) Water	Total Coliforms per 100 ml	Fecal Coliforms per 100 ml
1972	10-26	0800	1.5	5.5	20	0
	11-28	0920	-10.0	1.0	1400*	2
	12-27	0945	4.0	4.0	18	2
1973	1-23	1420	---	2.0	2	0
	2-27	0745	1.5	4.5	14	2
	3-26	0815	1.0	3.0	0	0
	4-25	0900	6.5	6.5	24	4
	5-21	0930	8.5	6.5	260	9
	6-18	0915	6.5	6.5	50	14
	7-16	0900	18.0	11.5	43	9
	8-13	0930	20.5	11.0	61	2
	9-11	0935	15.0	10.0	930	9

*Reported value based on non-ideal count of colonies.

APPENDIX H

Results of Field Analyses

Analyses were made with a HACH Model DR-EL water analysis kit. Air and water temperatures were determined with a Taylor pocket thermometer. All values except temperature and pH are given in mg/1. Alkalinity and hardness are reported as mg/l $CaCO_3$.

BLACKFOOT RIVER AT POP'S PLACE

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLI
2-17-68	1130	0	0	6.9	11	40	55	110	2	2	p.c.	B.D.
3-17-68	0800	1	1	7.3	12	45	65	105	0	2	snow	"
4-21-68	0930	1	-1	7.6	11	45	25	45	0	2	snow	"
5-26-68	1300	6	7	7.7	9	35	30	60	0	2	cloud	"
6-21-68	1030	8	12	8.1	9	50	40	75	0	2	p.c.	"
7-22-68	1930	13	10	8.2	8	60	55	95	0	2	p.c.	"
9-10-68	1045	10	20	8.0	9	60	50	95	0	2	p.c.	"

BLACKFOOT RIVER AT FLESHER PASS ROAD

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLI
2-17-68	1300	0	3	7.8	11	80	50	95	2	2	p.c.	BD
3-17-68	0915	1	1	8.2	11	55	50	90	0	2	snow	"
4-21-68	0845	1	-1	8.1	11	55	50	85	0	2	snow	"
5-26-68	1145	7	8	8.2	10	55	45	70	0	2	cloud	"
6-21-68	0930	10	11	8.4	10	60	50	80	0	2	p.c.	"
7-22-68	1845	16	17	8.4	9	80	60	100	0	2	p.c.	"
9-10-68	1135	10	24	8.3	9	75	60	100	0	2	clear	"
10-20-68	1015	3	0	7.7	10	70	60	95	0	2	cloud	"
12-1-68	1030	0	-7	7.5	11	75	60	100	0	2	p.c.	"
1-3-69	not taken, snow too deep											
2- 9-69	not taken, snow too deep											
3-29-69	0910	0	-2	7.4	11	80	50	85	0	2	p.c.	"
5- 4-69	0920	5	.6	7.6	9	70	45	75	0	2	cloud	"
6-17-69	1020	10	21	7.9	10	70	50	90	0	2	clear	"
7-17-69	1030	12	22	7.8	8	70	55	85	0	2	clear	"
8-27-69	0955	11	16	7.9	8	85	70	95	0	2	clear	"
10- 8-69	0915	4.5	1.5	8.5	10		50	110			p.c.	LS
11-29-69	1600	0	0	8.5	12			100			clear	LS
1-20-70	1650	-0.5	0.5	8.5	10.0						m.c	"

BLACKFOOT RIVER AT HOGUM CREEK ROAD BRIDGE

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLI
2-17-68	1500	1	3	8.3	12	110	75	115	5	2	cloud	B.D.
3-17-68	1015	2	1	8.6	11	95	65	105	0	2	snow	"
4-21-68	0715	2	0	8.1	10	85	60	95	0	2	snow	"
5-26-68	0915	7	9	8.2	11	60	45	70	5	2	cloud	"
6-21-68	0815	10	11	8.3	11	80	60	80	2	2	p.c.	"
7-22-68	1745	17	18	8.4	9	105	65	105	0	2	p.c.	"
9-12-68	1325	13	25	8.3	9	110	70	105	0	2	clear	"
10-20-68	0830	3	0	7.9	11	110	70	110	0	2	p.c.	"
12- 1-68	1130	0	-7	8.0	11	120	75	120	0	2	p.c.	"
1- 3-69	1130	0	-8	7.8	10	115	70	110	0	2	p.c.	"
2- 9-69	road closed by snow											
3-29-69	1005	0	-2	8.0	11	110	65	110	0	2	p.c.	"
5- 4-69	1015	5	6	7.9	10	80	50	80	0	2	cloudy	"
6-17-69	1120	11	20	8.0	10	90	60	90	0	2	clear	"
7-17-69	1110	13	23	7.9	9	90	55	90	0	2	clear	"
8-27-69	1150	13	25	8.0	9	120	70	120	0	2	clear	"
10- 8-69	1030	6	7	8.6	9		80	140			p.c.	LS
11-29-69	1630	1.5	-0.5	8.6	12			120			clear	LS
1-20-70	1700	-0.5	0	8.6	11.0						Snow	"

APPENDIX H continued

BLACKFOOT RIVER AT DALTON MTN ROAD BRIDGE

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLL
2-18-68	1215	4	6	8.3	11	165	60	160	0	2	rain	B.D
3-17-68	1130	4	1	8.4	11	165	110	160	0	2	snow	"
4-21-68	1045	6	8	8.4	11	160	110	160	0	2	pc & snow	"
5-25-68	1100	7	13	8.0	9	115	75	120	8	2	p.c.	"
6-20-68	1900	13	18	8.4	9	115	80	110	8	2	p.c.	"
7-22-68	2030	13	16	8.4	8	160	105	155	0	2	p.c.	"
9- 9-68	1410	13	23	8.3	8	155	110	160	0	2	clear	"
10-19-68	1530	8	9	7.9	9	165	120	170	0	2	p.c.	"
12-1 -68	1235	3	-3	8.0	9	180	115	170	0	2	p.c.	"
1- 2-69	1300	3	0	7.9	10	175	120	160	0	2	cloud	"
2- 9-69	0905	2	-2	8.0	10	170	120	160	0	2	snow	"
3-28-69	1500	8	9	8.0	10	170	115	155	0	2	p.c.	"
5- 3-69	1655	10	12	8.0	10	130	90	120	0	2	p.c.	"
6-16-69	1440	12	23	8.0	9	135	95	130	0	2	clear	"
7-17-69	1310	13	26	7.9	9	140	95	130	0	2	p.c.	"
8-26-69	1440	13	31	8.0	7	170	120	160	0	2	clear	"
10-8 -69	1130	8	11.5	8.6	8		130	180			cloudy	L.S.
11-29-69	1330	4.5	4	8.6				160			p.c.	L.S.
1-20-70	0930	2.5	0	8.7	10.0						O'cast	"

BLACKFOOT RIVER AT BLACKFOOT CANYON CAMP

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHE
2-18-68	1330	2	5	8.4	12	155	60	160	0	2	rain
3-17-68	1300	5	1	8.4	11	160	110	150	4	2	snow
4-20-68	1430	7	10	8.5	11	155	110	150	0	2	p.c.
5-25-68	1000	7	10	8.3	9	110	75	110	12	2	p.c.
6-20-68	1815	14	17	8.4	11	120	80	110	9	2	p.c.
7-23-68	0815	9	12	8.4	9	160	110	155	0	2	p.c.
9-10-68	1520	14	25	8.3	9	165	110	160	0	2	clear
10-19-68	1445	6	8	8.1	11	170	115	160	0	2	p.c.
12-1 -68	1315	2	3	8.1	11	170	115	160	0	2	p.c.
1- 2-69	1200	0	0	7.9	9	165	115	160	0	2	cloud
2- 8-69	1605	2	-2	8.1	12	165	120	165	0	2	p.c.
3-28-69	1215	5	8	8.1	12	165	120	155	0	2	p.c.
5- 3-69	1520	8	12	8.1	10	125	95	70	2	0	clear
6-16-69	1255	11	23	8.0	10	110	100	135	2	2	clear
7-16-69	1550	15	26	8.0	9	145	95	135	0	2	p.c.
8-26-69	1355	13	23	8.1	8	170	115	160	0	2	clear
10- 7-69	1540	9.5	16	8.6	10		120	160			p.c.
11-29-69	1300	2.5	2	8.6	12			160			clear
1/20-70	1440	3.0	1.5	8.6	8.5						O'cast

APPENDIX B continued

BLACKFOOT RIVER AT RAINBOW BEND

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLI
2-18-68	1530	0	6	8.5	10	135	80	130	0	2	rain	B.D.
3-16-68	0815	4	4	8.4	11	115	70	115	4	2	p.c.	"
4-20-68	0900	4	4	8.3	11	110	70	105	0	2	p.c.	"
5-25-68	0745	9	8	8.4	9	80	50	80	20	2	p.c.	"
6-20-68	1030	13	18	8.3	10	90	55	85	8	2	p.c	"
7-22-68	1330	17	26	8.6	9	130	80	120	0	2	clear	"
9- 9-68	1200	14	23	8.4	10	145	85	130	0	2	clear	"
10-19-68	0835	4	-1	8.1	10	135	90	130	0	2	clear	"
11-30-68	1100	0	1	8.1	12	135	85	130	0	2	p.c.	"
1- 2-69	0930	0	-7	7.9	11	140	85	135	0	2	cloud	"
2-8- 69	0930	1	0	7.8	12	130	90	120	0	2	cloud	"
3-28-69	1000	3	8	7.9	12	115	80	110	22	2	p.c.	"
5- 3-69	0920	7	7	7.9	11	100	65	95	10	2	clear	"
6-16-69	1130	13	23	8.1	10	110	70	105	2	2	clear	"
7-16-69	0930	16	17	8.1	10	115	70	110	0	2	clear	"
8-26-69	1115	16	22	8.2	7	140	95	135	0	2	clear	"
10- 7-69	0920	7	2.5	8.6	10		100	170			clear	< 5
11-29-69	1000	0	4.5	8.65	13			140			p.c.	< 5
1-20-70	1000	0	3.5	8.6	11.5						p.c	"

PASS CREEK

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLI
2-17-68	1015	2	0	7.6	9	65	40	65	8	2	clear	B.D.
5-26-68	1450	6	7	8.0	8	45	25	45	0	2	cloud	"
9-10-68	0815	9	15	8.1	7	75	40	75	0	2	p.c.	"
1- 3-69	0810	2	-11	7.2	9	75	40	65	0	2	p.c.	"
3-29-69	0750	0	-5	7.3	11	60	40	60	0	2	p.c.	"
6-17-69	0900	8	16	7.2	9	70	40	60	0	2	clear	"
8-27-69	0840	11	7	7.2	7	75	50	75	0	2	clear	"
11-29-69	1530	3.5	3.5	8.4				80			clear	< 5

SANDBAR CREEK

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLI
7-17-69	0955	14	20	6.9	7	40	25	45	27	2	clear	B.D.

ALICE CREEK

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLI
2-17-68	1400	1	3	8.0	11	115	70	115	7	2	p.c.	B.D.
5-26-68	1045	7	9	8.3	11	90	60	85	4	2	cloudy	"
9-10-68	1230	10	24	8.3	9	120	75	115	0	2	clear	"
1- 3-69	1015	0	-10	7.8	10	120	75	115	0	2	p.c.	"
3-28-69	1630	4	4	7.7	10	115	65	110	0	2	p.c.	"
6-17-69	1055	11	21	7.9	10	105	70	100	0	2	clear	"
8-27-69	1230	14	26	7.9	10	125	90	110	0	2	clear	"
11-30-69	1000	0.5	2	8.4				120			clear	< 5

HOGUM CREEK

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLI
10-8 -69	1000	5	3.5	8.5	9.0		60	100			p.c.	< 5
1-20-70	1630	-0.5	0	8.5	11.0						snow	"

LANDER'S FORK

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLI
2-17-68	1545	4	0	8.4	10	140	85	140	6	2	snow	B.D.
5-26-68	0815	4	8	8.3	10	110	75	110	5	2	cloud	"
9-10-68	1410	10	25	8.2	10	145	90	135	0	2	clear	"
1- 2-69	1450	4	-2	8.1	10	145	90	140	0	2	p.c.	"
3-28-69	1555	6	5	8.0	10	140	90	135	0	2	p.c.	"
6-17-69	1250	9	21	7.9	10	115	80	100	0	2	clear	"
8-27-69	1105	9	19	7.9	8	145	95	145	0	2	clear	"
11-30-69	0930	3	-1.5	8.6				140			clear	< 5

APPENDIX 4 continued

BEAVER CREEK

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLL
2-18-68	1100	0	2	8.4	11	140	110	110	0	2	rain	B.D.
5-25-68	1430	8	8	8.2	10	80	65	80	8	2	rain	"
9- 9-68	1500	13	24	8.5	10	155	120	145	0	2	clear	"
1- 2-69	1400	0	-2	7.8	10	130	100	120	0	2	cloudy	"
3-28-69	1420	4	9	7.9	11	130	100	115	0	2	p.c.	"
6-16-69	1515	13	23	8.0	10	110	75	100	0	2	clear	"
8-26-69	1705	16	28	8.0	9	155	115	150	0	2	clear	"
11-30-69	1120	0	0.5	8.6				160			clear	L.S.

WILLOW CREEK

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLL
3-16-68	1630	6	9	8.0	12	55	40	55	10	2	p.c.	B.D.
6-20-68	1940	16	17	8.0	8	80	50	75	15	2	p.c.	"
10-19-68	1620	6	9	7.8	9	90	55	75	2	2	p.c.	"
2- 9-69	0815	0	-2	7.2	9	85	50	70	0	2	snow	"
5- 3-69	1605	11	12	7.4	10	45	25	40	15	2	clear	"
7-17-69	1215	14	25	7.8	8	55	35	50	17	2	clear	"
10- 7-69	1640	9	13	8.6	11		60	100			p.c.	L.S.
1-20-70	0920	-0.5	0	8.4	10.0						O'cast	"

ARRASTRA CREEK

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLL
3-17-68	1400	4	2	8.4	11	100	65	95	0	2	rain	B.D.
6-20-68	1730	11	21	8.3	11	60	30	60	0	2	p.c.	"
10- 20-68	1315	6	9	8.2	12	105	60	100	0	2	cloud	"
2-8- 69	1510	2	-2	8.0	11	100	60	100	0	2	p.c.	"
5- 3-69	1440	7	12	8.0	11	90	50	85	0	2	clear	"
7-16-69	1505	15	26	7.9	9	100	55	85	0	2	p.c.	"
10- 7-69	1500	8	19	8.5	10		60	110			p.c.	L.S.
1-20-70	1400	3.5	2.0	8.6	11.0						O'cast	"

APPENDIX 4 continued

POORMAN CREEK

DATA	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLL
2-18-68	0745	2	1	8.1	11	120	85	125	0	2	snow	"
5-25-68	1215	6	12	8.3	10	95	75	105	18	2	pc.	"
9-9 -68	1820	14	23	8.4	9	125	90	125	0	2	p.c.	"
1- 2-69	1700	3	0	8.1	10	130	90	130	0	2	p.c.	"
3-28-69	1715	7	7	8.3	10	120	90	120	0	2	p.c.	"
6-16-69	1735	13	20	8.0	10	120	90	110	0	2	clear	"
8-27-69	1320	13	26	8.1	9	130	100	125	0	2	clear	"
11-29-69	1400	5	7.5	8.7				130			clear	L.S.

SPRING CREEK

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLL
2-18-68	0900	3	1	8.4	10	175	110	175	0	2	snow	B.D.
5-25-68	1645	9	11	8.3	11	160	105	170	0	2	cloudy	"
9- 9-68	1650	13	24	8.3	9	175	110	170	0	2	p.c.	"
1- 2-69	1530	4	0	8.1	10	180	120	170	0	2	cloudy	"
3-28-69	1315	7	9	8.0	10	180	120	175	0	2	p.c.	"
6-16-69	1650	14	20	8.0	10	175	115	165	0	2	clear	"
8-26-69	1540	14	29	8.1	9	180	120	170	0	2	clear	"
11-30-69	1035	3.5	1.5	8.6				180			clear	L.S.

KEEP COOL CREEK

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLL
2-18-68	1000	0	1	8.4	11	160	105	150	0	2	snow	B.D.
5-25-69	1530	11	11	8.4	10	145	90	140	10	2	p.c.	"
9- 9-68	1600	13	24	8.4	9	150	100	140	0	2	clear	"
1- 2-69	1500	0	0	7.8	10	155	105	145	0	2	cloudy	"
3-28-69	1350	4	9	7.9	11	145	100	135	0	2	p.c.	"
6-16-69	1605	15	21	7.9	10	140	95	130	0	2	clear	"
8-26-69	1610	15	28	8.0	9	160	105	150	0	2	clear	"
11-30-69	1050	0	1.5	8.6				170			clear	L.S.

APPENDIX C continued

KLEINSCHMIDT CREEK

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLI
3-17-68	1500	6	2	8.6	14	165	95	150	2	2	rain	B.D.
6-20-68	1615	16	24	8.6	10	150	90	145	0	2	p.c.	"
10-20-68	1415	9	8	8.3	10	155	90	145	0	2	cloud	"
2- 8-69	1430	6	-5	8.2	12	145	90	135	0	2	p.c.	"
5-3 -69	1405	11	15	8.3	11	145	90	140	0	2	clear	"
7-16-69	1435	16	26	8.1	10	160	95	145	0-2	2	clear	"
10- 7-69	[illegible]	13	19	8.6	10		80	150			clear	L.S.
1-20-70	1330	6.5	2.0	8.6	10.0						O'Cast	"

MONTURE CREEK

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLI
3-16-68	1520	7	9	8.3	12	80	45	75	0	2	cloud	B.D.
6-20-68	1600	10	24	8.1	11	40	20	30	2	2	p.c.	"
10-19-68	1350	6	8	8.0	12	80	45	80	0	2	p.c.	"
2- 8-69	1335	0	-5	7.7	11	110	75	115	0	2	p.c.	"
5- 3-69	1245	6	18	7.5	11	55	30	45	0	2	p.c.	"
7-16-69	1320	12	22	7.8	9	65	30	55	0	2	clear	"
10- 7-69	1300	8	15	8.1	11		50	100				L.S.
1-20-70	1130	1.0	1.5	8.6	9.0*						RAIN Cloudy	L.S.

* Oxygen sample could not be fixed immediately. Could have been some O2 loss.

NORTH FORK BLACKFOOT RIVER

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLI
4-21-68	1230	6	7	8.3	10	145	80	140	0	2	p.c.	B.D.
7-23-68	0945	8	15	8.5	10	140	80	130	0	2	p.c.	"
11-30-68	1630	6	0	7.9	10	140	80	135	0	2	p.c.	"
5-3-69	1330	6	15	8.0	11	120	70	115	0	2	p.c.	"
7-16-69	1405	12	26	7.9	10	120	70	115	0	2	clear	"
10- 7-69	1310	10	22	8.5	9.0		90	150			clear	L.S.
1-20-70	1315	6.0	1.5	8.6	9.0						o'cast	"

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COTTONWOOD CREEK

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLI
4-21-68	1420	6	4	8.4	11	145	100	145	0	2	p.c.	B.D.
7-22-68	1600	13	26	8.5	11	155	100	150	0	2	p.c.	"
11-30-68	1500	0	2	8.1	11	160	100	150	0	2	p.c.	"
5- 3-69	1205	6	12	8.0	11	135	80	120	2	2	p.c.	"
7-16-69	1235	12	22	8.0	9	155	95	150	0	2	clear	"

WARREN CREEK

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK.	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLI
4-21-68	1330	6	8	8.2	10	90	65	85	30	2	p.c.	B.D.
7-23-68	1030	14	19	8.4	9	95	60	90	8	2	p.c.	"
11-30-68	1550	0	3	7.8	10	110	65	105	5	2	p.c.	"

CLEARWATER RIVER

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLI
3-16-68	1400	4	13	8.2	11	75	45	70	0	2	p.c.	B.D.
6-20-68	1500	16	25	8.2	11	60	35	50	0	2	p.c.	"
10-19-68	1300	7	8	7.9	12	80	50	70	0	2	p.c.	"
2-8-69	1235	0	-7	7.6	11	70	45	65	0	2	p.c.	"
5- 3-69	1115	7	12	7.8	11	60	35	55	0-2	2	p.c.	"
7-16-69	1120	17	23	7.8	9	65	45	60	0	2	clear	"
10- 7-69	1140	10.5	7	8.6	9		50	90			clear	L.S
1-20-70	1130	1	3.5	8.6	10.5						p.c.	L.S.

APPENDIX 4 continued

BLANCHARD CREEK

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLI
4-21-68	1520	5	6	8.2	11	40	25	35	0	2	p.c.	B.D.
7-23-68	1230	stream dry										
11-30-68	1430	0	2	7.9	10	80	45	75	0	2	p.c.	"

GOLD CREEK

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLI
4-20-68	1030	3	6	8.4	11	80	50	75	0	2	p.c.	B.D.
7-22-68	1130	14	29	8.5	9	100	65	95	0	2	clear	"
11-30-68	1200	0	2	8.0	11	100	65	95	0	2	p.c.	"

UNION CREEK

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLI
3-16-68	1130	4	15	8.3	12	120	70	120	40	2	p.c.	B.D.
6-20-68	1300	18	22	8.5	9	195	110	180	25	2	p.c.	"
10-19-68	1130	2	3	8.1	9	210	120	200	15	2	clear	"
2- 8-69	1030	0	-4	7.6	10	195	110	185	5	2	cloud	"
3-28-69	1045	1	8	7.3	8	105	70	100	120*	2	p.c.	"
6-17-69	1550	21	28	8.1	9	160	90	145	15	2	clear	"
8-26-69	1210	16	23	8.1	7	190	115	170	20	2	clear	"
11-29-69	1050	0	7.5	8.6				200			p.c.	L.S.

* Flood Stage

ELK CREEK

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	CA HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLI
3-16-68	1315	6	15	8.3	11	125	90	125	60	2	p.c.	B.D.
6-20-68	1410	14	22	8.3	10	125	105	130	18	2	p.c.	"
10-19-68	1215	4	7	8.1	10	150	110	140	10	2	clear	"
2- 8-69	no sample due to ice											
5-3 -69	1030	4	12	7.9	12	95	60	80	28	2	p.c.	"
7-16-69	1035	12	23	7.9	8	130	85	110	24	2	clear	"
10- 7-69	1030	5	1	8.7	11		130	170			clear	LS
1-20-70	1100	Creek frozen solid, no sample taken										"

EAST TWIN CREEK

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLI
3-16-68	1045	3	10	7.3	13	10	5	10	4	2	p.c.	B.D.
6-20-68	1200	8	19	8.1	11	15	5	10	0	2	p.c.	"
10-19-68	1045	2	3	6.9	11	15	5	15	0	2	clear	"

BELMONT CREEK

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLI
4-20-68	1230	3	11	8.4	11	75	70	90	0	2	p.c.	B.D.
7-23-68	1320	11	24	8.5	10	150	120	145	0	2	clear	"
11-30-68	1300	0	2	8.1	11	145	110	140	0	2	p.c.	"

WEST TWIN CREEK

DATE	TIME	H_2O TEMP	AIR TEMP	pH	D.O.	ALK	Ca HARD	TOTAL HARD	TURB	CO_2	WEATHER	COLI
3-16-68	1000	3	5	7.1	12	10	5	10	0	2	p.c.	B.D.
6-20-68	1115	8	18	7.7	11	5	2	2	0	2	p.c.	"
10-19-68	1000	2	0	6.6	11	2	2	5	0	2	clear	"

APPENDIX I

Results of Diurnal Dissolved Oxygen and Water Temperature Determinations

Analyses made at approximately four-hour intervals for 24 hours using the azide modification of the Winkler method according to "Standard Methods for the Examination of Water and Wastewater," 13th ed. 1971.

Water samples were collected beneath the water surface using a homemade Kemmerer type water sampler (Spence, 1974).

Analyses at Pop's Place by the USGS were made with a YSI D.O. Meter checked at beginning and end of period by modified Winkler method.

Saturation percentages calculated from nomographs showing percent saturation as a function of dissolved oxygen (ppm) and water temperature (°F). Mean sea level (msl) elevation of stations rounded to nearest 200 feet for use with nomographs.

Blackfoot River near Lincoln (Pop's Place), USGS Analyses (Elevation 5130 feet msl)

1968

Date	Time	Water Temp (°F)	D.O. (mg/l)	Percent Saturation	pH
9-9	1200	52	8.8	96	8.1
	1400	54	8.8	99	8.3
	1600	55	8.8	101	8.5
	1800	55	8.6	99	8.4
	2000	55	8.2	94	8.5
	2200	54	7.8	88	8.2
	2400	54	8.0	89	8.5
9-10	0200	54	8.0	89	8.4
	0400	52	8.0	88	8.4
	0600	52	8.0	88	8.4
	0800	50	8.0	85	8.6
	1000	52	8.4	93	8.6
	1200	52	8.8	96	8.4
10-9	1200	39	10.4	96	7.3
	1400	39	10.4	96	7.3
	1600	41	10.2	98	7.4
	1800	41	9.8	94	7.3
	2000	41	9.8	94	7.3
	2200	41	10.0	95	7.3
	2400	39	9.8	90	7.3

Date	Time	Water Temp (°F)	D.O. (mg/l)	Percent Saturation	pH
10-10	0200	39	9.8	90	7.4
	0400	39	9.8	90	7.3
	0600	39	9.8	90	7.4
	0800	39	10.0	93	7.4
	1000	39	10.0	93	7.6
	1200	39	10.2	95	7.4

1969

Date	Time	Water Temp (°F)	D.O. (mg/l)	Percent Saturation	pH	Q (cfs)
7-22	1800	59	8.0	96	6.7*	13.6
	1900	59	8.0	96	7.7	12.9
	2000	59	8.0	96	7.6	12.9
	2100	59	-	-	7.7	12.5
	2200	59	7.9	94	8.0	12.5
	2400	57	8.0	94	7.6	12.9
7-23	0130	56	8.0	93	7.8	12.9
	0230	55	8.0	92	7.7	13.3
	0400	55	8.0	92	7.6	13.6
	0600	54	8.2	92	7.6	13.6
	0800	53	8.2	92	7.6	13.6

*Probably due to failure to properly calibrate pH meter (USGS field notation).

(continued)

Date	Time	Water Temp (°F)	D.O. (mg/l)	Percent Saturation	pH	Q (cfs)
7-23	1000	53	8.4	93	7.7	13.6
	1100	54	-	-	-	13.6
	1200	55	8.4	95	7.8	13.6
	1400	57	8.2	96	7.8	13.3
	1600	59	8.0	96	7.9	12.9
	1800	60	8.0	98	7.9	12.9
8-21	1200	55	7.9	92	7.8	5.3
	1400	58	7.7	92	7.8	5.3
	1600	61	7.5	92	7.8	
	1800	62	7.4	92	7.7	
	2000	61	7.3	89	7.7	
	2200	60	7.3	88	7.5	
	2400	59	7.4	88	7.5	
8-22	0200	57	7.5	88	7.4	
	0400	56	7.6	88	7.4	
	0600	55	7.7	89	7.4	5.3
	0800	54.5	7.9	89	7.5	
	1000	54.5	7.9	90	7.6	
	1200	56	8.0	93	7.5	

APPENDIX I continued

Blackfoot River at Pop's Place (Elevation 5130 feet msl)
(Fish and Game Analyses)

Date	Time	Water Temp (°F)	D.O. (mg/l)	Percent Saturation
1971				
8-31	2010	57	7.7	91
9-1	0045	54	7.7	88
	0400	54	7.9	91
	0815	52	8.0	89
	1245	53	8.1	90
	1625	56	8.0	93
	2025	54	7.8	89
1973				
8-17	1240	58	7.8	94
	1635	61	7.5	93
	2035	60	7.3	90
8-18	2440	57	7.2	85
	0440	55	7.5	87
	0840	53	7.8	87
	1235	56.5	8.0	93

Blackfoot River at Flesher Road (Elevation ± 5000 feet msl)
(Fish and Game Analyses)

Date	Time	Water Temp (°F)	D.O. (mg/l)	Percent Saturation
1971				
8-31	1945	57	7.9	92
	2400	54	7.9	89
9-1	0445	51	8.2	89
	0835	50	8.2	88
	1225	52	8.5	94
	1555	58	8.3	98
	1955	54	7.9	90
1973				
8-17	1220	59	8.4	101
	1615	67	8.1	106
	2010	61	7.2	98
8-18	2420	58	7.0	84
	0420	55	7.4	85
	0820	53	8.0	89
	1220	57	8.5	99

APPENDIX I continued

Alice Creek (Elevation ± 5000 feet msl) Fish and Game Analyses

Date	Time	Water Temp (°F)	D.O. (mg/l)	Percent Saturation
		1971		
8-31	2025	54	7.8	89
	0030	54	8.0	91
9-1	0425	50	8.1	87
	0800	50	8.3	89
	1200	55	8.4	96
	1610	57	8.1	94
	2010	53	7.9	88
		1973		
8-17	1200	58	8.8	105
	1600	64	7.7	98
	2000	57.5	7.6	89
	2400	53	7.7	86
8-18	0400	50.5	8.0	97
	0800	50	8.3	89
	1200	58	8.1	96
	1310	61	8.0	98

Poorman Creek (Elevation ± 4600 feet msl)
Fish and Game analyses

Date	Time	Water Temp (°F)	D.O. (mg/l)	Percent Saturation	Discharge (cfs)
		1971			
9-1	1140	50	9.3	99	
	1525	53	9.3	102	
	1900	52	8.6	94	
	2320	50	8.4	89	
9-2	0230	no sample collected			
	0725	48	8.8	92	
	1100	50	9.5	101	
		1972			
6-22	1230	49	10.4	108	35
	1710	54.5	9.6	108	35
	2030	53	9.5	104	32
	2425	49	9.9	104	32
6-23	0425	46	10.1	102	35
	0835	45.5	10.3	102	35
	1220	46	10.6	107	36

APPENDIX I continued

Blackfoot River at Dalton Mountain Road
(Elevation ± 4400 feet msl)

Fish and Game analyses

Date	Time	Water Temp (°F)	D.O. (mg/l)	Percent Saturation	Discharge (cfs)
1971					
9-1	1100	50	8.8	92	
	1455	53	8.6	94	
	1845	53	8.9	97	
	2250	52	8.0	86	
9-2	0230	no sample collected			
	0710	48	8.1	84	
	1045	49	8.9	93	
1972					
6-22	1210	50	10.3	108	1050
	1615	54.5	9.3	104	1050
	2000	56	8.9	101	960
	2400	52	9.0	97	940
6-23	0400	49	9.3	97	940
	0805	47	9.6	98	960
	1155	47	9.7	99	1025

Blackfoot River at Blackfoot Canyon Camp (Elevation ± 4400 feet msl)

Fish and Game Analyses

Date	Time	Water Temp (°F)	D.O. (mg/l)	Percent Saturation	Discharge (cfs)
1971					
9-1	1030	50	8.7	91	
	1430	53	8.8	96	
	1825	52	8.8	95	
	2225	52	8.4	91	
9-2	0230	no sample collected			
	0625	50	8.4	88	
	1025	50	8.9	93	
1972					
6-22	1130	50	9.8	103	930
	1635	54.5	9.5	107	920
	1935	54.5	9.7	108	910
	2330	55	8.8	98	900
6-23	0330	53	9.1	98	880
	0735	50	9.3	98	880
	1130	49	9.6	100	900

APPENDIX J

Miscellaneous Surface Water Temperatures

Temperatures given herein were obtained periodically during the study. All temperatures are given in degrees centrigrade and were obtained with a Taylor pocket thermometer. Conversion of ^{o}F to ^{o}C was done where necessary.

These temperatures are in addition to temperature data given in Appendix H, Field Analyses.

Temperatures from main Blackfoot River stations are given first in descending order downstream, followed similarly by tributary streams.

APPENDIX J continued

Blackfoot River at Pop's Place

Year	Date	Time	H_2O Temp
1972	11-1	--	0.6
1973	5-14	--	6.3
	8-17	1245	14.4

Blackfoot River at Flesher Road Bridge

Year	Date	Time	H_2O Temp
1971	3-26	1310	0.0
	4-27	1125	1.0
	5-21	1450	4.5
	6-23	1420	15.0
	8-23	1545	17.0
	9-21	1410	5.0
	11-22	1345	0.0
	12-21	1000	0.0
1972	3-23	1400	2.0
	4-20	1200	4.5
	5-22	1210	6.0
	6-20	0915	8.5
	7-19	1230	7.5
	8-31	1300	12.8
	9-26	1145	2.2
	10-31	1200	0.0
	11-1	--	0.0
	11-29	1400	0.0
1973	3-7	1230	0.0
	5-14	1150	8.3
	8-17	1520	18.9

Blackfoot River at Hogum Road Bridge

Year	Date	Time	H_2O Temp
1971	3-26	1230	3.5
	4-27	1040	1.5
	5-21	1320	5.0
	6-23	1445	17.5
	8-23	1355	14.0
	9-21	1300	7.5
	11-22	1235	4.0
	12-21	1140	1.0
1972	2-2	1330	0.0
	3-23	1200	2.5
	5-19	1050	5.0
	8-2	1020	12.2
	9-8	1010	7.2
	10-25	1130	3.5
1972 (con'd)	11-3	--	4.4
	11-28	1500	0.0
	12-27	1550	1.5
1973	1-23	1130	0.0
	2-27	1330	2.5
	3-28	1130	3.5
	4-25	1400	5.5
	5-21	1800	11.0
	6-18	1620	9.0
	7-16	1200	15.0
	8-13	1500	15.5
	8-20	1045	11.7
	9-11	1600	15.5

Blackfoot River below 7-up Pete Creek

Year	Date	Time	H_2O Temp
1972	10-26	1010	3.5
	11-3	--	3.9
	11-28	1115	0.0
	12-27	1140	3.0
1973	1-23	1615	1.0
	2-27	1010	3.0
	3-7	1020	0.3
	3-28	0935	0.5
1973 (con'd)	4-25	1100	5.0
	5-21	1300	7.0
	6-18	1200	5.5
	7-16	1115	11.5
	8-13	1145	12.0
	8-20	1120	9.4
	9-11	1230	11.0

APPENDIX J continued

Blackfoot River at Dalton Mtn Road Bridge

Year	Date	Time	H_2O Temp	Year	Date	Time	H_2O Temp
1971	3-26	1105	4.5	1973	1-23	1500	5.0
	4-27	0910	2.0		2-27	0900	4.0
	5-21	0935	4.0		3-5	1010	2.8
	6-23	1545	13.5		3-28	0900	3.5
	8-23	--	10.0		4-25	1000	6.0
	9-21	1600	10.0		5-21	1120	7.0
	11-22	1100	3.0		6-18	1040	6.5
	12-21	1340	3.5		7-16	1000	10.5
					8-13	1020	10.5
1972	2-2	0945	0.0		8-20	1315	12.2
	3-23	0945	5.0		9-11	1040	9.5
	4-20	0855	4.5				
	5-22	0900	5.5				
	6-20	1300	10.0				
	7-19	0910	7.5				
	8-2	0935	10.6				
	8-31	1520	13.3				
	9-8	0945	7.3				
	9-26	0930	5.0				
	10-26	0900	5.5				
	10-31	0950	2.8				
	11-28	1015	1.5				
	11-29	1000	1.7				
	12-27	1040	4.5				

Blackfoot River at Blackfoot Canyon Camp

Year	Date	Time	H_2O Temp	Year	Date	Time	H_2O Temp
1971	3-26	1030	4.5	1972 (con'd)	10-26	0800	5.5
	4-27	0910	3.0		10-31	0910	2.2
	5-21	0915	4.5		11-28	0920	1.0
	6-23	1600	13.0		11-29	0915	0.6
	8-23	--	10.0		12-27	0945	4.0
	9-21	1030	5.5	1973	1-23	1420	2.0
	11-22	0925	3.0		2-27	0745	4.5
	12-21	1430	3.0		3-5	0930	2.8
1972	3-23	0815	5.0		3-26	0815	3.0
	4-20	0800	5.0		4-25	0900	6.5
	5-22	0800	6.5		5-14	--	13.3
	6-20	1340	9.5		5-21	0930	6.5
	7-19	0820	8.0		6-18	0915	6.5
	8-2	0920	11.7		7-16	0900	11.5
	8-31	1600	13.3		8-13	0930	11.0
	9-8	0925	7.8		8-20	1345	14.4
	9-26	0840	5.0		9-11	0935	10.0

Willow Creek (Flesher)

Year	Date	Time	H_2O Temp	Year	Date	Time	H_2O Temp
1972	6-20	1000	9.0	1973	3-7	1200	0.0
	8-31	1215	12.8		4-24	--	2.8
	9-26	1110	2.4		5-14	1200	8.3
	10-31	1130	0.3		8-17	1435	17.4

APPENDIX J continued

Alice Creek at Highway 200

Year	Date	Time	H_2O Temp
1971	3-26	1300	3.0
	4-27	1105	1.5
	5-21	1400	5.0
	6-23	1430	16.5
	8-23	1620	16.0
	9-21	1335	8.5
	11-22	1315	2.5
	12-21	1041	1.0
1972	3-23	1315	3.5
	4-20	1100	5.0
	5-22	1130	5.0
1972 (con'd)	6-20	1030	9.5
	7-19	1150	8.5
	8-31	1330	14.0
	9-26	1040	4.4
	10-31	1100	2.8
	11-2	--	3.3
	11-29	1330	1.1
1973	3-5	1240	2.8
	4-24	--	8.9
	5-16	1400	10.7
	8-17	1115	13.3

Hardscrabble Creek

Year	Date	Time	H_2O Temp
1971	10-20	--	5.5
1972	3-23	1230	2.0
	4-20	1030	3.5
	5-22	1100	8.0
	7-19	1100	9.0
	11-29	1300	0.0
1973	3-5	1420	1.1
	4-24	--	7.2
	5-19	1000	10.6
	8-18	1115	12.2

Landers Fork at Highway 200

Year	Date	Time	H_2O Temp
1972	11-3	--	5.0
1973	3-5	1135	4.4
	5-19	1135	5.0
	8-20	0950	8.3

Poorman Creek

Year	Date	Time	H_2O Temp
1971	3-26	1200	5.0
	4-27	1330	4.0
	5-21	1650	5.5
	6-23	1525	13.0
	8-23	--	10.0
	9-21	1515	10.0
	11-22	1105	4.0
	12-21	1235	4.0
1972	3-23	1100	3.5
	4-20	0940	3.5
1972 (con'd)	5-22	1000	5.0
	6-20	1145	8.0
	7-19	0945	7.5
	8-31	1440	12.8
	9-26	1000	6.1
	10-26	--	6.3
	10-31	1020	4.4
	11-29	1200	3.9
1973	3-5	1045	2.2
	8-20	1215	10.6

APPENDIX K

Results of Turbidity Measurements

Depth-integrated samples were collected with a Model DH-48 hand-suspended sediment sampler. Samples were thoroughly mixed and split into three 30 milliliter glass vials, with caps, and transported to the laboratory. Turbidity was determined with a Hach Model 2100-A laboratory turbidimeter within 24 hours of collection. Turbidity in each of the three vials was measured, and the average of the three readings became the final figure used. Turbidity values were rounded off in accordance with "Standard Methods for the Examination of Water and Wastewater," 13 edition, 1971, page 352.

Turbidity measurements made at the beginning of the study in 1968 were made in the field with a Hach Model DR-EL field test kit. These measurements are probably less accurate than those obtained with the Model 2100-A meter.

Streamflow was determined from staff gage height reading at time of sample collection, or from USGS streamflow records (daily mean, CFS). Where no gage was installed, a brief description of flow characteristics is given.

Turbidity of Union Creek near McNamara Landing

	Date	Turb (JTU)	Flow
1972	3-13	50	High and muddy

Turbidity of Clearwater River at Highway 200

	Date	Turb (JTU)	Flow
1972	4-18	2.3	High (not measured)

Turbidity of Cottonwood Creek on B-C Game Range

	Date	Turb (JTU)	Flow
1972	4-10	2.1	High and clear
	5-16	14	Flooding, turbid
	6-5	4.8	High and flooding, partially clear

Turbidity of North Fork Blackfoot River at Highway 200

	Date	Turb (JTU)	Flow
1972	6-3	150	High, fast, muddy
	6-9	130	Flooding, muddy
	6-20	9.4	High, milky-clear

Turbidity of Arrastra Creek at Highway 200

	Date	Turb (JTU)	Flow
1972	5-18	3.5	Clear
	6-7	2.7	High and clear

APPENDIX K continued

Turbidity of Blackfoot River at Blackfoot Canyon Camp

	Date	Turb (JTU)	Flow (cfs)
1972	2-14	1.4	--
	3-17	4.4	--
	4-28	8.9	520
	5-8	3.9	620
	5-17	100	2830
	5-18	100	3100
	5-24	31	2150
	5-31	90	2700
	6-3	140	3500
	6-5	120	3175
	6-7	110	3050
	6-9	110	3100
	6-13	55	2360
	6-16	37	1488
	6-20	23	1045
	6-27	7.3	790
	7-10	3.5	574
1973	2-14	0.65	90 (est.)
	5-19	55	930
	5-22	19	840
	5-31	4.8	565
	6-4	2.5	540
	6-8	4.9	610
1974	1-16	4.2	± 100 (est.)
	5-28	47	1500

Turbidity of Willow Creek at Dalton Mtn Road

	Date	Turb (JTU)	Flow
1972	3-17	8.5	Slightly flooding
	5-8	9.2	Not too high, murky
	6-3	60	Flooding, culvert washed out
	6-5	40	Flooding
	6-27	7.1	Not too high, murky

Turbidity of Blackfoot River at Dalton Mtn Bridge

	Date	Turb (JTU)	Flow (cfs)
1972	3-1	.70	--
	3-17	1.8	--
	4-28	7.1	460
	5-8	2.6	580
	5-17	100	2475
	6-3	170	2950
	6-5	150	2800
	6-7	120	2625
	6-9	130	2625
	6-13	60	1950
	6-16	35	1550
	6-27	6.5	810
	7-10	2.5	600
1973	2-14	1.0	80
	5-19	40	875
	5-22	15	750
	5-31	4.0	475
	6-4	2.4	455
1974	5-28	45	1400

APPENDIX K continued

Turbidity of Beaver Creek at Highway 200

Date	Turb (JTU)	Flow
1972 3-1	1.0	Low and clear, ice covered

Turbidity of Spring Creek at Highway 200

Date	Turb (JTU)	Flow
1972 3-1	.75	Low and clear

Turbidity of Poorman Creek at Stemple Road

Date	Turb (JTU)	Flow (cfs)
1972 2-14	.85	--
3-1	.80	--
3-15	1.6	--
5-8	2.9	29
5-17	31	217
6-3	24	200
6-7	8.8	130
6-13	9.3	62
6-16	5.0	52
6-20	3.5	41
1973 2-14	.45	--
5-17	1.9	7.8
5-22	2.8	23
5-31	1.0	12.5
6-4	.90	9

Turbidity of Blackfoot River below 7-up Pete Creek

Date	Turb (JTU)	Flow
1973 2-22	.50	Very low, clear
5-17	34	High, fast, murky

Turbidity of Lander's Fork of Blackfoot

	Date	Turb (JTU)	Flow
1972	3-1	.30	Low and clear
	3-17	.55	Low and clear
	5-17	50	± 1,100 cfs
	5-24	7.1	Rising, milky gray
	5-31	120	High, muddy brown
	6-3	220	±2,000 cfs
	6-5	150	High, muddy brown
	6-7	130	High, muddy brown
	6-9	120	High, muddy brown
	6-13	50	Falling, light brown
	6-16	26	Falling, clearing up, brownish gray
	6-20	12	Falling, clearing up, milky green
	6-27	4.5	Falling, clear
	7-10	2.0	Low and clear
	11-22	.40	Low and clear
1973	2-22	.65	19 cfs
	5-17	45	Rising, murky
	5-19	40	High, fast, milky brown
	5-22	15	±565 cfs, milky green
	5-24	13	Fairly high, milky green
	5-31	4.4	Not too high, greenish clear
	6-4	2.2	Falling, clear
	6-8	5.5	± 2 inches rise, clearish green
	6-11	2.9	Fell ± 2 inches, colorless green
1974	5-28	45	Rising, light brown

Turbidity of Copper Creek

	Date	Turb (JTU)	Flow
1972	5-24	1.7	High and fast, clear
	6-5	6.0	High and fast, gray-green
1973	6-8	2.0	Mod. high, fast, greenish clear

Turbidity of Blackfoot River at Hogum Bridge
(USGS gage below Alice Creek near Lincoln)

	Date	Turb (JTU)	Flow (cfs)
1972	3-17	3.7	55
	4-28	7.4	
	5-17	42	900
	5-31	11	509*
	6-3	6.4	463*
	6-7	3.8	309*
	6-9	3.1	279*
	6-13	2.4	179*
	7-10	1.2	52*
	11-22	.80	25*
1973	2-22	.80	11*
	5-14	3.3	165*
	5-17	19	268*
	5-19	4.7	268*
	5-22	2.7	193*
	5-31	1.2	85*
	6-4	1.1	69*
1974	5-28	5.2	382

*Mean flow for the day from U.S.G.S. records.

APPENDIX K continued

Turbidity of Hogum Creek at Hogum Road Bridge

Date	Turb (JTU)	Flow
1972 6-9	5.5	Clear, slightly milky green

Turbidity of Hardscrabble Creek at Highway 200

Date	Turb (JTU)	Flow
1972 4-28	4.3	Flooding
5-17	2.5	Slight flooding, clear
11-22	.7	Low and clear, ice-covered
1973 3-5	.7	Low and clear, ice-covered
4-24	1.6	Rising, clear
5-17	1.0	Low and clear
5-19	1.0	Low and clear

Turbidity of Alice Creek at Highway 200

Date	Turb (JTU)	Flow (cfs)
1972 3-1	.55	--
3-17	1.6	--
4-10	1.9	48
4-28	7.7	102
5-17	31	450
5-19	13	240
5-24	27	190
6-3	4.9	215
6-9	3.6	95
6-13	2.6	71
11-22	1.1	8
1973 2-22	.70	5.7
4-24	1.4	11
5-14	3.1	50
5-16	14	78
5-17	15	94
5-19	4.5	105
5-22	2.6	35
5-31	1.3	28
6-4	.90	27

Turbidity of Willow Creek (Flesher) at confluence with Blackfoot River

	Date	Turb (JTU)	Flow
1972	6-3	2.8	High, colorless
	11-22	4.2	Low, clear, oily appearance
1973	4-24	7.5	Rising, grayish green
	5-14	2.6	High, fast, oily blue, clear

Turbidity of Blackfoot River at Flesher Road

	Date	Turb (JTU)	Flow (cfs)
1972	3-1	1.3	--
	4-10	1.1	51
	5-5	1.5	112
	5-17	4.6	337 +
	5-31	.25	149
	6-3	1.3	125
	6-9	.90	80
	6-13	1.1	46
	11-22	1.2	-- (gage frozen in ice)
1973	2-22	1.0	-- (gage frozen in ice)
	4-24	5.2	42
	5-14	1.1	66
	5-16	2.6	95
	5-19	1.6	100
	5-22	1.2	66
	5-31	1.1	34
	6-4	.95	29

Turbidity of Blackfoot River at Pop's Place

	Date	Turb (JTU)	Flow
1972	3-15	8.3	Rising, orange color, detritus
1973	5-14	1.9	High, clear with oily color

APPENDIX L

Streamflow Record

Records are based on periodic staff gage readings and flow measurements. Measurements were made with a Price model AA or a pygmy current meter according to USGS recommended techniques. Gage height was plotted against flow to form a stage-discharge curve from which the flow from other gage height readings was obtained. Annual high flows were measured by USGS personnel.

The staff gages were 4 inches wide, in sections 3.33 feet long, and were marked at 1.0 foot, 0.10 foot, and 0.02 foot intervals.

Staff gage height was recorded at each station whenever water quality, turbidity or insect samples were collected, and at other times the station was visited. Staff gages were read as frequently as possible during spring runoff periods.

An asterick (*) indicates a flow measurement was made that day.

APPENDIX L continued

Streamflow based on periodic staff gage readings and flow measurements

Blackfoot River at Flesher

	Date	Gage Ht. (ft)	Flow (CFS)
1972	3-24	1.47	88*
	4-10	1.17	51*
	4-13	1.10	50
	4-17	1.00	43
	4-20	.96	40
	4-26	1.36	75
	5-5	±1.70	112
	5-17	2.40	337*
	5-19	±2.25	200
	5-22	±2.10	170
	5-31	±1.96	149
	6-3	±1.78	125
	6-9	1.40	80
	6-13	1.12	46
	6-16	.95	44*
	6-19	.90	37
	6-20	.87	35
	7-10	.50	13*
	7-19	.74	26
	8-9	.34	7*
	8-25	.36	8
	8-31	.28	5
	9-13	.34	7
	9-26	.30	6
	10-18	.28	4*

	Date	Gage Ht. (ft)	Flow (CFS)
1973	4-24	.97	42*
	5-1	.91	38
	5-14	1.26	66
	5-16	±1.54	95
	5-17	±1.62	104
	5-19	±1.58	100
	5-22	1.26	66
	5-23	1.16	56
	5-31	.86	34
	6-4	.79	29*
	7-23	.29	5
	7-26	.27	4*
	8-7	.24	4
	8-17	.16	3
	9-11	.31	6
	9-25	.28	5

Streamflow based on periodic staff gage readings and flow measurements

Alice Creek at Highway 200

	Date	Gage Ht. (ft)	Flow (CFS)
1972	3-24	1.12	23*
	3-30	1.11	23
	4-10	1.47	48*
	4-13	1.40	40
	4-14	1.35	37
	4-17	1.29	33
	4-20	1.25	31
	4-26	1.63	60
	4-28	1.93	102*
	5-4	1.94	102
	5-16	±2.64	430*
	5-17	2.70	450
	5-19	±2.55	310
	5-22	±2.50	280
	5-24	±2.30	190
	5-31	±2.36	215
	6-3	±2.26	177
	6-9	1.90	95
	6-13	1.68	71
	6-16	1.50	50
	7-10	1.04	21
	8-9	.85	15*
	8-25	.83	13
	9-13	.80	12
	10-18	.73	9.7*
	11-22	.65	8
1973	2-1	.61	7

Date	Gage Ht. (ft)	Flow (CFS)
2-22	.54	5.7*
4-24	.78	11
4-27	.84	13
5-1	.79	12
5-11	1.50	50
5-14	1.50	50
5-16	±1.80	78
5-17	±1.90	94
5-19	±1.95	105
5-21	±1.72	68
5-22	±1.26	35
5-23	±1.55	54
5-31	1.17	29
6-4	1.08	27*
7-23	.66	8
7-26	.65	8*
8-7	.60	7
8-14	.61	7
9-25	.58	6.5
9-26	.57	6

APPENDIX L continued

Streamflow based on periodic staff gage readings and flow measurements

Poorman Creek

	Date	Gage Ht. (ft)	Flow (CFS)	
1972	3-22	.92	21*	
	3-23	.98	23	
	4-5	.82	11*	
	4-10	.94	19	
	4-13	.90	16	
	4-17	.83	10	
	4-20	.83	10	
	4-25	.87	14	
	5-5	±1.10	32	
	5-8	1.06	29	
	5-16	1.88	171*	
	5-17	±2.05	217	
	5-22	±1.70	117	
	6-3	1.92	169*	
	6-3	±2.00	200	
	6-7	±1.75	130	
	6-13	±1.42	62	
	6-16	1.35	52*	
	6-20	1.22	41	
	7-10	1.00	18	
	7-19	1.00	18	
	8-7	.90	12.5	
	8-10	.88	12*	
	8-31	.82	8.6	
	9-13	.81	8.4	
	9-26	.78	5	
	10-19	.76	5*	
	10-31	.74	5	
1973	2-27	.52	1	gage reset-new rating begins
	3-5	.54	1	
	4-26	.62	2.8	
	5-17	.78	7.8	
	5-19	.89	13.5	
	5-22	.99	23	
	5-23	.97	19	
	5-31	.87	12.5	
	6-4	.81	9*	
	7-23	.54	2	
	7-24	.54	2*	
	8-7	.50	1-2 (poor curve)	
	8-14	.49	1-2 (poor curve)	
	8-20	.47	1	
	9-25	.46	1	
	9-27	.46	1	

Streamflow in Landers Fork and Copper Creek based only on flow measurements 1/

(1) Landers Fork above Copper Creek		(2) Copper Creek		(3) Landers Fork at Highway 200	
Date	Flow (CFS)	Date	Flow (CFS)	Date	Flow (CFS)
These sites not used in 1972				4-19-72	40
				5-8-72	160
				5-16-72	1,100
				6-2-72	2,000
				6-10-72	1,990
				8-9-72	136
				10-18-72	26
				2-22-73	19
5-21-73	388	5-21-73	177	5-21-73	565*
6-18-73	131	6-18-73	107	6-18-73	238*
7-25-73	15	7-25-73	34	7-25-73	73**
9-27-73	4	9-27-73	16	9-27-73	36**

*Flow not measured at Highway 200
This is probably the approximate flow at Highway 200 (Copper + Landers) during this high water period because water table is saturated.

**Copper (2) plus Landers (1) does not equal flow of Landers at Highway 200 (3) due to ground water accretion. Landers (1) is dry below measuring site above Copper Creek and Copper Creek (2) contributes most of flow. Ground water accretion at Highway 200 (3) was 32% on 7-25-73 and 45% on 9-27-73.

1/ Extreme channel instability in Landers Fork precluded normal use of staff gage or other reference points.

APPENDIX L continued

Streamflow based on periodic staff gage readings and flow measurements

Blackfoot River at Dalton Mtn Bridge

	Date	Gage Ht. (ft)	Flow (CFS)
1972	3-22	1.02	152*
	3-23	1.18	190
	3-29	1.16	185
	3-30	1.13	178
	4-5	1.17	185
	4-10	±1.45	285
	4-13	1.42	275
	4-14	1.40	265
	4-17	1.39	260
	4-19	1.36	252*
	4-20	±1.35	245
	4-26	±1.56	330
	4-28	±1.78	460
	5-4	±1.88	520
	5-8	±1.98	580
	5-16	3.90	2150*
	5-17	±4.20	2475
	5-19	±4.15	2425
	5-22	±4.10	2385
	6-2	4.80	3330*
	6-3	±4.65	2950
	6-5	±4.50	2800
	6-7	±4.35	2625
	6-9	±4.35	2625
	6-13	±3.66	1950
	6-16	±3.20	1550
	6-20	±2.86	1240
	6-27	2.38	810
	7-10	±2.00	600
	7-19	±1.86	505
	8-2	±1.46	310
	8-10	±1.25	221*
	8-25	1.18	190
	8-31	±1.10	170
	9-8	.96	133
	9-13	±.98	140
	10-19	.95	125*
	10-31	.89	118
	11-29	.81	100
1973	2-1	±.69	77
	2-14	.70	80
	2-15	.68	72*
	3-5	.67	70
	4-26	±.67	70
	5-3	±.66	70
	5-11	±1.00	142
	5-17	±1.86	505
	5-19	±2.42	875
	5-21	±2.35	850
	5-21	±2.46	889*
	5-22	2.26	750
	5-23	±2.10	670
	5-31	±1.80	475
	6-4	1.76	455
	6-8	±1.90	540
	6-18	1.68	432
	7-23	±.94	126
	7-24	.94	126*
	8-7	±.89	118
	8-14	.86	112
	8-20	.82	103
	9-25	.78	95
	9-28	.79	81*

Streamflow based on periodic staff gage readings and flow measurements

Blackfoot River at Blackfoot Canyon Camp

	Date	Gage Ht. (ft)	Flow (CFS)
1972	3-22	1.53	244*
	3-29	1.59	265
	3-30	1.55	250
	4-5	1.63	267*
	4-10	2.01	385
	4-13	1.96	370
	4-14	1.90	350
	4-17	1.93	362
	4-20	1.81	327
	4-26	2.12	415
	4-28	2.44	520
	5-4	2.59	561
	5-8	2.78	620
	5-17	±5.80	2830*
	5-18	±6.10	3100
	5-19	±5.90	2850
	5-22	±5.70	2700
	5-24	±5.30	2150
	5-31	±5.70	2700
	6-2	6.50	3670*
	6-3	±6.40	3500
	6-5	±6.15	3175
	6-7	±6.05	3050
	6-9	±6.10	3100
	6-13	±5.46	2360
	6-16	4.58	1488
	6-20	4.08	1045
	6-27	3.30	790
	7-10	2.63	574
	7-18	2.30	462
	7-19	2.48	529
	7-27	2.06	400
	7-31	1.92	357
	8-2	1.92	357
	8-7	1.77	315
	8-10	1.70	287*
	8-25	1.60	265
	8-31	1.48	234
	9-8	1.35	197
	9-13	1.37	203
	9-26	1.33	193
	10-19	1.30	172
	10-31	1.25	171
	11-29	1.14	142
1973	2-1	.94	102
	2-14	.88	90
	2-15	.90	99*
	3-5	.94	135
	4-20	.94	102
	4-26	.96	106
	5-3	.93	101
	5-7	.96	106
	5-11	1.28	180
	5-14	1.22	220
	5-16	1.50	310
	5-17	2.15	560
	5-19	±3.10	930
	5-21	3.00	895
	5-21	3.16	1000*
	5-22	2.87	840
	5-23	2.66	760
	5-24	2.60	740
	5-31	2.15	565
	6-4	2.10	540
	6-8	2.28	610
	6-18	1.99	471*
	7-23	1.03	156
	7-24	1.03	156*
	8-7	.96	143
	8-14	.90	133
	8-20	.85	122
	9-14	.87	127
	9-25	.83	118
	9-28	.82	120*

APPENDIX M

Laboratory analyses made by the Anaconda Company on acid mine seepage in the Heddleston Mining District in 1972 and 1973.

Cation - anion balances do not agree in these analyses. The computer program which analyzed the laboratory data did not take into account milliequivalents for H^+ from extremely low pH or high concentrations of heavy metals in the cation summation. However, individual values of the parameters given are correct, according to the Anaconda Company.

Appendix H (continued)

THE ANACONDA COMPANY

DATE 6/24/73 SUBJECT HEDDLESTON MINE SEEPAGE PLANT

REMARKS BY D.C.N.T. FILE

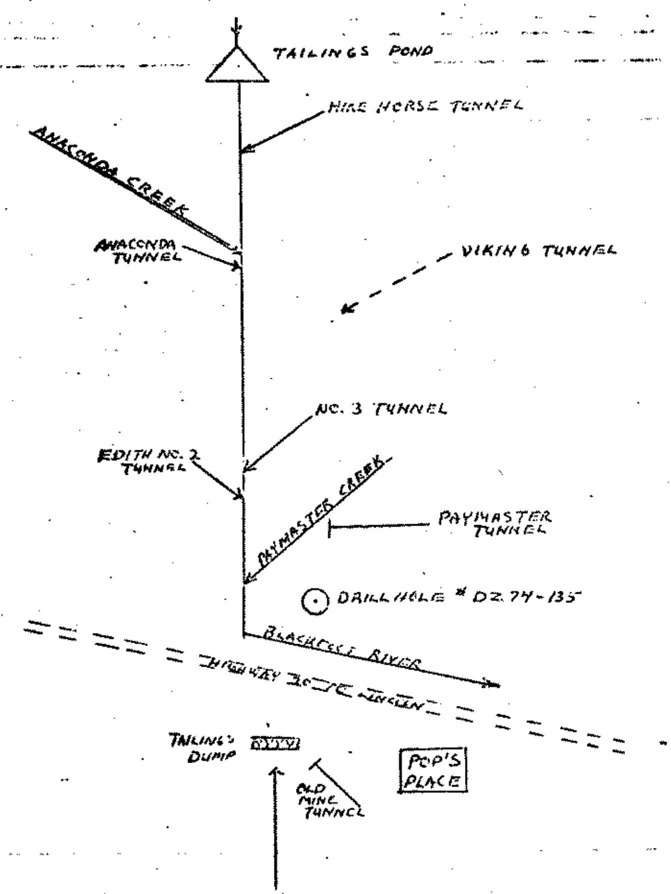

FIG. # 1

SCHEMATIC OF TUNNEL LOCATIONS

ENVIRONMENTAL ENGINEERING DEPARTMENT

THE ANACONDA COMPANY BUTTE, MONTANA 59701

WATER QUALITY ANALYSIS

NATION OR STATE	MONTANA	PROPERTY OR OPERATION	HEDDLESTON
PROV. OR COUNTY	LEWIS&CLARK	LABORATORY NUMBER	72-1149
LOCATION		SAMPLE OR BOTTLE NUMBER	1696
DATE SAMPLED	08-04-72	STATION NUMBER	
TIME SAMPLED	1145	SAMPLE TYPE	DRAINAGE
WATER FLOW RATE	5. GPM (E)	SAMPLE HANDLING	4100
FLOW MEAS METHOD		PRINCIPAL USE OF WATER	RECREATION

PROJECT HEDDLESTON HQ

REMARKS PAYMASTER TUNNEL DRAINAGE IRON PPT & DENSE ALGAE MAT

PARAMETERS REPORTED IN MILLIGRAMS PER LITER EXCEPT AS INDICATED

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)	48.	2.400	BICARBONATE(HCO3)	0.	0.0
MAGNESIUM (MG)	13.3	1.097	CARBONATE (CO3)	0.	0.0
SODIUM (NA)	8.4	0.365	HYDROXIDE (OH)	0.	0.000
POTASSIUM (K)	1.20	0.031	CHLORIDE (CL)	11.2	0.316
TOT. IRON (FE)	120.	6.446	SULFATE (SO4)	696.	14.484
MANGANESE (MN)	4.56	0.166	NITRATE (NO3)	.00	0.0
ALUMINUM (AL)	15.8	1.757	FLUORIDE (F)	.37	0.046
SILICA (SIO2)			PHOSPHATE (PO4)		
TOTAL CATIONS		12.262	TOTAL ANIONS		14.345

STANDARD DEVIATION OF CATION-ANION BALANCE 8.14 SIGMA

LABORATORY PH	2.62	CARBONATE HARDNESS AS CACO3	0
FIELD TEMPERATURE DEGREES F	44.	NON-CARB. HARDNESS AS CACO3	174
CALCULATED DISSOLVED SOLIDS	919.1	TOTAL HARDNESS AS CACO3	174
EVAPORATED SOLIDS AT 105 C	1104.	TOTAL ALKALINITY AS CACO3	0
SPECIFIC CONDUCTANCE IN MICROMHOS/CM AT 25 C	1690.0	FIELD TURBIDITY (JTU)	
ACIDITY AS CACO3		TOTAL FILTERABLE SOLIDS	
		DISSOLVED OXYGEN AS (O2)	

SELECTED TRACE METALS (RECOVERABLE BY ACID DIGESTION OF UNFILTERED SAMPLE)

ARSENIC (AS)	.021	COPPER (CU)	21.0	NICKEL (NI)	.08
CADMIUM (CD)	.048	LEAD (PB)	.10	ZINC (ZN)	3.40
CHROMIUM (CR)	<.02	MERCURY (HG)			

ADDITIONAL PARAMETERS

AA CALCIUM (CA) 40. AA MAGNESIUM (MG) 16.50

NOTE. PARAMETERS ARE TOTAL DISSOLVED UNLESS LABELED TR-TOTAL RECOVERABLE

SAMPLED BY RLD

ANALYSIS REQUESTED BY GNM

DATE ANALYSIS COMPLETED 8-14-72

ANALYST MAC

PERCENT REACTANCE VALUES

CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
62	28	9	1	2	98	0	0	0

OSC MEAS. OSC CALC.

NOTE. IN CORRESPONDENCE RELATED TO THIS ANALYSIS REFER TO NUMBER 72-1149

Appendix M (continued)

THE ANACONDA COMPANY
ENVIRONMENTAL ENGINEERING DEPARTMENT
BUTTE, MONTANA 59701
WATER QUALITY ANALYSIS

NATION OR STATE	MONTANA	PROPERTY OR OPERATION	HEDDLESTON
PROV. OR COUNTY	LEWIS&CLARK	LABORATORY NUMBER	72-1144
LOCATION		SAMPLE OR BOTTLE NUMBER	257
DATE SAMPLED	08-04-72	STATION NUMBER	
TIME SAMPLED	1405	SAMPLE TYPE	DRAINAGE
WATER FLOW RATE	5. GPM (E)	SAMPLE HANDLING	4100
FLOW MEAS METHOD		PRINCIPAL USE OF WATER	

PROJECT HEDDLESTON WQ
REMARKS ANACONDA TUNNEL ABUNDANT ALGAE, MOSS AND IRON PPT

PARAMETERS REPORTED IN MILLIGRAMS PER LITER EXCEPT AS INDICATED

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)	68.	3.372	BICARBONATE(HCO3)	0.	0.0
MAGNESIUM (MG)	38.	3.162	CARBONATE (CO3)	0.	0.0
SODIUM (NA)	5.6	0.244	HYDROXIDE (OH)	0.	0.000
POTASSIUM (K)	1.14	0.029	CHLORIDE (CL)	1.4	0.039
TOT. IRON (FE)	28.	1.504	SULFATE (SO4)	466.	9.696
MANGANESE (MN)	12.6	0.459	NITRATE (NO3)	.00	0.0
ALUMINUM (AL)	4.9	0.545	FLUORIDE (F)	.61	0.032
SILICA (SIO2)			PHOSPHATE (PO4)		
		------			------
TOTAL CATIONS		9.313	TOTAL ANIONS		9.768

STANDARD DEVIATION OF CATION-ANION BALANCE 1.78 SIGMA

LABORATORY PH	2.96	CARBONATE HARDNESS AS CACO3	0
FIELD TEMPERATURE DEGREES F	52.	NON-CARB. HARDNESS AS CACO3	327
CALCULATED DISSOLVED SOLIDS	626.0	TOTAL HARDNESS AS CACO3	327
EVAPORATED SOLIDS AT 105 C	740.	TOTAL ALKALINITY AS CACO3	0
SPECIFIC CONDUCTANCE IN		FIELD TURBIDITY (JTU)	
MICROMHOS/CM AT 25 C	1140.0	TOTAL FILTERABLE SOLIDS	
ACIDITY AS CACO3		DISSOLVED OXYGEN AS (O2)	

SELECTED TRACE METALS (RECOVERABLE BY ACID DIGESTION OF UNFILTERED SAMPLE)

ARSENIC (AS)	.016	COPPER (CU)	4.30	NICKEL (NI)	.05
CADMIUM (CD)	.028	LEAD (PB)	.08	ZINC (ZN)	6.20
CHROMIUM (CR)	<.02	MERCURY (HG)			

ADDITIONAL PARAMETERS
AA CALCIUM (CA) 58. AA MAGNESIUM (MG) 26.20

NOTE. PARAMETERS ARE TOTAL DISSOLVED UNLESS LABELED TR-TOTAL RECOVERABLE
SAMPLED BY RLD
ANALYSIS REQUESTED BY GMM
DATE ANALYSIS COMPLETED 8-14-72
ANALYST MAC

PERCENT REACTANCE VALUES

CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
50	46	4	0	0	100	0	0	0

DSC MEAS. DSC CALC.
NOTE. IN CORRESPONDENCE RELATED TO THIS ANALYSIS REFER TO NUMBER 72-1144

THE ANACONDA COMPANY
ENVIRONMENTAL ENGINEERING DEPARTMENT
BUTTE, MONTANA 59701
WATER QUALITY ANALYSIS

NATION OR STATE	MONTANA	PROPERTY OR OPERATION	HEDDLESTON
PROV. OR COUNTY	LEWIS&CLARK	LABORATORY NUMBER	72-1145
LOCATION		SAMPLE OR BOTTLE NUMBER	227
DATE SAMPLED	08-04-72	STATION NUMBER	
TIME SAMPLED	1225	SAMPLE TYPE	DRAINAGE
WATER FLOW RATE	7. GPM (E)	SAMPLE HANDLING	4100
FLOW MEAS METHOD		PRINCIPAL USE OF WATER	

PROJECT HEDDLESTON WQ
REMARKS EDITH NO 2 TUNNEL ALGAE SPARCE SOME IRON PPT

PARAMETERS REPORTED IN MILLIGRAMS PER LITER EXCEPT AS INDICATED

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)	25.	1.240	BICARBONATE(HCO3)	0.	0.0
MAGNESIUM (MG)	2.2	0.179	CARBONATE (CO3)	0.	0.0
SODIUM (NA)	14.2	0.618	HYDROXIDE (OH)	0.	0.000
POTASSIUM (K)	1.28	0.033	CHLORIDE (CL)	2.2	0.061
TOT. IRON (FE)	13.4	0.720	SULFATE (SO4)	189.	3.932
MANGANESE (MN)	.78	0.028	NITRATE (NO3)	.00	0.0
ALUMINUM (AL)	4.7	0.523	FLUORIDE (F)	.51	0.027
SILICA (SIO2)			PHOSPHATE (PO4)		
		------			------
TOTAL CATIONS		3.340	TOTAL ANIONS		4.019

STANDARD DEVIATION OF CATION-ANION BALANCE 4.15 SIGMA

LABORATORY PH	3.12	CARBONATE HARDNESS AS CACO3	0
FIELD TEMPERATURE DEGREES F	53.	NON-CARB. HARDNESS AS CACO3	70
CALCULATED DISSOLVED SOLIDS	252.9	TOTAL HARDNESS AS CACO3	70
EVAPORATED SOLIDS AT 105 C	354.	TOTAL ALKALINITY AS CACO3	0
SPECIFIC CONDUCTANCE IN		FIELD TURBIDITY (JTU)	
MICROMHOS/CM AT 25 C	610.0	TOTAL FILTERABLE SOLIDS	
ACIDITY AS CACO3		DISSOLVED OXYGEN AS (O2)	

SELECTED TRACE METALS (RECOVERABLE BY ACID DIGESTION OF UNFILTERED SAMPLE)

ARSENIC (AS)	[redacted] .005	COPPER (CU)	5.08	NICKEL (NI)	.05
CADMIUM (CD)	.012	LEAD (PB)	.12	ZINC (ZN)	.58
CHROMIUM (CR)	<.02	MERCURY (HG)			

ADDITIONAL PARAMETERS
AA CALCIUM (CA) 14.2 AA MAGNESIUM (MG) 11.22

NOTE. PARAMETERS ARE TOTAL DISSOLVED UNLESS LABELED TR-TOTAL RECOVERABLE
SAMPLED BY RLD
ANALYSIS REQUESTED BY GMM
DATE ANALYSIS COMPLETED 8-14-72
ANALYST MAC

PERCENT REACTANCE VALUES

CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
60	9	30	2	2	98	0	0	0

DSC MEAS. DSC CALC.
NOTE. IN CORRESPONDENCE RELATED TO THIS ANALYSIS REFER TO NUMBER 72-1145

Appendix M (continued)

THE ANACONDA COMPANY — ENVIRONMENTAL ENGINEERING DEPARTMENT — BUTTE, MONTANA 59701

WATER QUALITY ANALYSIS

NATION OR STATE	MONTANA	PROPERTY OR OPERATION	HEDDLESTON
PROV.OR COUNTY	LEWIS&CLARK	LABORATORY NUMBER	72-115[illegible]
LOCATION		SAMPLE OR BOTTLE NUMBER	105[illegible]
DATE SAMPLED	08-04-72	STATION NUMBER	
TIME SAMPLED	1300	SAMPLE TYPE	DRAINAGE
WATER FLOW RATE	30. GPM (F)	SAMPLE HANDLING	410[illegible]
FLOW MEAS METHOD		PRINCIPAL USE OF WATER	RECREATION

PROJECT HEDDLESTON WD
REMARKS TUNNEL NO 3 SPARCE ALGAE LIGHT IRON PRECIPITATE

PARAMETERS REPORTED IN MILLIGRAMS PER LITER EXCEPT AS INDICATED

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)	16.8	0.840	BICARBONATE(HCO3)	0.	0.0
MAGNESIUM (MG)	7.9	0.639	CARBONATE (CO3)	0.	0.0
SODIUM (NA)	3.2	0.139	HYDROXIDE (OH)	0.	0.000
POTASSIUM (K)	1.30	0.033	CHLORIDE (CL)	3.2	0.089
TOT. IRON (FE)	17.2	0.924	SULFATE (SO4)	211.	4.385
MANGANESE (MN)	.31	0.011	NITRATE (NO3)	.00	0.0
ALUMINUM (AL)	7.7	0.856	FLUORIDE (F)	.33	0.017
SILICA (SIO2)			PHOSPHATE (PO4)		
TOTAL CATIONS		3.443	TOTAL ANIONS		4.492

STANDARD DEVIATION OF CATION-ANION BALANCE 6.24 SIGMA

A-70

LABORATORY PH	3.02	CARBONATE HARDNESS AS CACO3	0
FIELD TEMPERATURE DEGREES F	40.	NON-CARB. HARDNESS AS CACO3	74
CALCULATED DISSOLVED SOLIDS	268.4	TOTAL HARDNESS AS CACO3	74
EVAPORATED SOLIDS AT 105 C	344.	TOTAL ALKALINITY AS CACO3	0
SPECIFIC CONDUCTANCE IN MICROMHOS/CM AT 25 C	690.0	FIELD TURBIDITY (JTU)	
		TOTAL FILTERABLE SOLIDS	
ACIDITY AS CACO3		DISSOLVED OXYGEN AS (O2)	

SELECTED TRACE METALS (RECOVERABLE BY ACID DIGESTION OF UNFILTERED SAMPLE)

ARSENIC (AS)	.013	COPPER (CU)	30.4	NICKEL (NI)	.06
CADMIUM (CD)	<.010	LEAD (PB)	<.02	ZINC (ZN)	.18
CHROMIUM (CR)	<.02	MERCURY (HG)			

ADDITIONAL PARAMETERS

AA CALCIUM (CA) 2.3 AA MAGNESIUM (MG) 4.75
PH,FIELD 4.

NOTE. PARAMETERS ARE TOTAL DISSOLVED UNLESS LABELED TR-TOTAL RECOVERABLE

SAMPLED BY RLD
ANALYSIS REQUESTED BY GMM
DATE ANALYSIS COMPLETED 8-14-72
ANALYST MAC

PERCENT REACTANCE VALUES

CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
51	39	8	2	2	98	0	0	0

DSC MEAS. DSC CALC.

NOTE. IN CORRESPONDENCE RELATED TO THIS ANALYSIS REFER TO NUMBER 72-115[illegible]

THE ANACONDA COMPANY — ENVIRONMENTAL ENGINEERING DEPARTMENT — BUTTE, MONTANA 59701

WATER QUALITY ANALYSIS

NATION OR STATE	MONTANA	PROPERTY OR OPERATION	HEDDLESTON
PROV.OR COUNTY	LEWIS&CLARK	LABORATORY NUMBER	72-1148
LOCATION		SAMPLE OR BOTTLE NUMBER	55G
DATE SAMPLED	08-04-72	STATION NUMBER	
TIME SAMPLED	1510	SAMPLE TYPE	DRAINAGE
WATER FLOW RATE	300. GPM (M)	SAMPLE HANDLING	4100
FLOW MEAS METHOD		PRINCIPAL USE OF WATER	

PROJECT HEDDLESTON W D
REMARKS MIKE HORSE MINE TUNNEL NO ALGAE -IRON PPT - TURBID

PARAMETERS REPORTED IN MILLIGRAMS PER LITER EXCEPT AS INDICATED

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)	150.	7.480	BICARBONATE(HCO3)	61.	1.000
MAGNESIUM (MG)	158.	13.002	CARBONATE (CO3)	0.	0.0
SODIUM (NA)	3.8	0.165	HYDROXIDE (OH)	0.	0.000
POTASSIUM (K)	1.20	0.031	CHLORIDE (CL)	1.6	0.045
TOT. IRON (FE)	20.	1.074	SULFATE (SO4)	928.	19.315
MANGANESE (MN)	26.6	0.968	NITRATE (NO3)	.16	0.003
ALUMINUM (AL)	.2	0.022	FLUORIDE (F)	.99	0.052
SILICA (SIO2)			PHOSPHATE (PO4)		
TOTAL CATIONS		22.743	TOTAL ANIONS		20.420

STANDARD DEVIATION OF CATION-ANION BALANCE -5.27 SIGMA

LABORATORY PH	6.33	CARBONATE HARDNESS AS CACO3	50
FIELD TEMPERATURE DEGREES F	42.	NON-CARB. HARDNESS AS CACO3	981
CALCULATED DISSOLVED SOLIDS	1351.6	TOTAL HARDNESS AS CACO3	1031
EVAPORATED SOLIDS AT 105 C	1454.	TOTAL ALKALINITY AS CACO3	50
SPECIFIC CONDUCTANCE IN MICROMHOS/CM AT 25 C	1460.0	FIELD TURBIDITY (JTU)	
		TOTAL FILTERABLE SOLIDS	
ACIDITY AS CACO3		DISSOLVED OXYGEN AS (O2)	

SELECTED TRACE METALS (RECOVERABLE BY ACID DIGESTION OF UNFILTERED SAMPLE)

ARSENIC (AS)	.006	COPPER (CU)	1.45	NICKEL (NI)	.10
CADMIUM (CD)	.094	LEAD (PB)	.22	ZINC (ZN)	52.
CHROMIUM (CR)	<.02	MERCURY (HG)			

ADDITIONAL PARAMETERS

AA CALCIUM (CA) 150. AA MAGNESIUM (MG) 134.00
PH,FIELD 5.

NOTE. PARAMETERS ARE TOTAL DISSOLVED UNLESS LABELED TR-TOTAL RECOVERABLE

SAMPLED BY RLD
ANALYSIS REQUESTED BY GMM
DATE ANALYSIS COMPLETED 8-14-72
ANALYST MAC

PERCENT REACTANCE VALUES

CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
36	63	1	0	0	95	5	0	0

DSC MEAS. DSC CALC.

NOTE. IN CORRESPONDENCE RELATED TO THIS ANALYSIS REFER TO NUMBER 72-1148

THE ANACONDA COMPANY — ENVIRONMENTAL ENGINEERING DEPARTMENT — BUTTE, MONTANA 59701

WATER QUALITY ANALYSIS

NATION OR STATE	MONTANA	PROPERTY OR OPERATION	HEDDLESTON
PROV.OR COUNTY	LEWISACLARK	LABORATORY NUMBER	72-1146
LOCATION		SAMPLE OR BOTTLE NUMBER	204
DATE SAMPLED	08-04-72	STATION NUMBER	
TIME SAMPLED	1700	SAMPLE TYPE	DRAINAGE
WATER FLOW RATE	10. GPM (E)	SAMPLE HANDLING	4100
FLOW MEAS METHOD		PRINCIPAL USE OF WATER	

PROJECT HEDDLESTON
REMARKS MINE DRAINAGE NEAR POPS PLACE

PARAMETERS REPORTED IN MILLIGRAMS PER LITER EXCEPT AS INDICATED

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)	18.4	0.920	BICARBONATE(HCO3)	25.	0.404
MAGNESIUM (MG)	7.3	0.599	CARBONATE (CO3)	0.	0.0
SODIUM (NA)	6.4	0.278	HYDROXIDE (OH)	0.	0.000
POTASSIUM (K)	.60	0.015	CHLORIDE (CL)	2.0	0.055
TOT. IRON (FE)	15.6	0.838	SULFATE (SO4)	67.	1.396
MANGANESE (MN)	1.6	0.058	NITRATE (NO3)	.12	0.002
ALUMINUM (AL)	1.4	0.155	FLUORIDE (F)	.29	0.015
SILICA (SIO2)			PHOSPHATE (PO4)		
TOTAL CATIONS		2.864	TOTAL ANIONS		1.872

STANDARD DEVIATION OF CATION-ANION BALANCE -6.93 SIGMA

LABORATORY PH	6.19	CARBONATE HARDNESS AS CACO3	20
FIELD TEMPERATURE DEGREES F	58.	NON-CARB. HARDNESS AS CACO3	55
CALCULATED DISSOLVED SOLIDS	145.4	TOTAL HARDNESS AS CACO3	76
EVAPORATED SOLIDS AT 105 C	90.	TOTAL ALKALINITY AS CACO3	20
SPECIFIC CONDUCTANCE IN		FIELD TURBIDITY (JTU)	
MICROMHOS/CM AT 25 C	170.0	TOTAL FILTERABLE SOLIDS	
ACIDITY AS CACO3		DISSOLVED OXYGEN AS (O2)	

SELECTED TRACE METALS (RECOVERABLE BY ACID DIGESTION OF UNFILTERED SAMPLE)

ARSENIC (AS)	.001	COPPER (CU)	.23	NICKEL (NI)	<.02
CADMIUM (CD)	.014	LEAD (PB)	.08	ZINC (ZN)	.16
CHROMIUM (CR)	<.02	MERCURY (HG)			

ADDITIONAL PARAMETERS

AA CALCIUM (CA) 18. AA MAGNESIUM (MG) 7.00

NOTE. PARAMETERS ARE TOTAL DISSOLVED UNLESS LABELED TR-TOTAL RECOVERABLE

SAMPLED BY RLD
ANALYSIS REQUESTED BY GHM
DATE ANALYSIS COMPLETED 8-14-72
ANALYST MAC

PERCENT REACTANCE VALUES

CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
51	38	15	1	3	75	22	0	0

DSC MEAS. DSC CALC.

NOTE. IN CORRESPONDENCE RELATED TO THIS ANALYSIS REFER TO NUMBER 72-1146

THE ANACONDA COMPANY — ENVIRONMENTAL ENGINEERING DEPARTMENT — BUTTE, MONTANA 59701

WATER QUALITY ANALYSIS

NATION OR STATE	MONTANA	PROPERTY OR OPERATION	HEDDLESTON
PROV.OR COUNTY	LEWISACLARK	LABORATORY NUMBER	72-1147
LOCATION		SAMPLE OR BOTTLE NUMBER	566
DATE SAMPLED	08-04-72	STATION NUMBER	
TIME SAMPLED	1620	SAMPLE TYPE	DRAINAGE
WATER FLOW RATE		SAMPLE HANDLING	41
FLOW MEAS METHOD		PRINCIPAL USE OF WATER	

PROJECT HEDDLESTON W Q
REMARKS BEAR TRAP CREEK BELOW TAILINGS POND

PARAMETERS REPORTED IN MILLIGRAMS PER LITER EXCEPT AS INDICATED

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)	22.	1.098	BICARBONATE(HCO3)	125.	2.045
MAGNESIUM (MG)	15.2	1.250	CARBONATE (CO3)	0.	0.000
SODIUM (NA)	3.5	0.152	HYDROXIDE (OH)	0.	0.000
POTASSIUM (K)	.94	0.024	CHLORIDE (CL)	1.9	0.054
TOT. IRON (FE)	.1	0.005	SULFATE (SO4)	34.	0.702
MANGANESE (MN)	.08	0.003	NITRATE (NO3)	.02	0.000
ALUMINUM (AL)	.2	0.022	FLUORIDE (F)	.19	0.010
SILICA (SIO2)			PHOSPHATE (PO4)		
TOTAL CATIONS		2.545	TOTAL ANIONS		2.812

STANDARD DEVIATION OF CATION-ANION BALANCE 1.80 SIGMA

LABORATORY PH	8.24	CARBONATE HARDNESS AS CACO3	102
FIELD TEMPERATURE DEGREES F	59.	NON-CARB. HARDNESS AS CACO3	15
CALCULATED DISSOLVED SOLIDS	202.5	TOTAL HARDNESS AS CACO3	117
EVAPORATED SOLIDS AT 105 C	120.	TOTAL ALKALINITY AS CACO3	102
SPECIFIC CONDUCTANCE IN		FIELD TURBIDITY (JTU)	
MICROMHOS/CM AT 25 C	230.0	TOTAL FILTERABLE SOLIDS	
ACIDITY AS CACO3		DISSOLVED OXYGEN AS (O2)	

SELECTED TRACE METALS (RECOVERABLE BY ACID DIGESTION OF UNFILTERED SAMPLE)

ARSENIC (AS)	.008	COPPER (CU)	<.02	NICKEL (NI)	<.02
CADMIUM (CD)	<.010	LEAD (PB)	<.02	ZINC (ZN)	.08
CHROMIUM (CR)	<.02	MERCURY (HG)			

ADDITIONAL PARAMETERS

AA CALCIUM (CA) 23.8 AA MAGNESIUM (MG) 15.60
PH,FIELD 5.

NOTE. PARAMETERS ARE TOTAL DISSOLVED UNLESS LABELED TR-TOTAL RECOVERABLE

SAMPLED BY RLD
ANALYSIS REQUESTED BY GHM
DATE ANALYSIS COMPLETED 8-14-72
ANALYST MAC

PERCENT REACTANCE VALUES

CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
43	50	6	1	2	25	73	0	0

DSC MEAS. DSC CALC.

NOTE. IN CORRESPONDENCE RELATED TO THIS ANALYSIS REFER TO NUMBER 72-1147

ENVIRONMENTAL ENGINEERING DEPARTMENT
THE ANACONDA COMPANY BUTTE, MONTANA 59701
WATER QUALITY ANALYSIS

NATION OR STATE	MONTANA	PROPERTY OR OPERATION	HEDDLESTON
PROV. OR COUNTY	LEWIS&CLARK	LABORATORY NUMBER	72-1139
LOCATION		SAMPLE OR BOTTLE NUMBER	204-2[illegible]
DATE SAMPLED	08-[illegible]	STATION NUMBER	
TIME SAMPLED	17[illegible]	SAMPLE TYPE	[illegible]ELL
WATER FLOW RATE	5. GPM (E)	SAMPLE HANDLING	41[illegible]
FLOW MEAS METHOD		PRINCIPAL USE OF WATER	

PROJECT HEDDLESTON [illegible]
REMARKS DRILL HOLE 0274-135 FL[illegible]ING HOLE

PARAMETERS REPORTED IN MILLIGRAMS PER LITER EXCEPT AS INDICATED

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)	14.[illegible]	[illegible]	BICARBONATE(HCO3)		
MAGNESIUM (MG)	6.[illegible]	0.561	CARBONATE (CO3)		
SODIUM (NA)	9.4	[illegible]	HYDROXIDE (OH)		
POTASSIUM (K)	1.65	0.042	CHLORIDE (CL)		
TOT. IRON (FE)	14.2	0.763	SULFATE (SO4)		
MANGANESE (MN)	.79	0.029	NITRATE (NO3)		
ALUMINUM (AL)	2.0	0.222	FLUORIDE (F)		
SILICA (SIO2)			PHOSPHATE (PO4)		
TOTAL CATIONS		2.5[illegible]1	TOTAL ANIONS		0.000

STANDARD DEVIATION OF CATION-ANION BALANCE -[illegible] SIGMA

LABORATORY PH		CARBONATE HARDNESS AS CACO3	0
FIELD TEMPERATURE DEGREES F	42.	NON-CARB. HARDNESS AS CACO3	59
CALCULATED DISSOLVED SOLIDS	45.9	TOTAL HARDNESS AS CACO3	58
EVAPORATED SOLIDS AT 105 C	[illegible].	TOTAL ALKALINITY AS CACO3	0
SPECIFIC CONDUCTANCE IN MICROMHOS/CM AT 25 C		FIELD TURBIDITY (JTU)	
ACIDITY AS CACO3		TOTAL FILTERABLE SOLIDS	
		DISSOLVED OXYGEN AS (O2)	

SELECTED TRACE METALS (RECOVERABLE BY ACID DIGESTION OF UNFILTERED SAMPLE)

ARSENIC (AS)	.005	COPPER (CU)	.25	NICKEL (NI)	.02
CADMIUM (CD)	<.010	LEAD (PB)	<.02	ZINC (ZN)	.42
CHROMIUM (CR)	<.02	MERCURY (HG)			

ADDITIONAL PARAMETERS
AA CALCIUM (CA) 12. AA MAGNESIUM (MG) 6.32

NOTE. PARAMETERS ARE TOTAL DISSOLVED UNLESS LABELED TR-TOTAL RECOVERABLE
SAMPLED BY RLD
ANALYSIS REQUESTED BY GMM
DATE ANALYSIS COMPLETED 9-14-72
ANALYST TF

PERCENT REACTANCE VALUES

CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
38	36	23	3	0	0	0	0	0

DSC MEAS. DSC CALC.
NOTE. IN CORRESPONDENCE RELATED TO THIS ANALYSIS REFER TO NUMBER 72-1139

A-72

ENVIRONMENTAL ENGINEERING DEPARTMENT
THE ANACONDA COMPANY BUTTE, MONTANA 59701
WATER QUALITY ANALYSIS

NATION OR STATE	MONTANA	PROPERTY OR OPERATION	HEDDLESTON
PROV. OR COUNTY	LEWIS&CLARK	LABORATORY NUMBER	73-1690
LOCATION		SAMPLE OR BOTTLE NUMBER	205
DATE SAMPLED	07-12-73	STATION NUMBER	
TIME SAMPLED	1200	SAMPLE TYPE	DRAINAGE
WATER FLOW RATE	300. GPM (E)	SAMPLE HANDLING	41
FLOW MEAS METHOD	(MN)	PRINCIPAL USE OF WATER	

PROJECT HEDDLESTON WATER QUAL ENV ENG DEPT
REMARKS MIKE HORSE TUNNEL

PARAMETERS REPORTED IN MILLIGRAMS PER LITER EXCEPT AS INDICATED

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)	96.	4.800	BICARBONATE(HCO3)	~~[illegible]~~ 61	1.000
MAGNESIUM (MG)	83.	6.810	CARBONATE (CO3)	0.	0.0
SODIUM (NA)	1.90	0.083	HYDROXIDE (OH)	0.	0.000
POTASSIUM (K)	1.75	0.045	CHLORIDE (CL)	0.0	0.000
TOT. IRON (FE)	9.0	0.483	SULFATE (SO4)	652.	13.585
MANGANESE (MN)	15.3	0.557	NITRATE (NO3)	0.52	0.008
ALUMINUM (AL)	.24	0.027	FLUORIDE (F)	0.680	0.036
~~SILICA (SIO2)~~ Zinc	26.5	.81	PHOSPHATE (PO4)	0.0	0.0
TOTAL CATIONS		~~12.804~~ 13.615	TOTAL ANIONS		~~15.928~~ 14.628

STANDARD DEVIATION OF CATION-ANION BALANCE ~~[illegible]~~ 3.04 SIGMA

LABORATORY PH	6.80	CARBONATE HARDNESS AS CACO3	85
FIELD TEMPERATURE DEGREES F	52.	NON-CARB. HARDNESS AS CACO3	496
CALCULATED DISSOLVED SOLIDS	964.5	TOTAL HARDNESS AS CACO3	581
EVAPORATED SOLIDS AT 105 C	1156.	TOTAL ALKALINITY AS CACO3	85
SPECIFIC CONDUCTANCE IN MICROMHOS/CM AT 25 C	1140.0	FIELD TURBIDITY (JTU)	
ACIDITY AS CACO3		TOTAL FILTERABLE SOLIDS	
		DISSOLVED OXYGEN AS (O2)	

SELECTED TRACE METALS (RECOVERABLE BY ACID DIGESTION OF UNFILTERED SAMPLE)

ARSENIC (AS)	.04	COPPER (CU)	.260	NICKEL (NI)	.067
CADMIUM (CD)	.055	LEAD (PB)	.050	ZINC (ZN)	26.5
CHROMIUM (CR)	.005	MERCURY (HG)			

ADDITIONAL PARAMETERS
AA MAGNESIUM (MG) 88.0
TR SILVER (AG) .001

NOTE. PARAMETERS ARE TOTAL DISSOLVED UNLESS LABELED TR-TOTAL RECOVERABLE
SAMPLED BY RLD
ANALYSIS REQUESTED BY RLD
DATE ANALYSIS COMPLETED 07-20-73
ANALYST LAB

PERCENT REACTANCE VALUES

CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
41	58	1	0	0	89	11	0	0

DSC MEAS. DSC CALC.
NOTE. IN CORRESPONDENCE RELATED TO THIS ANALYSIS REFER TO NUMBER 73-1690

ENVIRONMENTAL ENGINEERING DEPARTMENT
THE ANACONDA COMPANY BUTTE, MONTANA 59701
WATER QUALITY ANALYSIS

NATION OR STATE	MONTANA	PROPERTY OR OPERATION	HEDDLESTON
PROV.OR COUNTY	LEWIS&CLARK	LABORATORY NUMBER	73-1687
LOCATION		SAMPLE OR BOTTLE NUMBER	150G
DATE SAMPLED	07-12-73	STATION NUMBER	
TIME SAMPLED	1145	SAMPLE TYPE	DRAINAGE
WATER FLOW RATE	1. GPM (E)	SAMPLE HANDLING	41
FLOW MEAS METHOD	(MN)	PRINCIPAL USE OF WATER	

PROJECT HEDDLESTON WATER QUAL ENV ENG DEPT
REMARKS ANACONDA TUNNEL

PARAMETERS REPORTED IN MILLIGRAMS PER LITER EXCEPT AS INDICATED

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)	54.	2.700	BICARBONATE(HCO3)		
MAGNESIUM (MG)	28.	2.316	CARBONATE (CO3)		
SODIUM (NA)	3.70	0.161	HYDROXIDE (OH)		
POTASSIUM (K)	1.40	0.036	CHLORIDE (CL)	0.0	0.000
TOT. IRON (FE)	8.3	0.446	SULFATE (SO4)	466.	9.696
MANGANESE (MN)	15.5	0.564	NITRATE (NO3)	0.54	0.009
ALUMINUM (AL)	4.2	0.467	FLUORIDE (F)	0.438	0.023
SILICA (SIO2)			PHOSPHATE (PO4)	0.0	0.0

TOTAL CATIONS 6.690 TOTAL ANIONS 9.728
STANDARD DEVIATION OF CATION-ANION BALANCE 9.99 SIGMA

LABORATORY PH	2.77	CARBONATE HARDNESS AS CACO3	0
FIELD TEMPERATURE DEGREES F	64.0	NON-CARB. HARDNESS AS CACO3	251
CALCULATED DISSOLVED SOLIDS	582.0	TOTAL HARDNESS AS CACO3	251
EVAPORATED SOLIDS AT 105 C	712.	TOTAL ALKALINITY AS CACO3	0
SPECIFIC CONDUCTANCE IN		FIELD TURBIDITY (JTU)	
MICROMHOS/CM AT 25 C	1110.0	TOTAL FILTERABLE SOLIDS	
ACIDITY AS CACO3		DISSOLVED OXYGEN AS (O2)	

SELECTED TRACE METALS (RECOVERABLE BY ACID DIGESTION OF UNFILTERED SAMPLE)

ARSENIC (AS)	<.001	COPPER (CU)	1.75	NICKEL (NI)	.050
CADMIUM (CD)	.043	LEAD (PB)	.405	ZINC (ZN)	4.30
CHROMIUM (CR)	.003	MERCURY (HG)			

ADDITIONAL PARAMETERS
AAAMGGNESCNM(CRG) 86.8
TR SILVER (AG) .010

NOTE. PARAMETERS ARE TOTAL DISSOLVED UNLESS LABELED TR-TOTAL RECOVERABLE
SAMPLED BY RLO
ANALYSIS REQUESTED BY RLO
DATE ANALYSIS COMPLETED 07-20-73
ANALYST LAB

PERCENT REACTANCE VALUES

CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
52	44	3	1	0	100	0	0	0
DSC MEAS.					DSC CALC.			

NOTE. IN CORRESPONDENCE RELATED TO THIS ANALYSIS REFER TO NUMBER 73-1687

ENVIRONMENTAL ENGINEERING DEPARTMENT
THE ANACONDA COMPANY BUTTE, MONTANA 59701
WATER QUALITY ANALYSIS

NATION OR STATE	MONTANA	PROPERTY OR OPERATION	HEDDLESTON
PROV.OR COUNTY	LEWIS&CLARK	LABORATORY NUMBER	73-1686
LOCATION		SAMPLE OR BOTTLE NUMBER	1780
DATE SAMPLED	07-12-73	STATION NUMBER	
TIME SAMPLED	1100	SAMPLE TYPE	DRAINAGE
WATER FLOW RATE	1. GPM (E)	SAMPLE HANDLING	41
FLOW MEAS METHOD	(MN)	PRINCIPAL USE OF WATER	

PROJECT HEDDLESTON WATER QUAL ENV ENG DEPT
REMARKS EDITH NO 2 TUNNEL

PARAMETERS REPORTED IN MILLIGRAMS PER LITER EXCEPT AS INDICATED

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)	10.4	0.520	BICARBONATE(HCO3)		
MAGNESIUM (MG)	7.6	0.623	CARBONATE (CO3)		
SODIUM (NA)	8.50	0.370	HYDROXIDE (OH)		
POTASSIUM (K)	6.2	0.159	CHLORIDE (CL)	0.0	0.000
TOT. IRON (FE)	10.0	0.537	SULFATE (SO4)	188.	3.906
MANGANESE (MN)	1.00	0.036	NITRATE (NO3)	0.22	0.004
ALUMINUM (AL)	5.7	0.634	FLUORIDE (F)	0.42	0.022
SILICA (SIO2)			PHOSPHATE (PO4)	0.0	0.0

TOTAL CATIONS 2.879 TOTAL ANIONS 3.931
STANDARD DEVIATION OF CATION-ANION BALANCE 6.61 SIGMA

LABORATORY PH	2.98	CARBONATE HARDNESS AS CACO3	0
FIELD TEMPERATURE DEGREES F	60.	NON-CARB. HARDNESS AS CACO3	57
CALCULATED DISSOLVED SOLIDS	237.6	TOTAL HARDNESS AS CACO3	57
EVAPORATED SOLIDS AT 105 C	414.	TOTAL ALKALINITY AS CACO3	0
SPECIFIC CONDUCTANCE IN		FIELD TURBIDITY (JTU)	
MICROMHOS/CM AT 25 C	668.0	TOTAL FILTERABLE SOLIDS	
ACIDITY AS CACO3		DISSOLVED OXYGEN AS (O2)	

SELECTED TRACE METALS (RECOVERABLE BY ACID DIGESTION OF UNFILTERED SAMPLE)

ARSENIC (AS)	<.001	COPPER (CU)	3.70	NICKEL (NI)	.056
CADMIUM (CD)	.013	LEAD (PB)	.148	ZINC (ZN)	.61
CHROMIUM (CR)	.002	MERCURY (HG)			

ADDITIONAL PARAMETERS
AAAMGGNESUNM(CRG) 10.6
TR SILVER (AG) .001

NOTE. PARAMETERS ARE TOTAL DISSOLVED UNLESS LABELED TR-TOTAL RECOVERABLE
SAMPLED BY RLO
ANALYSIS REQUESTED BY RLO
DATE ANALYSIS COMPLETED 07-20-73
ANALYST LAB

PERCENT REACTANCE VALUES

CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
31	37	22	9	0	100	0	0	0
DSC MEAS.					DSC CALC.			

NOTE. IN CORRESPONDENCE RELATED TO THIS ANALYSIS REFER TO NUMBER 73-1686

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                    ENVIRONMENTAL ENGINEERING DEPARTMENT
THE ANACONDA COMPANY                              BUTTE, MONTANA  59701
                        WATER QUALITY ANALYSIS

 NATION OR STATE  MONTANA          PROPERTY OR OPERATION  HEDDLESTON
 PRCV.OR COUNTY   LEWIS&CLARK          LABORATORY NUMBER  73-1684
        LOCATION                 SAMPLE OR BOTTLE NUMBER  155G
    DATE SAMPLED  07-12-73                STATION NUMBER
    TIME SAMPLED  1130                       SAMPLE TYPE  DRAINAGE
 WATER FLOW RATE       2.  GPM (E)       SAMPLE HANDLING  41
FLOW MEAS METHOD  (MN)             PRINCIPAL USE OF WATER

PROJECT  HEDDLESTON WATER QUAL ENV ENG
REMARKS  TUNNEL NO 3

     PARAMETERS REPORTED IN MILLIGRAMS PER LITER EXCEPT AS INDICATED
                   MG/L      MEQ/L                           MG/L      MEQ/L
  CALCIUM (CA)      1.3      0.064  BICARBONATE(HCO3)
MAGNESIUM (MG)      6.0      0.495    CARBONATE (CO3)
   SODIUM (NA)      1.60     0.070    HYDROXIDE  (OH)
POTASSIUM  (K)      4.70     0.120     CHLORIDE  (CL)        0.0       0.000
TOT. IRON (FE)     19.0      1.021      SULFATE (SO4)      252.        5.242
MANGANESE (MN)       .43     0.016      NITRATE (NO3)        0.82      0.013
 ALUMINUM (AL)     10.0      1.112     FLUORIDE   (F)        0.38      0.020
 SILICA (SIO2)                        PHOSPHATE (PO4)        0.038     0.001

        TOTAL CATIONS       2.898                  TOTAL ANIONS        5.276
      STANDARD DEVIATION OF CATION-ANION BALANCE  9.99 SIGMA

            LABORATORY PH      2.84  CARBONATE HARDNESS AS CACO3       0
FIELD TEMPERATURE DEGREES F   42.    NON-CARB. HARDNESS AS CACO3      28
CALCULATED DISSOLVED SOLIDS  296.1       TOTAL HARDNESS AS CACO3      28
  EVAPORATED SOLIDS AT 105 C 486.      TOTAL ALKALINITY AS CACO3       0
     SPECIFIC CONDUCTANCE IN                FIELD TURBIDITY (JTU)
        MICROMHOS/CM AT 25 C 835.0        TOTAL FILTERABLE SOLIDS
           ACIDITY AS CACO3               DISSOLVED OXYGEN AS (O2)

SELECTED TRACE METALS (RECOVERABLE BY ACID DIGESTION OF UNFILTERED SAMPLE)
 ARSENIC (AS)   .04       COPPER (CU)  28.5          NICKEL (NI)    .085
 CADMIUM (CD)   .004        LEAD (PB)    .005          ZINC (ZN)    .26
CHROMIUM (CR)   .009     MERCURY (HG)

                        ADDITIONAL PARAMETERS
   AAAMGGNESONM(CMG)     6.8
    TR SILVER (AG)      .001


NOTE. PARAMETERS ARE TOTAL DISSOLVED UNLESS LABELED TR-TOTAL RECOVERABLE
                SAMPLED BY  RLD                PERCENT REACTANCE VALUES
     ANALYSIS REQUESTED BY  RLD          CA  MG  NA  K   CL  SC4 HCO3 CO3  NO3
 DATE ANALYSIS COMPLETED    07-20-73      9  66   9 16    0  100   0    0    0
                   ANALYST  LAB         OSC MEAS.          OSC CALC.
 NOTE. IN CORRESPONDENCE RELATED TO THIS ANALYSIS REFER TO NUMBER  73-1684
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                    ENVIRONMENTAL ENGINEERING DEPARTMENT
    ANACONDA COMPANY                              BUTTE, MONTANA  59701
                        WATER QUALITY ANALYSIS

 NATION OR STATE  MONTANA          PROPERTY OR OPERATION  HEDDLESTON
 PRCV.OR COUNTY   LEWIS&CLARK          LABORATORY NUMBER  73-1682
        LOCATION                 SAMPLE OR BOTTLE NUMBER  264
    DATE SAMPLED  07-12-73                STATION NUMBER
    TIME SAMPLED  1230                       SAMPLE TYPE  STREAM
 WATER FLOW RATE        .  GPM (E)       SAMPLE HANDLING  41
FLOW MEAS METHOD  (MN)             PRINCIPAL USE OF WATER

PROJECT  HEDDLESTON WATER QUALITY ENV ENG DEPT
REMARKS  BEAR TRAP CREEK BELOW TAILINGS POND

     PARAMETERS REPORTED IN MILLIGRAMS PER LITER EXCEPT AS INDICATED
                   MG/L      MEQ/L                           MG/L      MEQ/L
  CALCIUM (CA)     11.0      0.548  BICARBONATE(HCO3)      104.        1.700
MAGNESIUM (MG)     14.7      1.210    CARBONATE (CO3)        0.        0.0
   SODIUM (NA)      1.25     0.054    HYDROXIDE  (OH)        0.        0.000
POTASSIUM  (K)       .75     0.019     CHLORIDE  (CL)        0.0       0.000
TOT. IRON (FE)      .083     0.004      SULFATE (SO4)       26.        0.548
MANGANESE (MN)      .065     0.003      NITRATE (NO3)        0.40      0.006
 ALUMINUM (AL)      .02      0.002     FLUORIDE   (F)        0.07      0.004
 SILICA (SIO2)                        PHOSPHATE (PO4)        0.0       0.0

        TOTAL CATIONS       1.841                  TOTAL ANIONS        2.258
      STANDARD DEVIATION OF CATION-ANION BALANCE  3.01 SIGMA

            LABORATORY PH      8.08  CARBONATE HARDNESS AS CACO3      85
FIELD TEMPERATURE DEGREES F   54.0   NON-CARB. HARDNESS AS CACO3       3
CALCULATED DISSOLVED SOLIDS  158.4       TOTAL HARDNESS AS CACO3      88
  EVAPORATED SOLIDS AT 105 C 210.      TOTAL ALKALINITY AS CACO3      85
     SPECIFIC CONDUCTANCE IN                FIELD TURBIDITY (JTU)
        MICROMHOS/CM AT 25 C 248.0        TOTAL FILTERABLE SOLIDS
           ACIDITY AS CACO3               DISSOLVED OXYGEN AS (O2)

SELECTED TRACE METALS (RECOVERABLE BY ACID DIGESTION OF UNFILTERED SAMPLE)
 ARSENIC (AS)   .03       COPPER (CU)   .013         NICKEL (NI)    .007
 CADMIUM (CD)   .002        LEAD (PB)   .03            ZINC (ZN)    .065
CHROMIUM (CR)   .001     MERCURY (HG)

                        ADDITIONAL PARAMETERS
   AAAMGGNESONM(CMG)    14.0
    TR SILVER (AG)      .001


NOTE. PARAMETERS ARE TOTAL DISSOLVED UNLESS LABELED TR-TOTAL RECOVERABLE
                SAMPLED BY  RLD                PERCENT REACTANCE VALUES
     ANALYSIS REQUESTED BY  RLD          CA  MG  NA  K   CL  SO4 HCO3 CO3  NO3
 DATE ANALYSIS COMPLETED    07-20-73     30  66   3  1    0   24  75    0    0
                   ANALYST  LAB         OSC MEAS.          OSC CALC.
 NOTE. IN CORRESPONDENCE RELATED TO THIS ANALYSIS REFER TO NUMBER  73-1682
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APPENDIX N

Results of Metals Analyses of Stream Sediments, 1973

MONTANA BUREAU OF MINES AND GEOLOGY

BUTTE, MONTANA 59701

November 15, 1973

Mr. Liter Spence
Box 27
Ovando, MT 59854

MF&G Stream Sediment Samples
Received 10-11-73

Field No.	Cu	Ni	Pb	Cd	Zn	Fe	LOI @ 750°C
1	24	10	47.5	<1	52	25,700	4.80
2	23	10	28	<1	53	26,700	4.55
3	88	20	70	1	73.5	24,700	9.40
4	29	10.5	28	1	41.5	25,700	7.33
5	47	11.5	29.5	1.2	259	25,700	4.55
Repeat	47	21.5	29.5	1.0	259	not done - not enough sample.	
6	42	12	32.5	<1	35	31,700	5.10
7	80	30.5	83	47.5	1,000	34,600	5.98
8	700	50	400	282.5	4,080	36,600	7.85
9	73	18	39.5	1.2	152	40,600	10.70
10	25	12	24.5	1.0	77.5	29,700	5.90

Respectfully submitted,

L. A. Wegelin
Chief Chemist

LAW/np

Note: Results expressed in micrograms per gram, dry weight. LOI = Loss of organic matter on ignition in percent.

November 12, 1973

ITEMIZED INVOICE -- Stream Sediment Samples

Lab No.	Sample No.		
1	0920	Blackfoot R @ Canyon Camp	8-14-73
2	1100	Blackfoot R @ Dalton Mtn. Bridge	8-14-73
3	1150	Poorman Ck	8-14-73
4	1340	Landers Fork of Blackfoot R	8-14-73
5	1520	Blackfoot R @ Hogeim Rd Bridge	8-14-73
6	1545	Alice Ck @ Highway 200, Bridge	8-14-73
7	1615	Blackfoot R @ Flesher	8-14-73
8	1650	Blackfoot R @ Pop's Place	8-14-73
9	1440	Willow Creek (Flesher)	8-14-73
10	1140	Blackfoot R. below 7-up	8-20-73

10 Stream Sediment Samples @ $6 $60.00

MONTANA BUREAU OF MINES AND GEOLOGY

BUTTE, MONTANA 59701

April 25, 1974

Mr. Liter Spence
Montana Fish and Game Commission
Box 27
Ovando, Montana 59854

Dear Liter:

Please find under separate cover the canvas sample sack as requested. Please return it with approximately 25 pounds of sediment.

We will complete the following investigations that may assist you in understanding the relationship of metal ion concentration versus particle size. We will separate the particles with a series of standard sieves and analyze each series or fraction for Cu, Pb, Zn, Cd, and Ni, and will also provide you with analyses showing what percent each fraction or group of particles represents in the sample. The sieve analysis and trace metal analyses will be done in duplicate to reveal homogeneity and replication of values.

I have included a copy of the report, dated November 15, 1973, to clarify how these values were reported. The metals are reported in micrograms per gram, meaning that 1×10^{-6} grams is one microgram (1 ppm) or $\frac{.000,001 \text{ grams}}{1,000,000 \text{ grams}}$. For example--Field No. 1 shows 24 for Cu.

This means that each gram of sediment of −100 mesh size contains .000,024 grams of elemental copper, commonly referred to as parts per million or formally expressed as 24 micrograms/gram (µg/g). The L.O.I. (loss on ignition) is expressed in percent (Weight/Weight). For example--Field No. 1 shows 4.80 L.O.I. @ 750°. This indicates that each gram of −100 mesh sediment loses .048 grams upon heating the sample to 750°C. I apologize for not clarifying this on the report.

On Field sample No. 5, as discussed on the telephone, the only significant change was that of Ni from 11.5 µg/g to 21.5 µg/g. I shall try to explain in more detail why replicate analyses do not always agree closely. First, homogeneity of the sample is difficult to obtain without more elaborate preparation, which may be justified in your investigations.

To approach homogeneity, the bulk of the sample must consist of particles of almost uniform size. Normally this requires pulverization of the sample to a very fine particle,

Mr. Liter Spence
Page two
April 25, 1974

−325 mesh. The Bureau and other investigators have found that by removing the −100 mesh fraction from soils and sediments they begin to approach homogeneity to the degree that metal concentration profiles are well enough defined to allow interpretation of their mobilities. After giving this some thought, do you feel that you must have a more precisely defined profile, approaching absolute trace metal values? If so, we can pulverize the −100 material or the entire sediment sample to −325 to assure homogeneity.

Respectfully yours,

L. A. Wegelin

L. A. Wegelin
Chief Chemist

LAW:eh

Enclosure

MONTANA BUREAU OF MINES AND GEOLOGY

BUTTE, MONTANA 59701

July 17, 1974

RECEIVED
JUL 1? 1974
ENVIRON. RESOURCES

Mr. Liter Spence
Montana Fish & Game Commission
Helena, Montana 59601

Dear Liter:

I am reporting the results of our investigations on the large sediment sample. To prepare the sample for analysis it was dried at 110°C to constant weight, blended to assure homogeneity, and split into four representative portions.

The particle size or sieve analyses were performed on two of the four split portions, and the elemental determinations were performed in duplicate on each fraction of the two sieve analyses. I did this to reveal repetition and homogeneity and to provide enough statistical information for standard deviation. The data are shown in four tables. Table I converts mesh (Tyler, U.S. Number) to actual opening dimension of each sieve. Table II shows trace-metal relationship to particle size.

Table III shows each fraction or group of particles in terms of weight percent of the sample. Table IV shows the standard deviation of the analyses versus particle size.

I have enclosed a graph relating particle size to trace-metal concentrations. In the graph, the metals show a sharp increase in concentration from the -200 to -230 fractions. Looking at this, your investigations may justify using the -200 mesh particle rather than the -100 mesh particle. In looking at Table IV you will notice how the standard deviation of the analyses improves as the particle becomes smaller, I believe I mentioned this to you previously. Again, the standard deviation, no matter what fraction or particle size, would be improved tremendously if the samples were pulveized to -325. This again may be another consideration for future work.

I hope you find this report in order and informative, and should you have any questions please feel free to inquire.

Yours truly,

Laurence A. Wegelin

Laurence A. Wegelin
Chief Chemist

LAW/jp

TABLE I

Tyler Sieve (mesh) U.S. Standard No.	Opening in millimeters	Opening in inches
-16	1.190	.0469
-20	.841	.0331
-40	.420	.0165
-60	.250	.0098
-100	.149	.0059
-140	.105	.0041
-200	.074	.0029
-230	.063	.0025
-325	.044	.0017

TABLE II

Metal Concentration/Particle Size Relationship

Tyler Sieve (mesh) Standard U.S. No.		Cu	Pb	Zn	Cd	Ni	Fe
Sieve Test	+16	25	11.5	120	.05	11.5	15,470
A	+16	36.5	13	130	.05	14	13,970
Sieve Test	+16	26.5	29	115	.05	11.5	13,470
B	+16	45.5	20	1725	.05	11	13,470
Mean		33.38	18.38	134.38	.05	12.00	14,095.00
Std. Deviation		9.56	7.99	26.17	.00	1.35	946.48
Sieve Test	-16	38	16	137.5	.05	13.5	18,960
A	-16	37	18.5	140	.10	13.5	18,460
Sieve Test	-16	38	22	145	.05	12	14,970
B	-16	32.5	16.5	127.5	.05	12	16,970
Mean		36.38	18.25	137.50	.06	12.75	17,340.00
Std. Deviation		2.63	2.72	7.36	.03	.87	1,791.89
Sieve Test	-20	38	22	157.5	.05	13.5	18,960
A	-20	38	20	142.5	.05	13	18,960
Sieve Test	-20	37	21	172.5	.08	14.5	20,460
B	-20	36	18	160	.08	13	20,460
Mean		37.25	20.25	158.13	.07	13.50	19,710.00
Std. Deviation		.96	1.71	12.31	.02	.71	866.03
Sieve Test	-40	36	24.5	175	.05	14	21,460
A	-40	36	32.5	180	.05	14	21,460
Sieve Test	-40	38	21	175	.08	13.5	19,960
B	-40	45	21.5	175	.08	13.5	19,960
Mean		38.75	24.88	176.25	.07	13.75	20,710
Std. Deviation		4.27	5.31	2.50	.02	.29	866.03

Sieve Test A	-60	36.5	19.5	140	.05	11.5	16,970
	-60	35.5	17	425	.05	19	15,970
Sieve Test B	-60	39	22.5	152.5	.05	11.5	17,960
	-60	33	24	142	.05	11	18,460
Mean		36.00	20.75	214.88	.05	13.25	17,340.00
Std. Deviation		2.48	3.12	140.19	.00	3.84	1,103.41
Sieve Test A	-100	30.5	20	157.5	.05	9	17,470
	-100	39.5	22.5	155	.05	11	16,470
Sieve Test B	-100	39	24	147.5	.08	11	18,960
	-100	34	22	145	.08	11	18,960
Mean		35.75	22.12	151.25	.07	10.50	17,965.00
Std. Deviation		4.29	1.65	5.95	.02	1.00	1,219.30
Sieve Test A	-140	40	20	612.5	.05	42	18,460
	-140	35.5	19	140	.05	9	18,460
Sieve Test B	-140	46	24	150	.08	10.5	19,960
	-140	40	24	152.5	.08	10.5	20,460
Mean		40.38	21.75	263.75	.07	18.00	19,335.00
Std. Deviation		4.30	2.63	232.56	.02	16.02	1,030.00
Sieve Test A	-200	53.5	25	157.5	.05	9.5	19,460
	-200	60	22.5	182.5	.05	9	18,960
Sieve Test B	-200	55	23	165	.08	11	19,460
	-200	54.5	24	167.5	.08	11	18,460
Mean		55.75	23.63	168.13	.07	10.13	19,563.71
Std. Deviation		2.90	1.11	10.48	.02	1.03	478.71

Sieve Test A	-230	95	32.5	250	.05	14.5	19,960
	-230	105.5	36	262.5	.05	15	19,960
Sieve Test B	-230	102	26.5	192.5	.08	11.5	20,960
	-230	111	23	187.5	.08	11.5	20,460
Mean		103.38	29.50	223.13	.07	13.13	20,335.00
Std. Deviation		6.70	5.85	38.64	.02	1.88	478.71
Sieve Test A	-325	122.5	34	270	.13	15	24,450
	-325	125.5	60	270	.13	15	24,450
Sieve Test B	-325	127.5	35	262.5	.13	14.5	24,950
	-325	124	36	262.5	.13	15	24,450
Mean		124.88	41.25	266.25	.13	14.88	24,575.00
Std. Deviation		2.14	12.53	4.33	.00	.25	250.00

Note: All concentrations are reported as micrograms per gram (ppm).

APPENDIX N continued

TABLE III

Sieve Analysis

Sieve Test	Tyler Sieve (mesh) U.S. Standard No.	Grams Recovered	% (W/W)
A	+16	271.0	14.8
B	+16	237.8	13.3
A	-16	149.9	8.2
B	-16	147.4	8.3
A	-20	226.3	12.3
B	-20	220.7	12.4
A	-40	403.9	22.0
B	-40	427.6	24.0
A	-60	466.7	25.4
B	-60	440.7	24.7
A	-100	145.0	7.9
B	-100	141.2	7.9
A	-140	90.2	4.9
B	-140	88.8	5.0
A	-200	17.1	.9
B	-200	18.3	1.0

A	-230	29.7	1.6
B	-230	28.5	1.6
A	-325	34.2	1.9
B	-325	31.7	1.8

Seive Test A

Total Recovered Wt.	1,834.0	
Total Beggining Wt.	1,836.3	
Percent Recovered		99.87

Sieve Test B

Total Recovered Wt.	1,782.7	
Total Beggining Wt.	1,784.0	
Percent Recovered		99.92%

TABLE IV

Standard Deviation/Particle Size

	Cu Mean & Std. Dev.	Pb Mean & Std. Dev.	Zn Mean & Std. Dev.	Cd Mean & Std. Dev.	Ni Mean & Std. Dev.	Fe Mean & Std. Dev.
	33.38	18.38	134.38	.05	12.00	14,095.00
+16	9.56	7.99	26.17	.00	1.35	946.48
	36.38	18.25	137.50	.06	12.75	17,340.00
-16	2.63	2.72	7.36	.03	.87	1,791.89
	37.25	20.25	158.13	.07	13.50	19,710.00
-20	.96	1.71	12.31	.02	.71	866.00
	38.75	24.88	176.25	.07	13.75	20,710
-40	4.27	5.31	2.50	.02	.29	866.03
	36.00	20.75	214.88	.05	13.25	17,340.00
-60	2.48	3.12	140.19	.00	3.84	1,103.41
	35.75	22.12	151.25	.07	10.50	17,965.00
-100	4.29	1.65	5.95	.02	1.00	1,219.30
	40.38	21.75	263.75	.07	18.00	19,335.00
-140	4.30	2.63	232.56	.02	16.02	1,030.00
	55.75	23.63	168.13	.07	10.13	19,563.71
-200	2.90	1.11	10.48	.02	1.03	478.71
	103.38	29.50	223.13	.07	13.13	20,335.00
-230	6.70	5.85	38.64	.02	1.88	478.71
	124.88	41.25	266.25	.13	14.88	24,575.00
-325	2.14	12.53	4.33	.00	.25	250.00

APPENDIX O

Bottom Fauna Station Locations

Station Number	Station Name	Location	ELEVATION (ft. msl)
1	Blackfoot River at Pop's Place	Across from Pop's Place Bar, 1 mile downstream from mouth of Pass Creek	5130
2	Blackfoot River at Flesher	Upstream from culvert at crossing of the river by state highway 279	4960
3	Alice Creek above National Forest Boundary	At Bear Gulch road crossing of creek 1.1 mile above national forest boundary	5400
4	Alice Creek at Highway 200	50 ft. upstream from highway bridge	4950
5	Blackfoot River at Hogum	50 ft. upstream from USFS bridge crossing river on Hogum Creek road	4815
6	Landers Fork at Highway 200	300 ft. upstream from highway bridge	4750
7	Blackfoot River between Landers Fork and Lincoln (below Landers)	At end of county road 1.4 miles downstream from mouth of Landers Fork	4680
8	Poorman Creek	0.1 mile south of where Poorman Creek first crosses Stemple road about 3 miles south of Lincoln	4640
9	Blackfoot River at Dalton	300 ft. upstream from Dalton Mountain road bridge west of Lincoln	4460
10	Blackfoot River at Canyon	50 ft. upstream from USFS cement bridge over river at Blackfoot Canyon campground	4400
11	Blackfoot River at Rainbow Bend	At small island in river which is reached by taking pulloff to the left 1/8 mile downstream from Rainbow Bend and going 100 yards to river	3400

APPENDIX P

Kinds and abundance of bottom fauna collected from the Blackfoot River and certain tributaries, 1968 - 1971, including diversity indices.

Organisms were sorted to order, counted and volumes determined at the Pollution Control Laboratory, State Department of Health and Environmental Sciences, Helena. Sorted organisms were further identified to lowest taxa and recounted by Ms. Patricia Ann Mitchell, Department of Zoology, University of Alberta, Edmonton, Alberta, Canada. (1968 and 1969 samples were identified but not recounted.)

Identifications have been made only on the following samples to date: All of 1968 and 1969; March/April 1971; August 1971; and October/November 1971. The remaining samples collected in 1972 and 1973 have only been sorted and counted to order.

The 1968 and 1969 samples were ± 4 square feet in area and were obtained with a two-foot wide Needham kick screen. All other samples were obtained with a modified Waters round square foot stream bottom sampler (Waters 1961). Three one-square foot samples were collected at each station. Each square foot sample which has been identified is shown in this appendix. Numbers (i.e., #1, #2, #3) following station name are the individual square foot sample numbers.

Diversity indices were calculated using the method of Wilhm and Dorris (1968). These indices are given for each ±4 square foot sample in 1968 and 1969, and each one square foot sample in 1971. The 1971 samples have indices given on only one sheet. However, indices are for the three one-square foot samples combined. Only one index (for the entire station) is given for the 1968 and 1969 data because the numbers in each species were not determined. This index is based on the number of orders and the number of individuals in each order. The 1971 samples are based on the number of species and number of individuals in each species. An index is given for each order as well as for the entire station. Diversity indices were not computed for all the October/November 1971 samples because the identification data were received too late to be processed prior to report completion.

Only the five major insect orders (Ephemeroptera, Plecoptera, Tricoptera, Diptera, and Coleoptera) were used in diversity index calculations. Items with a check mark (✓) preceding them were omitted from the diversity index computations due to their indefinite or non-specific identification. The diversity index computed for the entire station (three square feet combined) is shown as "Station D. I."

In the cases where an organism could be identified only to family, each family was assumed to possess at least one species and the numbers in the family were used as if they comprised only one species. The same holds true for genera if the species were unknown but shown as "spp." indicating more than one unidentifiable species was present.

Figures shown as "Original Total" are numbers of organisms of all kinds (including noninsects and fish) in a sample as counted by Pollution Control Laboratory personnel. "Final Total" was determined by Ms. Mitchell after identifications were made. The variations in numbers may be due to inaccurate original count or deterioration of insects between counts. Except for 1968 and 1969, "Final Total" was used for computing diversity indices, since it was believed to be more accurate than "Original Total".

Diversity indices were computed by Dr. Don O. Loftsgaarden, Professor of Mathematics, University of Montana, Missoula. His explanation of the procedure and computer program used is given in Appendix Q.

D = diversity index. DMAX is the maximum diversity index which could occur in the given sample, DMIN is the minimum diversity index which could occur, and R is redundancy, or a measure of how evenly or unevenly the numbers of organisms are distributed in the sample. When redundancy is high at a station, diversity is low and vice versa. DMAX and DMIN are limits which allow one to position D and aid in its interpretation. Redundancy is always between 0 and 1. Diversity can range from less than 1 in heavily polluted areas to more than 3 in clean water areas. Values from 1 to 3 are found in areas of moderate pollution (Wilhm and Dorris 1968).

A comparison of total numbers of organisms collected per square foot with the Needham kick screen and the modified Waters round-square-foot sampler (at those stations where both were used simultaneously) shows the Waters sampler to be more efficient in collecting total numbers of insects. The mesh size used in the Needham screen was 16 meshes per inch compared to 38 meshes per inch for the Waters sampler, and more insects were retained by the latter. Also the design and use of the Waters sampler precludes much loss of insects around the screen and enables one to retain more insects in a sample.

Blackfoot River at Pop's Place 7/16/68

#1 Plecoptera 2 T

Paraperla, Alloperla or Kathroperla spp. (too small to identify)

Trichoptera 7 .2 cc

Rhyacophila angelita Banks
Brachycentrus sp.

Coleoptera 1 T

Zaitzevia sp.

Diptera 34 .1 cc

Tendipedidae:
Hydrobaenus sp.

#2 Plecoptera 2 T

Nemoura besametsa Ricker
Paraperla, Alloperla or Kathroperla spp. (too small to identify)

Trichoptera 5 .2 cc

Rhyacophila angelita Banks
Brachycentrus sp.
Hydropsyche sp.
Arctopsyche sp.

Station D. I.

D = 1.37131 DMIN = 0.305691
DMAX = 2. R= 0.37106

Coleoptera 7 .05 cc

Zaitzevia sp.

#1 And #2 combined

Diptera 17 T

Tendipedidae
Hydrobaenus sp.

Blackfoot at Pop's Place 4/29/69 pH 7.9

Plecoptera 1

Nemoura cinciptes Banks

D = DMIN = DMAX
R is undefined

Ephemeroptera 1

Cinygmula sp.

Blackfoot River at Pop's Place 10/1/69

Plecoptera 95, 0.3 cc

Hastaperla brevis ?
Nemoura cinctipes Banks
Alloperla sp.
Isogenus sp.

Station D. I.

D = 0.244142 DMIN = 8.14620E-2 = .0814620
DMAX = 1. R= 0.822893

Trichoptera 4, 0.1 cc

Parapsyche sp.
Rhyacophila acropedes or vao
Arctopsyche sp.

APPENDIX P CONTINUED

BLACK-FOOT RIVER AT POP'S PLACE #1
8-20-71
1 sq. ft. L. Spence

S=1 No diversity computed

EPHEMEROPTERA 1 T

Baetis sp. 1 Total 1

D = 1.34479 DMIN = 0.264832
DMAX = 2.32193 R= 0.475037

PLECOPTERA 35 T

Nemoura cinctipes 23
Isogenus sp. 8
Alloperla sp. 4 Total 34

TRICHOPTERA 2 P

S=2 D= DMAX = DMIN, R is undefined
1 of each species

✓ Pupae 2 Total 2

D = 2.02492 DMIN = 0.927075
DMAX = 2.32193 R= 0.212932

DIPTERA 20 T

Simuliidae 3
Cardiocladius sp. 4
Brillia sp. 6
Orthocladius sp. 1 7 Total 20

Original Total 58 Final Total 57

Identified and Enumerated by
Patricia Ann Mitchell
MS, University of Montana, 1968

January 29, 1973
Patricia Ann Mitchell

Station D.I.

D = 2.4173 DMIN = 0.813952
DMAX = 4. R= 0.496293

BLACKFOOT RIVER AT POP'S PLACE #2
8-20-71
1 sq. ft. L. Spence

PLECOPTERA 45 T

Nemoura cinctipes 29
Isogenus sp. 3
Acroneuria theodora 1
Alloperla sp. 9
Paraperla frontalis 2 Total 44

TRICHOPTERA 2 T

Rhyacophila angelita? (unsure of species) 1
Parapsyche almota 1 Total 2

DIPTERA 4 T

Orthocladius sp. 1 3
Orthocladius sp. 5 1 Total 4

D = 1.37095 DMIN = 1.37095
DMAX = 1.58496 R= 1.

COLEOPTERA 4 T

Optioservus sp. adult 1
Heterlimnius corpulentus adult 2
Zaitzevia sp. adult 1 Total 4

Original Total 55 Final Total 54

Identified and Enumerated by
Patricia Ann Mitchell
MS, University of Montana, 1968

Dept. of Entomology
University of Alberta, Edmonton

January 29, 1973
Patricia Ann Mitchell

BLACKFOOT RIVER AT POP'S PLACE #3
8-20-71
1 sq. ft. L. Spence

PLECOPTERA 48 T

Nemoura cinctipes 37
Paraperla frontalis 2
Isogenus sp. 2
Alloperla sp. 8 Total 49

DIPTERA 2 T

Simuliidae 1
Orthocladius sp. 1 1 Total 2

COLEOPTERA 1 T

Heterlimnius corpulentus adult 1 Total 1

Original Total 51 Final Total 52

Identified and Enumerated by
Patricia Ann Mitchell
MS, University of Montana, 1968

January 30, 1973
Patricia Ann Mitchell

APPENDIX P CONTINUED

BLACKFOOT RIVER AT POP'S PLACE #1
10-19-71
1 sq. ft. L. Spence

PLECOPTERA 43 0.1

Nemoura cinctipes	23	D = 1.97962 DMIN = 0.215382
Eucapnopsis brevicauda	1	DMAX = 2.02193 R= 0.166763
Isogenus sp.	7	
Alloperla sp.	10	
Paraperla frontalis	2	Total 43

TRICHOPTERA 2 T

D = 1.5 DMIN = 1.5
DMAX = 1.58496 R= 1

Arctopsyche grandis	1	
Parapsyche almota	1	Total 2

DIPTERA 2 T

D = 0.455021 DMIN = 0.455021
DMAX = 1.58496 R= 1

Metriocnemius sp.	1	
Unknown Chironomidae	1	Total 2

Original Total 47 Final Total 47

Identified and Enumerated by
Patricia Ann Mitchell
MS, University of Montana, 1968
July 31, 1973
Patricia Ann Mitchell

Station D.I.

D = 2.58616 DMIN = 0.588174
DMAX = 3.58496 R= 0.353625

BLACKFOOT RIVER AT POP'S PLACE #2
10-19-71
1 sq. ft. L. Spence

PLECOPTERA 34 0.1

Nemoura cinctipes	12	
Eucapnopsis brevicauda	5	
Isogenus sp.	4	
Alloperla sp.	12	
Paraperla frontalis	1	Total 34

COLEOPTERA 1 T

Set No diversity computed

Zaitzevia sp. adult	1	

DIPTERA 1 T

Could not find a dipteran

Original Total 36 Final total 35

Identified and enumerated by
Patricia Ann Mitchell
MS, University of Montana, 1968
July 31, 1973
Patricia Ann Mitchell

BLACKFOOT RIVER AT POP'S PLACE #3
10-19-71
1 sq. ft. L. Spence

PLECOPTERA 87 0.2

Nemoura cinctipes	27	
Eucapnopsis brevicauda	12	
Isogenus sp.	13	
Alloperla sp.	32	
Paraperla frontalis	2	Total 86

TRICHOPTERA 2 T

Arctopsyche grandis	1	
Hydropsychidae (head missing)	1	Total 2

DIPTERA 26 T

Antocha sp.	1	
Unknown Chironomidae	24	Total 25

Original Total 115 Final Total 113

Identified and Enumerated by
Patricia Ann Mitchell
MS, University of Montana, 1968
July 31, 1973
Patricia Ann Mitchell

Blackfoot at Flesher Pass Road Bridge 7/16/68

Station D.I.

D = 1.93312 DMIN = 0.199112
DMAX = 2.32193 R= 0.183153

Plecoptera 22 .4 cc

Claassenia sabulosa
Alloperla sp.
Acroneuria pacifica
Nemoura cinctipes
~~[illegible] sp.~~
HASTAPERLA SP.

Trichoptera 24 .2 cc

Rhyacophila vao or acropedes
Rhyacophila angelita
Brachycentrus sp.

Ephemeroptera 10 .1 cc

Epeorus longimanus (Eaton)
Baetis sp.
Cinygmula sp.

Coleoptera 32 .05 cc

Zaitzevia sp
Narpus concolor Le Conte
Lara sp.
Optioservus prob. quadrimaculatus

Diptera 91 .4 cc

Simuliidae
Hexatoma sp.
Empididae
Tendipedidae

Blackfoot River at Flesher Pass Road Bridge 4/29/69

Plecoptera 8, 0.3 cc

Claassenia sabulosa Banks
Nemoura besametsa Ricker
Isogenus sp.
Alloperla sp.
Nemoura cinctipes Banks

Trichoptera 7, 0.1 cc

Hydropsyche sp.
Lepidostoma sp.

Ephemeroptera 1, T

Epeorus longimanus (Eaton)

Coleoptera

Zaitzevia sp. 7

Diptera 10, T

Simuliidae
Antocha sp.
Tendipedidae
Brillia sp.

Blackfoot at Flesher Pass Road Bridge 10/1/69

Plecoptera 42, (no vol given)

Nemoura cinctipes Banks
Alloperla sp.
Claassenia sabulosa Banks
Acroneuria pacifica Banks
Isoperla frontalis Banks

Trichoptera 8,

Brachycentrus sp.
Arctopsyche sp.

Ephemeroptera

Cinygmula sp.

Diptera 24,

Antocha sp.
Simuliidae
Hexatoma sp.
Tendipedidae

APPENDIX P CONTINUED

BLACKFOOT RIVER AT FLESHER PASS ROAD BRIDGE #1

3/19/71

1 sq. ft. sample from middle of riffle above culvert. L. Spence. 1400

meroptera 99 .1

Baetis sp. -43
Epeorus longimanus -18
Cinygmula sp. -25

D = 1.22395 DMIN = 0.10[illegible]
DMAX = 1.53496 E= 0.175214

Total 86

optera 186 .4

Nemoura sp. prob. besametsa -66
Capnia spp. -11
Arcynopteryx parallela -1
Acroneuria pacifica -2
Alloperla sp. -46
Nemoura cinctipes -17
Isogenus sp. -6
Paraperla frontalis -2
Eucapnopsis brevicauda -5
Brachyptera sp.-1
Unknown Plecoptera -2

D = 2.23047 DMIN = 0.235109
DMAX = 3.45945 E= 3.[illegible]1163

Total 161

choptera 36 .1

Rhyacophila acropedes -1
Hydropsyche sp. -24
Arctopsyche sp. -2
Brachycentrus sp. -10

D = 1.66666 DMIN = 0.549689
DMAX = 2.58496 E= 0.451194

Total 37

era 203 .2

Cardiocladius sp. -3
Hydrobaenus sp. 1 -7
Hydrobaenus sp. 3 -97
Brillia sp.-9
Calopsectra sp. -1
Metriocnemus sp. -1
Pericoma sp. -14
Simuliidae -33
Empididae -2
Antocha sp. -14
Hexatoma sp. -1

D = 2.15584 DMIN = 0.234755
DMAX = 3.58496 E= 0.433041

Total 182

Original Total 424
Final Total 466

station D.I.

D = 3.75[illegible] DMIN = 1.334928
DMAX = 5. E= 0.[illegible]3117

BLACKFOOT RIVER AT FLESHER PASS ROAD BRIDGE #2

3/19/71

1 sq. ft. sample from center of riffle 50' above culvert. L.Spence.

Ephemeroptera 29 T		
Baetis spp.	17	
Epeorus longimanus	2	
Cinygmula sp.	2	Total 21
Plecoptera 62 0.2		
Nemoura sp. prob. besametsa	30	
Nemoura cinctipes	12	
Alloperla sp.	11	
Capnia spp.	7	
Isogenus sp.	1	
Claassenia sabulosa	1	
Eucapnopsis brevicauda	1	
Brachyptera sp.	1	Total 64
Trichoptera 8 T		
Hydropsyche sp.	5	
Brachycentrus sp.	2	
Limnephilidae	1	Total 8
Diptera 111 0.1		
Hydrobaenus sp. 3	14	
Brillia sp.	3	
Hydrobaenus-type unknown	1	
Brillia-type unknown	1	
Antocha sp.	11	
Simuliidae	79	Total 109

Original total 210
Final Total 202

BLACKFOOT RIVER AT FLESHER PASS ROAD BRIDGE #3

3-19-71

1 sq. ft. sample from center of riffle, 75 ft. above culvert. L. Spence

Ephemeroptera 98 0.1		
Cinygmula sp. 16		
Baetis spp. 47		
Epeorus longimanus 4		Total 67
Plecoptera 189 0.5		
Arcynopteryx paralella or curvata	2	
Nemoura cinctipes	20	
Nemoura sp. prob. besametsa	103	
Alloperla sp.	47	
Isogenus sp.	10	
Capnia spp.	20	
Brachyptera sp.	2	
Claassenia sabulosa	1	
Acroneuria pacifica	1	
Eucapnopsis brevicauda?	4	
Unknown small plecopteran	1	Total 211
Trichoptera 25 0.2		
Brachycentrus sp.	8	
Rhyacophila acropedes	3	
Hydropsyche sp.	9	
Arctopsyche grandis	1	
Glossosoma sp.	1	
Limnephilidae	1	Total 23
Diptera 105 0.1		
Antocha sp.	12	
Pericoma sp.	10	
Hydrobaenus sp. 3	46	
Hydrobaenus sp. 1	1	
Brillia sp.	9	
Dicranota sp.	1	
Simuliidae	19	Total 98

Original Total ...
Final Total ...

APPENDIX P

BLACKFOOT RIVER AT FLESHER ROAD BRIDGE #1
8-20-71
1 sq. ft. from center of riffle — L. Spence

D = 0.196792 DMIN = 0.196792
DMAX = 1. R= 1

EPHEMEROPTERA 20 T		
Baetis spp.	17	
terrestrial hemipteran	1	Total 18

D = 0.892377 DMIN = 7.74919E-2 = .0774919
DMAX = 2.30735 R= 0.761492

PLECOPTERA 205 0.1		
Nemoura cinctipes	155	
Eucapnopsis or Capnia sp.	4	
Acroneuria pacifica	1	
Isogenus sp.	1	
Alloperla sp.	50	Total 211

D = 2.26353 DMIN = 0.433675
DMAX = 3.16993 R= 0.331751

TRICHOPTERA 77 0.1		
Arctopsyche grandis	33	
Hydropsyche sp.	24	
Brachycentrus sp.	11	
Limnephilid Genus 2	2	
Pupa	1	Total 71
DIPTERA 109 T		
Antocha sp.	16	
Simuliidae	9	
Pericoma sp.	20	
Heleidae - Palpomyia type	1	
Tanytarsus sp.	4	
Metriocnemius sp.	4	
Brillia sp.	9	
Unknown Chironomidae	56	Total 119

D = 2.43089 DMIN = 0.253334
DMAX = 3.45943 R= 0.329808

D = 0.442561 DMIN = 0.442561
DMAX = 1.53496 R= 1

COLEOPTERA 20 T		
Optioservus sp. adult	1	
Zaitzevia sp. ad-1, lar-3	4	
Lara sp. larva	1	Total 6
NEMATODA 4 T		
I guess they are nematodes	4	Total 4

Original Total 435 Final Total 429

Identified and Enumerated by
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Dept. of Entomology
University of Alberta
Edmonton, Alberta, Canada
MS Univ. of Montana, Missoula, 1968

Patricia Ann Mitchell
April 16, 1973

Station D.I.
D = 3.013 DMIN = 0.244483
DMAX = 5. R= 0.417305

CONTINUED

BLACKFOOT RIVER AT FLESHER PASS BRIDGE #2
8-20-71
1 sq.ft. from center of riffle — L. Spence

EPHEMEROPTERA 21 T		
Baetis spp.	16	Total 16
PLECOPTERA 285 0.1		
Nemoura cinctipes	249	
Alloperla sp.	43	Total 292
TRICHOPTERA 57 0.2		
Brachycentrus sp.	17	
Rhyacophila acropedes or vao	5	
Arctopsyche grandis	9	
Hydropsyche sp.	15	
Limnephilidae	3	Total 49
DIPTERA 167 T		
Antocha sp.	17	
Hexatoma sp.	1	
Pericoma sp.	30	
Simuliidae	2	
Heleidae - Palpomyia type	1	
Metriocnemius sp.	6	
Brillia sp.	12	
Tanytarsus sp.	10	
Pentaneura sp.	1	
Orthoclad unknown #1-see Alice Creek	18	
Unknown Chironomidae	91	Total 188
COLEOPTERA 28 T		
Zaitzevia sp. lar- 3, ad-4	7	Total 7

Original Total 558 Final Total 552

Identified and Enumerated by
Patricia Ann Mitchell
MS University of Montana, Missoula, 1968
April 23, 1973

Patricia Ann Mitchell

BLACKFOOT RIVER AT FLESHER ROAD BRIDGE #3
8-20-71
1 sq. ft. from left of center of stream — L. Spence

EPHEMEROPTERA 48 0.1		
Ephemerella doddsi	1	
Baetis spp.	37	Total 38
PLECOPTERA 358 0.9		
Nemoura cinctipes	259	
Claassenia sabulosa	2	
Isogenus sp.	1	
Arcynopteryx curvata or parallela	2	
Perlodidae (too small to identify)	1	
Alloperla sp.	99	
Capnia sp.	5	Total 369
TRICHOPTERA 48 0.2		
Brachycentrus sp.	6	
Arctopsyche grandis	8	
Hydropsyche sp.	10	
Rhyacophila acropedes or vao	2	
Limnephilid genus 1	1	
Limnephilid genus 2	11	
Lepidostoma sp.	1	
Tinodes sp.	1	
Pupa	1	Total 41
DIPTERA 101 T		
Antocha sp.	14	
Pericoma sp.	5	
Simuliidae	3	
Metriocnemius sp.	1	
Brillia sp.	5	
Tanytarsus sp.	11	
Unknown Orthoclad #1	9	
Unknown Chironomidae	42	Total 90
COLEOPTERA 8 T		
Zaitzevia sp. lar-10,ed-5	15	Total 15

Original Total 563, Final Total 553

Identified and Enumerated by
Patricia Ann Mitchell
MS, Univ. of Montana, 1968
April 27, 1973
Patricia Ann Mitchell

APPENDIX P CONTINUED

BLACKFOOT RIVER AT FLESHER PASS ROAD BRIDGE #1
10-19-71
1 sq. ft. 1245 L. Spence

EPHEMEROPTERA 22 T		
Baetis sp.	16	
Cinygmula sp.	5	Total 21
PLECOPTERA 130 0.2		
Nemoura cinctipes	21	
Capnia sp.	2	
Leuctra sp.	20	
Isogenus sp.	5	
Acroneuria sp.		
Alloperla sp.	79	
Paraperla frontalis	2	Total 131
TRICHOPTERA 49 0.1		
Hydropsyche sp.	13	
Brachycentrus sp.	34	
Rhyacophila acropedes or vao	1	
Limnephilid #2	1	Total 49
DIPTERA 161 0.1		
Antocha sp.	88	
Pericoma sp.	64	
Tanypodinae	4	
Orthoclads	2	Total 158

Original Total 362 Final Total 359

BLACKFOOT RIVER AT FLESHER PASS ROAD BRIDGE #2
10-19-71
1 sq. ft. L. Spence

EPHEMEROPTERA 60 T		
Baetis sp.	40	
Cinygmula sp.	15	Total 55
PLECOPTERA 145 0.6		
Nemoura cinctipes	34	
Capnia sp.	6	
Leuctra sp.	11	
Arcynopteryx parallela or curvata	2	
Isogenus sp.	6	
Acroneuria pacifica	2	
Claassenia sabulosa	2	
Alloperla sp.	81	Total 144
TRICHOPTERA 54 0.1		
Hydropsyche sp.	14	
Arctopsyche grandis	1	
Glossosoma sp.	1	
Rhyacophila acropedes or vao	2	
Brachycentrus sp.	33	
Limnephilidae #2	2	
Hydroptila sp.	1	Total 54
DIPTERA 137 0.2		
Antocha sp.	72	
Pericoma sp.	59	
Orthoclad chironomidae (several species)	3	
Tanytarsini chironomidae (one species)	1	Total 135
UNKNOWN 2 T		
Nematoda	2	Total 2

Original Total 398 Final Total 390

Enumerated and Identified by
/s/ Patricia Ann Mitchell
Department Zoology
University of Alberta

BLACKFOOT RIVER AT FLESHER PASS ROAD BRIDGE #3
10-19-71
1 sq. ft. 1300 L. Spence

EPHEMEROPTERA 149 T		
Baetis sp.	101	
Cinygmula sp.	37	
Ephemerella intrequens	3	Total 141
PLECOPTERA		
Nemoura cinctipes	26	
Capnia sp.	20	
Leuctra sp.	15	
Arcynopteryx curvata or parallela	1	
Isogenus sp.	4	
Isoperla sp.	2	
Acroneuria pacifica	3	
Claassenia sabulosa	2	
Paraperla frontalis	4	
Alloperla sp.	83	Total 160
TRICHOPTERA 45 0.1		
Hydropsyche sp.	3	
Arctopsyche grandis	1	
Rhyacophila acropedes or vao	3	
Rhyacophila coloradensis	2	
Glossosoma sp.	1	
Brachycentrus sp.	35	Total 45
DIPTERA 313 0.3		
Hexatoma sp.	5	
Dicranota sp.	4	
Antocha sp.	191	
Empididae #1	1	
Pericoma sp.	85	
Tanypodinae chironomidae (prob. 1 species)	4	
Orthoclad chironomidae (several species)	27	Total 317
ANNELIDA 2 T		
Oligochaeta	2	Total 2

Original Total 674 Final Total 665

/s/ Patricia Ann Mitchell

APPENDIX P CONTINUED

ALICE CREEK ABOVE NATIONAL FOREST BOUNDARY #1
8-24-71

1 sq. ft. sample — L. Spence

EPHEMEROPTERA 156 0.5 cc		
Epeorus deceptivus	16	
Baetis spp.	17	
Cinygmula sp.	110	
Ephemerella doddsi	3	
Ephemerella coloradensis	7	
Ameletus sp.	1	Total 154
PLECOPTERA 44 T		
Eucapnopsis brevicauda	45	
Alloperla sp. or Arcynopteryx sp.	1	Total 46
TRICHOPTERA 6 T		
No trichoptera		
DIPTERA		
Orthocladius sp. 5 (all same species)	6	Total 6
ANNELIDA 8 T		
Annelida	8	Total 8

Original Total 214 Final Total 214

Identified and Enumerated by
Patricia Ann Mitchell
MS Univ. of Montana, 1968

Dept. of Entomology
University of Alberta
Edmonton, Alberta, Canada

January 18, 1973

Patricia Ann Mitchell

ALICE CREEK ABOVE NATIONAL FOREST BOUNDARY ~~#2~~
8-24-71

1 sq. ft. — L. Spence

EPHEMEROPTERA 378 1.0		
Baetis spp.	73	
Cinygmula sp.	253	
Epeorus deceptivus	13	
Ephemerella doddsi	13	
Ephemerella coloradensis	13	
Ephemerella grandis	1	
Ameletus sp.	2	Total 368
PLECOPTERA 76 0.1		
Eucapnopsis brevicauda	77	
Nemoura cinctipes	1	
Arcynopteryx signata	2	
Arcynopteryx sp. (too small to identify further)	3	Total ~~##~~ 83
TRICHOPTERA 0		
Rhyacophila sp.	1	Total 1
DIPTERA 15 T		
Orthocladius sp. 1	1	
Orthocladius sp. 5	11	
Metriocnemius sp.	1	
Tipulid - Polymeda sp. (probably)	2	Total 15
NEMATODA 10 T		
Annelida - Oligochaeta	10	Total 10

Original Total 479 Final Total ~~478~~ 477

Identified and Enumerated by:
Patricia Ann Mitchell
MS Univ. Of Montana, Missoula, 1968

Patricia Ann Mitchell
January 22, 1973

ALICE CREEK ABOVE NATIONAL FOREST BOUNDARY #3
8-24-71

EPHEMEROPTERA 399 1.6	D = 1.[illegible] DMIN = [illegible] DMAX = 3.15993 R= [illegible]	
Cinygmula sp.	174	
Baetis spp.	81	
Epeorus deceptivus	61	
Epeorus longimanus	1	
Ephemerella coloradensis	33	
Ephemerella doddsi	17	
Ephemerella tibialis	1	Total 368
PLECOPTERA 114 0.1	D = 0.861[illegible] DMIN = [illegible] DMAX = 2.32193 R= [illegible]	
Nemoura cinctipes	23	
Eucapnopsis brevicauda	82	
Arcynopteryx signata	2	
Arcynopteryx sp.	10	
Acroneuria sp.	1	
Unknown Plecoptera (too small to identify)	1	Total 119
TRICHOPTERA 4 T	D = 1.59193 DMIN = 1.37[illegible]5 DMAX = 1.58496 R= 0.294537	
Glossosoma sp.	2	
Psychomyiidae	2	Total 4
DIPTERA 49 T	D = 2.17278 DMIN = 0.537[illegible]4 DMAX = 2.53496 R= 0.201273	
Metriocnemius sp.	10	
Orthocladius sp. 1	7	
Orthocladius sp. 5	5	
Cardiocladius sp.	3	
Brillia sp.	24	Total 49
COLEOPTERA 3 T	D = 0.918296 DMIN = 0.918296 DMAX = 1. R= 1	
Zaitzevia sp. adult 1, larva 1	2	
Optioservus sp. adult	1	Total 3
NEMATODA 20 T		
Annelida - Oligochaeta	20	Total 20

Original Total 589 Final Total 563

Identified and Enumerated by
Patricia Ann Mitchell
MS, 1968, University of Montana

Dept. of Entomology
University of Alberta, Edmonton

Station D.I.

D = 2.64755 DMIN = [illegible] DMAX = 4.64386 R= [illegible]

January 28, 1973

Patricia Ann Mitchell

Sample #2 lost in Helena lab.

APPENDIX P CONTINUED

ALICE CREEK AT HIGHWAY 200 BRIDGE #1

3/19/71

1 sq. ft. sample from left side of riffle 50' above bridge. L. Spence. 1515

Ephemeroptera 280 .2

Baetis spp. 147
Cinygmula sp. 38
Ephemerella infrequens 41
Rhithrogena sp. 1
Epeorus longimanus 13
Paraleptophlebia sp. 3
Ephemerella sp. 21

D = 2.11523 DMIN = 0.101582
DMAX = 3. R= 0.305263

Total 264

Trichoptera 159 0.5

Rhyacophila acropedes 10
Rhyacophila vepulsa 2
Hydropsyche sp. 103
Arctopsyche ~~sp.~~ 4 grandis
Glossosoma sp. 30
Limnephilidae 5
Tricoptera pupa 1

D = 1.5996 DMIN = 0.1561
DMAX = 3. R= 0.492422

Total 155

Plecoptera 145 0.2

Alloperla sp. 16
Capnia spp. 14
Nemoura cinctipes 4
Nemoura besametsa 95
Isogenus sp. 5

D = 1.49163 DMIN = 0.112932
DMAX = 3. R= 0.522439

Total 134

Diptera 309 0.5

Cardiocladius sp. 24
Hydrobaenus sp. 1 69
Hydrobaenus sp. 2 5
Hydrobaenus sp. 3 74
Metriocnemus sp. 17
Pupae - Hydrobaenus 4
Unknown Tendip. 24
Pericoma sp. 18
Antocha sp. 29
Simuliidae 3
Heleinae 3

D = 3.04267 DMIN = 0.226642
DMAX = 3.80735 R= 0.213557

Total 270

Coleoptera 9 T

Heterlimnius sp. prob. corpulentus larvae 3
Optioservus sp. larvae 6
Optioservus sp. adults 4
Zaitzevia sp. larva 1

D = 1.26939 DMIN = 0.37314
DMAX = 1.53496 R= 0.425456

Total 14

Station D.I.

Original Total 902
Final Total ~~836~~ 837

D = 4.1217 DMIN = 0.2003
DMAX = 5.35755 R= 0.239657

ALICE CREEK AT HIGHWAY 200 BRIDGE #3

3/19/71

1 sq. ft. sample from center of riffle 75' above bridge. L.Spence.

Ephemeroptera 565 1.1

Ephemerella infrequens 97
Ephemerella doddsi 9
Ephemerella sp. 2
Ephemerella sp. too small to identify 29
Rhithrogena sp. 13
Epeorus longimanus 14
Cinygmula spp. 172
Baetis sp. 173
Paraleptophlebia sp. 14
523

Total 523

Plecoptera 525 1.0

Nemoura sp. prob. besametsa 335
Alloperla sp. 119
Capnia spp. 64
Nemoura cinctipes 12
Isogenus sp. 4
Brachyptera sp. 1
Acroneuria pacifica 1
Arcynopteryx parallela or curvata 1
Unknown small plecoptera 3
540

Total 540

Trichoptera 320 0.6

Hydropsyche sp. 204
Glossosoma sp. 51
Brachycentrus sp. 20
Rhyacophila acropedes 16
Limnephilidae (small, reddish flat head) 7
Trichopteran pupae 5
Arctopsyche grandis ~~sp.~~ 5
Rhyacophila vepulsa 3
Psychoronia sp. 1
312

Total 312

Diptera 396 1.5

Cardiocladius sp. 62
Hydrobaenus sp. 1 63
Hydrobaenus sp. 2 20
Hydrobaenus sp. 3 49
Metriocnemus sp. 36
Diamesa sp. larvae 6
Diamesa sp. pupae 5
Brillia sp. 1
Pentaneura sp. 1
Other Tendipedidae 25
Pericoma sp. 45
Antocha sp. 29
Hexatoma sp. 2
Simuliidae 2
347

Total 347

Coleoptera 5 T

Optioservus sp. adults 5
Optioservus sp. larvae 10
Heterlimnius sp. larvae 5
Zaitzevia sp. larvae 1

Total 21

Oligochaeta 1 T

Total 1

Original total 1812
Final total ~~1743~~ 1744

APPENDIX P CONTINUED

ALICE CREEK AT HIGHWAY 200 Bridge #1
8-24-71
1 sq. ft. L. Spence

EPHEMEROPTERA 285 0.2

Baetis sp.	132	
Cinygmula sp.	73	
Rhithrogena sp.	25	D = 2.24696 DMIN = 0.132307
Paraleptophlebia sp.	7	DMAX = 3.45943 R= 0.36469
Epeorus sp.	2	
Ephemerella doddsi	10	
Ephemerella infrequens	9	
Ephemerella grandis ingens	11	
Ephemerella tibialis	5	
Ephemerella hystrix	1	Total 275

PLECOPTERA 120 0.5

Nemoura cinctipes	33	
Alloperla sp.	73	
Arcynopteryx curvata or parallela	1	D = 1.55281 DMIN = 0.192418
Arcynopteryx sp. (too small to identify)	5	DMAX = 3.16993 R= 0.543112
Acroneuria pacifica	4	
Acroneuria californica	3	
Acroneuria sp. (small)	7	Total 126

TRICHOPTERA 102 0.5

Hydropsyche sp.	39	
Arctopsyche grandis	32	
Glossosoma sp.	10	D = 2.32339 DMIN = 0.239137
Rhyacophila acropedes or vao	6	DMAX = 3.70044 R= 0.397343
Rhyacophila sp. (small)	1	
Brachycentrus sp.	7	
Lepidostoma sp.	1	
Limnephilidae Genus 2	2	
Pupa	1	Total 99

DIPTERA 133 0.2

Hexatoma sp.	2	
Antocha sp.	15	
Simuliidae	41	
Pericoma sp.	31	D = 2.89004 DMIN = 0.184938
Cardiocladius sp.	9	DMAX = 3.70044 R= 0.230523
Metriocnemius sp.	17	
Tanytarsus sp.	1	
Orthocladius sp. 2	2	
Orthocladius spp. 1 (several species)	37	
Brillia sp.	1	Total ~~132~~ 156

DMAX = 5.64386 R= 0.227147

COLEOPTERA 29 0.1

Optioservus sp.	Larvae	25	
	Adults	9	D = 1.39391 DMIN = 0.204085
Heterlimnius sp.	Larvae	3	DMAX = 2. R= 0.337431
	Adults	3	
Zaitzevia sp.	Larvae	9	
	Adults	1	Total 50

NEMATODES 2 T
Nematoda 2 Total 2

Cottus 1

Original Total 672 Final Total 708

ALICE CREEK AT HIGHWAY 200 ~~BRIDGE #2~~
8-24-71
1 sq. ft. L. Spence

EPHEMEROPTERA 248 0.1

Baetis spp.	80	
Cinygmula sp.	112	
Rhithrogena sp.	1	
Paraleptophlebia sp.	12	
Ephemerella doddsi	7	
Ephemerella infrequens	34	
Ephemerella hystrix	1	
Ephemerella grandis ingens	13	Total 260

PLECOPTERA 187 0.2

Nemoura cintipes	39	
Capnia sp.	5	
Alloperla sp.	100	
Arcynopteryx curvata or parallela	17	
Isogenus (Cultus) aestivalis	1	
Isogenus sp.	2	
Acroneuria pacifica	1	Total 165

TRICHOPTERA 248 0.4

Hydropsyche sp.	111	
Arctopsyche sp.	23	
Glossosoma sp.	24	
Rhyacophila acropedes or vao	9	
Rhyacophila sp.	1	
Brachycentrus sp.	5	
Limnephilid Genus 1	33	
Limnephilid Genus 2	1	
Lepidostoma sp.	22	
Chimarra sp.	1	
Ochrotrichia sp.	1	
pupae	20	Total 251

DIPTERA 287 0.5

Antocha sp.	106	
Hexatoma sp.	4	
Simuliidae	6	
Empididae #1	2	
Pericoma sp.	56	
Orthocladius sp. 1 (all unknown Orthocladius)	58	
Orthocladius sp. 4	1	
Orthocladius sp. 2	5	
Metriocnemius sp.	45	
Cardiocladius sp.	17	
Brillia sp.	7	
Tanytarsus sp.	4	
Unknown tendipedid (chironomid)*	27	Total 338

COLEOPTERA 94 T

Heterlimnius sp. larvae	19		
Optioservus sp. Larvae	13	adults 13	
Zaitzevia sp. larvae	4	adults 1	Total 50

*1 species - pale head, mentum

Original Total 1064 Final Total 1064

ALICE CREEK AT HIGHWAY 200 BRIDGE #3
8-24-71
1 sq. ft. L. Spence

EPHEMEROPTERA 293 0.1

Baetis spp.	55	
Cinygmula sp.	159	
Rhithrogena sp.	7	
Paraleptophlebia sp.	35	
Ephemerella infrequens	33	
Ephemerella doddsi	5	
Ephemerella tibialis	4	
Ephemerella grandis ingens	9	
Ephemerella margarita?	1	Total 308

PLECOPTERA 163 0.1

Nemoura cinctipes	41	
Alloperla sp.	83	
Isogenus sp.	2	
Arcynopteryx signata	1	
Arcynopteryx parallela or curvata	15	
Capnia sp.	1	Total 143

TRICHOPTERA 215 0.2

Hydropsyche sp.	133	
Arctopsyche grandis	17	
Glossosoma sp.	7	
Rhyacophila verrulsa	2	
Rhyacophila acropedes or vao	1	
Brachycentrus sp.	5	
Limnephilid Genus 1	24	
Limnephilid Genus 2	2	
Lepidostoma sp.	6	
Trichoptera pupae	16	Total 213

DIPTERA 156 0.4

Hexatoma sp.	3	
Antocha sp.	41	
Simuliidae	3	
Empididae #1	1	
Pericoma sp.	71	
Cardiocladius sp.	5	
Metriocnemius sp.	6	
Orthocladius sp. 1 (all unknown Ortho.)	50	
Orthocladius sp. 2	5	
Unknown Chiron.*	22	
Brillia sp.	5	
Tanytarsus sp.	1	Total 213

COLEOPTERA 86 T

Optioservus sp.	larvae 6	adults 9	
Heterlimnius sp.	larvae 3		
Zaitzevia sp.	larvae 4		
Brychius sp.	larva 1		Total 23

NEMATODA 1 T
No nematodes

Original Total 914 Final Total 900

*Appears to be 1 species - pale head, light mentum

APPENDIX P CONTINUED

ALICE CREEK AT HIGHWAY 200 #1
10-19-71
1 sq. ft. 1315 L. Spence

EPHEMEROPTERA 290 0.5		
Baetis spp.	69	
Cinygmula sp.	111	
Rhithrogena sp.	21	
Ephemerella grandis ingens	10	
E. infrequens	57	
E. doddsi	12	
Paraleptophlebia sp.	19	Total 299
PLECOPTERA 145 0.5		
Nemoura cinctipes	15	
Capnia sp.	12	
Isogenus sp.	8	
Alloperla sp.	91	
Acroneuria pacifica	4	
Acroneuria californica	1	Total 131
TRICHOPTERA 269 0.9		
Hydropsyche sp.	146	
Arctopsyche grandis	7	
Glossosoma sp.	64	
Brachycentrus sp.	19	
Rhyacophila vao or *acropedes*	5	
R. vepulsa	1	
pupae (pupae usually are same as above larvae)	2	Total 244
DIPTERA 465 T + 42		
Hexatoma sp.	5	
Antocha so.	131	
Pericoma sp.	152	
Orthoclad #2 (one easily recognizable species that lives in the blue-green alga *Nostoc*)	162	
Other Orthocladinae	40	
Tanytarsini	1	
Brillia sp.	1	Total 492
COLEOPTERA 73 0.1		
Optioservus sp.	38	
Heterlimnius sp.	18	
Zactzevia sp.	17	Total 73
ANNELIDA 2 T		
Oligochaeta - family Naididae	2	Total 2

Original Total 1286 Final Total 1241

s/ Patricia Ann Mitchell
May 9, 1974

ALICE CREEK AT HIGHWAY 200 #2
10-19-71
1 sq. ft. 1330 L. Spence

EPHEMEROPTERA 210 0.4			
Baetis sp.	69		
Cinygmula sp.	51		
Rhithrogena sp.	2		
Ephemerella grandis ingens	10		
E. infrequens	61		
E. doddsi	8		
E. tibialis	1		
Paraleptophlebia sp.	5		Total 207
PLECOPTERA 110 0.1			
Nemoura cinctipes	56		
Capnia sp.	5		
Isogenus sp.	15		
Acroneuria sp. (small)	1		
Alloperla sp.	26		
Arcynopteryx curvata or *parallela*	1		Total 104
TRICHOPTERA 318 1.9			
Hydropsyche sp.	158		
Arctopsyche grandis	18		
Glossosoma sp.	37		
Brachycentrus sp.	56		
Rhyacophila acropedes or *vao*	33		
R. vepulsa	1		
Chimarra sp.	9		
Limnephilidae sp. 2	1		
pupae	3		Total 316
DIPTERA 411 0.2 + 60			
Hexatoma sp.	3		
Antocha sp.	129		
Pericoma sp.	106		
Orthoclad #2	137		
other orthocladinae	17		
Brillia sp.	1		
Simuludae	2	+60	
Empididae	3		Total 458
COLEOPTERA 38 T			
Optioservus sp.	30		
Heterlimnius sp.	5		
Zactzevia sp.	3		Total 38
UNKNOWN 1 T			
Nematoda	1		Total 1

Original Total 1148 Final Total 1124

ALICE CREEK AT HIGHWAY 200 #3
10-19-71
1 sq. ft. L. Spence

EPHEMEROPTERA 275 0.5		
Baetis spp. (2 species present)	35	
Cinygmula sp.	106	
Rhithrogena sp.	7	
Ephemerella doddsi	11	
E. grandis ingens	24	
E. infrequens	72	
E. spinifera	1	
E. tibialis	1	
Paraleptophlebia sp.	12	Total 269
PLECOPTERA 119 0.3		
Nemoura cinctipes	6	
Capnia sp.	8	
Isogenus sp.	20	
Arcynopteryx curvata or *parallela*	4	
Acroneuria sp. (prob. pacifica)	3	
Alloperla sp.	69	
Small Chloroperlidae (maybe *paraperla frontalis* - too small to be sure)	5	Total 115
TRICHOPTERA 344 0.8		
Hydropsyche sp.	116	
Arctopsyche grandis	5	
Glossosoma sp.	136	
Brachycentrus sp.	58	
Rhyacophila acropedes or *vao*	12	
R. vepulsa	2	
Limnephilidae #1	4	
pupae	2	Total 335
DIPTERA 700 0.2 + 107		
Hexatoma sp.	1	
Antocha sp.	158	
Empididae #1	4	
Pericoma sp.	223	
Orthoclad #2	360 (including those in *Nostoc*)	
other orthoclad chironomidae	58	
Brillia sp.	3	
Metriocnemius sp.	2	
Tanytarsini	1	Total 810
COLEOPTERA 60 T		
Optioservus sp.	39	
Zactzevia sp.	6	
Heterlimnius sp.	15	Total 60
COTTUS	1 T	

Original Total 1606 Final Total 1589

/s/ Patricia Ann Mitchell

APPENDIX P CONTINUED

ackfoot River at Hogum Creek Road Bridge 7/15/68

Plecoptera 53 .7 cc

Claassenia sabulosa Banks
Acroneuria pacifica Banks
Kathroperla sp.
Acroneuria theodora Needham and Claassen
Nemoura cinctipes Banks
Alloperla sp.

Trichoptera 155 1.3 cc

Brachycentrus sp.
Rhyacophila acropedes or vao
Rhyacophila angelita Banks
Hydropsyche sp.
Limnephilidae (keys to Astenophylax in key, but isnt.)
Psychoglypha flavida (Hagen) or lumina (Ross)
Anagapetus sp.
Lepidostoma sp.
Ochrotrichia sp.

Ephemeroptera 508 1.4 cc

Paraleptophlebia vaciva ?
Ephemerella flavilinea McDunnough
Ephemerella tibialis McDunnough
Epeorus longimanus (Eaton)
Baetis spp.
Cinygmula sp.

Coleoptera 124 .05 cc

Zaitzevia sp.
Lara sp.
Narpus sp. prob. concolor
Optioservus sp.
Heterlimnius sp. prob. corpulentus
Chrysomelidae adult, prob. not aquatic

Diptera 813 2.0 cc

Hexatoma sp.
Antocha sp.
Simuliidae
Rhabdomastix sp. ?
Tendipedidae
Pentaneura sp.
Tanytarsus sp.

Station D.I.

D = 1.73697 DMIN = 2.93571E-2 = .0293571
DMAX = 2.32193 R= 0.233651

Blackfoot River at Hogum Creek Road Bridge 4/29/69

Plecoptera 65, 1.10 cc

Acroneuria pacifica Banks
Claassenia sabulosa Banks
Nemoura besametsa Ricker
Nemoura cinctipes Banks
Alloperla sp.
Capnia distincta
Capnia sp. prob. elongata or confusa
Isoperla sp.

Trichoptera 62, 0.5 cc

Rhyacophila acropedes or vao
Glossosoma sp.
Lepidostoma sp.
Hydropsyche sp.
Brachycentrus sp.
Limnephilidae

Ephemeroptera 254, 1.4 cc

Baetis spp.
Ephemerella infrequens McDunnough
Cinygmula sp.
Epeorus longimanus (Eaton)
Ephemerella grandis ingens McDunnough
Paraleptophlebia vaciva Eaton ?
Rhithrogena sp. (too small for proper identification)
Ephemerella sp. (too small for proper identification)

Coleoptera 14, .05 cc

Narpus concolor LeConte
Optioservus prob. quadrimaculatus
Heterlimnius prob. corpulentus

Diptera 91, 0.1 cc

Pericoma sp.
Simuliidae
Tendipedidae
Metriocnemus sp.
Cardiocladius sp.
Diamesa sp.
Shells of Stagnicola palustris snails 10, 0.1 cc

Station D.I.

D = 1.25639 DMIN = 8.52903E-2 = .0852903
DMAX = 2.32193 R= 0.23314

Blackfoot River at Hogum Creek Road Bridge 10/1/69

Plecoptera 49

Hastaperla sp.
Arcynopteryx parallela Frison (or curvata)
Acroneuria pacifica Banks
Capnia distincta or confusa
Nemoura cinctipes Banks

Trichoptera 399

Rhyacophila acropedes Banks or vao Milne
Brachycentrus sp.
Lepidostoma sp.
Hydropsyche sp.
Limnephilidae

Ephemeroptera 32

Ephemerella grandis ingens McDunnough
Paraleptophlebia sp., prob. vaciva Eaton
Cinygmula sp.
Ephemerella sp.

Coleoptera 50

Heterlimnius corpulentus (Le Conte)
Optioservus sp. prob. quadrimaculatus
Zaitzevia sp.

Diptera 44

Antocha sp.
Rhabdomastix sp.
Pericoma sp.
Hexatoma sp.
Simuliidae

Station D.I.

D = 1.49271 DMIN = 7.38855E-2 = . [redacted]
DMAX = 2.32193 R= 0.36975

.0738855

APPENDIX P CONTINUED

BLACKFOOT RIVER AT HOGUM CREEK BRIDGE #1
3/19/71
1 sq. ft. sample from left side of riffle above bridge. L. Spe

EPHEMEROPTERA 617 0.3		
Baetis parvus type (prob. tricaudatus)	14	
Baetis sp.	121	
Cinygmula sp.	376	
Rhithrogena sp.	1	
Epeorus longimanus	28	
Ephemerella infrequens	42	
Ephemerella sp. prob. flavilinea	22	
Paraleptophlebia sp.	7	
Ameletus sp.	1	Total 614
PLECOPTERA 205 0.4		
Nemoura besametsa	109	
Nemoura cinctipes	10	
Capnia sp.	38	
Isogenus sp.	3	
Isoperla sp.	2	
Alloperla sp.	37	
Hastaperla brevis	1	
Acroneuria pacifica	1	
Claassenia sabulosa	1	Total 202
TRICHOPTERA 195 0.2		
Hydropsyche sp.	46	
Rhyacophila acropedes or vao	33	
Rhyacophila vepulsa	1	
Glossosoma sp.	6	
Brachycentrus sp.	5	
Lepidostoma sp.	5	
Limnephilidae	3	Total 99
DIPTERA 153 0.2		
Antocha sp.	20	
Hexatoma sp.	2	
Dicranota sp.	2	
Simuliidae	26	
Empididae #1	1	
Empididae #2	1	
Empididae #3	1	
Pericoma sp.	29	
Brillia sp.	5	
Hydrobaenus sp. 2	108	
Cardiocladius sp.	16	
Hydrobaenus sp. 3	32	
Metriocnemus sp.	8	
Unknown Chironomidae	34	Total 285
COLEOPTERA 59 0.1		
Optioservus sp. larvae	12	
Optioservus sp. adult	1	
Zaitzevia sp. larvae	4	
Zaitzevia sp. adult	1	
Heterlimnius sp. larvae	1	Total 19

original total 1229
Final total 1219

BLACKFOOT RIVER AT HOGUM CREEK BRIDGE #2
3/19/71
1 sq. ft. from center of riffle above bridge. L. Spe

EPHEMEROPTERA 1123 0.6 D = [illegible] DMIN = 4.67529E-2 = [illegible]
DMAX = 3.45943 R= 0.395167

Baetis parvus type	63	
Baetis sp.	140	
Paraleptophlebia sp. prob. heteronea	35	
Siphlonurinae prob. Ameletus sp.	2	
Ephemerella infrequens	198	
Ephemerella sp. prob. flavilinea	82	
Ephemerella grandis ingens	1	
Cinygmula sp.	509	
Epeorus longimanus	94	Total 1124

PLECOPTERA 450 1.0

D = 2.22968 DMIN = 0.113794
DMAX = 3.45943 R= 0.374107

Nemoura besametsa	183	
Nemoura cinctipes	45	
Capnia spp.	65	
Alloperla sp.	110	
Chloroperlidae	3	
Isoperla sp.	14	
Isogenus sp.	1	
Claassenia sabulosa	4	
Acroneuria pacifica (and/or small unknown)*	3	Total 428

TRICHOPTERA 1013 1.4

D = 1.74198 DMIN = 6.74341E-2 = .0674341
DMAX = 3.16993 R= 0.460258

Hydropsyche sp.	608	
Arctopsyche grandis	2	
Brachycentrus sp.	21	
Glossosoma sp.	191	
Rhyacophila acropedes or vao	39	
Rhyacophila vepulsa	1	
Rhyacophila sp.	1	
Lepidostoma sp.	131	
Limnephilidae	7	
Pupae	10	Total 1011

Station D.I.
D = 4.0033 DMIN = 0.120759
DMAX = 5.72792 R= 0.306685

DIPTERA 399 0.5

D = 2.59819 DMIN = 0.233239
DMAX = 4.24793 R= 0.419923

Hexatoma sp.	5	
Antocha sp.	19	
Dicranota sp.	1	
Simuliidae	19	
Empididae #1	3	
Empididae #2	1	
Hydrobaenus sp. 2	258	
Cardiocladius sp.	7	
Brillia sp. 1	35	
Pentaneura sp.	1	
Brillia sp. 2	2	
~~Cricotopus sp.~~ Orthocladius sp. 1	1	
Hydrobaenus sp. 3	[illegible]	
Metriocnemus sp.	1	
Cricotopus sp.	1	
Hydrobaenus sp. 1	3	
Unknown Tendipedidae	20	
Pericoma sp.	39	Total [illegible]

COLEOPTERA 182 0.1

D = [illegible] DMIN = [illegible]
DMAX = 1.58496 R= 0.597561

Optioservus sp. adult	22	
Optioservus sp. larvae	24	
Zaitzevia sp. adult	2	
Zaitzevia sp. larvae	3	Total 51

✓ UNKNOWN 1

✓ COTTUS 2

ORIGINAL TOTAL 3130

FINAL TOTAL 3091

BLACKFOOT RIVER AT HOGUM CREEK BRIDGE #3
3/19/71
1 sq. ft. sample from right side of riffle above bridge. L. Spence. 1300

EPHEMEROPTERA 998 0.4		
Baetis parvus type (tricaudatus?)	12	
Baetis sp.	111	
Cinygmula sp.	574	
Rhithrogena sp.	2	
Epeorus longimanus	97	
Ephemerella infrequens	144	
Ephemerella flavilinea	49	
Paraleptophlebia sp. prob. heteronea	22	
Ameletus sp.	1	Total 1012
PLECOPTERA 358 1.0		
Nemoura besametsa	113	
Nemoura cinctipes	41	
Capnia spp.	58	
Alloperla sp.	74	
Hastaperla brevis	4	
Isoperla sp.	24	
Isogenus sp.	5	
Arcynopteryx parallela or curvata	1	
Acroneuria pacifica	3	
Claassenia sabulosa	1	Total 324
TRICHOPTERA 311 0.5		
Hydropsyche sp.	195	
Arctopsyche grandis	1	
Brachycentrus sp.	8	
Glossosoma sp.	38	
Rhyacophila acropedes or vao	13	
Lepidostoma sp.	52	
Limnephilidae	5	
✓ Pupae	2	Total 314
DIPTERA 111 0.1		
Hexatoma sp.	1	
Antocha sp.	3	
Empididae #2	2	
Hydrobaenus sp. 2	60	
Cardiocladius sp.	7	
Brillia sp.	24	
Calopsectra sp.	1	
Pentaneura sp.	2	
Metriocnemus sp.	1	
Unknown Chironomidae (Tendipedidae)	3	Total 104
*Coleoptera 52 0.1		
Heterlimnius sp. larva	1	
✓ Cottus	1	Original Total 1331

*Vial containing Coleoptera was missing from sample.

*Final Total 1755 1756

APPENDIX P CONTINUED

Blackfoot River at Hogum Creek Bridge #1
8-23-71

1 sq. ft. — L. Spence

D = 1.77145 DMIN = 0.116373
EROPTERA 314 0.1 DMAX = 3.16993 R= 0.457932

Cinygmula sp.	179	
Baetis spp.	71	
Rhithrogena sp.	2	
Ephemerella grandis ingens	4	
Ephemerella infrequens	46	
Ephemerella tibialis	2	
Paraleptophlebia sp.	9	Total 313

OPTERA 159 0.7 D = 1.32418 DMIN = 0.128098
DMAX = 3. R= 0.533522

Nemoura cinctipes	78	
Alloperla sp.	107	
Claassenia sabulosa	9	
Acroneuria pacifica	3	
Acroneuria sp. (small)	2	Total 199

D = 1.26725 DMIN = 6.13306E-2 = .0613306
CHOPTERA 692 1.3 DMAX = 3.58496 R= 0.657772

Hydropsyche sp.	448	
Arctopsyche grandis	22	
Brachycentrus sp.	122	
Glossosoma sp.	16	
Anagapetus sp.	1	
Rhyacophila acropedes	3	
Rhyacophila sp. (small)	2	
Lepidostoma sp.	11	
Limnephilidae	37	
Chimarra sp. (or Dortosa ?)	1	
Pupae	4	Total 667

TERA 137 0.1 D = 3.00112 DMIN = 0.213305
DMAX = 3.58496 R= 0.173161

Chironomidae

Tanytarsus sp. (= Calopsectra)	58	
Orthocladius sp. 2 (= Hydrobaenus) in Nostoc	9	
Cardiocladius sp.	3	
Metriocnemus sp.	17	
Brillia sp.	11	
Orthocladius sp. 1	5	
Hexatoma sp.	2	
Simuliidae	14	
Pericoma sp.	10	Total 129

LEOPTERA 208 0.1 D = 1.40533 DMIN = 0.123737
DMAX = 2.58496 R= 0.400241

Optioservus sp.	34	
Heterlimnius sp.	3	
Zaitzevia sp.	95	
Narpus sp.	6	Total 138

igochaete	1	Total 1

Station D.I.

D = 3.56544 DMIN = 0.133123
DMAX = 5.55459 R= 0.367794

Original Total 1510
Final Total 1497

BLACKFOOT RIVER AT HOGUM CREEK BRIDGE #2
8-23-71

1 sq. ft. — L. Spence

EPHEMEROPTERA 268 0.1

Baetis spp.	72	
Cinygmula sp.	144	
Ephemerella infrequens	36	
Ephemerella doddsi	1	
Ephemerella grandis ingens	5	
Ephemerella tibialis	1	
Ephemerella hystrix	2	Total ~~263~~ 261

PLECOPTERA 147 1.1

Nemoura cinctipes	30	
Alloperla sp.	113	
Isogenus sp.	1	
Claassenia sabulosa	16	
Acroneuria pacifica	1	
Arcynopteryx parallela or curvata	1	Total ~~152~~ 162

TRICHOPTERA 920 1.2

Glossosoma sp.	21	
Rhyacophila acropedes or vao	18	
Rhyacophila sp. (too small for ident.)	4	
Brachycentrus sp.	33	
Hydropsyche sp.	740	
Arctopsyche grandis	32	
Parapsyche sp.?	3	
Limnephilid genus 2	46	
Lepidostoma sp.	5	
Pupae and 1 adult	6	Total ~~904~~ 908

DIPTERA 221 0.1

Simuliidae	67	
Empididae #1	1	
Antocha sp.	1	
Hexatoma sp.	2	
Pericoma sp.	22	
Tanytarsus sp.	54	
Metriocnemius sp.	40	
Orthocladius sp. 2 (in Nostoc)	17	
Brillia sp.	4	
Cardiocladius sp.	8	
Unknown Orthoclads (in family Tendipedidae)	23	Total 239

COLEOPTERA 104 ?

Optioservus sp.	larvae	33	
	adults	16	
Zaitzevia sp.	larvae	24	
	adults	5	
Cleptelmis ornata	larvae	4	
	adults	1	
Narpus sp.	larvae	1	
Heterlimnius sp.	larvae	4	Total 88

Original Total 1664
Final Total ~~1645~~ 1651.
Patricia Ann [illegible]

BLACKFOOT RIVER AT HOGUM CREEK BRIDGE #3
8-23-71

1 sq. ft. — L. Spence

EPHEMEROPTERA 182 0.1

Baetis spp.	61	
Cinygmula sp.	67	
Rhithrogena sp.	3	
Ephemerella grandis ingens	4	
Ephemerella tibialis	3	
Ephemerella hystrix	2	
Ephemerella infrequens	40	Total 152

PLECOPTERA 221 0.2

Nemoura cinctipes	66	
Arcynopteryx curvata or parallela	2	
Isogenus sp.	1	
Acroneuria pacifica	3	
Acroneuria californica (probably)	1	
Alloperla sp.	146	Total 2[illegible]

TRICHOPTERA 759 0.7

Glossosoma sp.	16	
Rhyacophila acropedes or vao	7	
Rhyacophila sp.	[illegible]	
Hydropsyche sp.	602	
Arctopsyche grandis	14	
Brachycentrus sp.	14	
Limnephilidae Genus 2	37	
Lepidostoma sp.	1	
Psychomyiidae	4	
Pupae	6	Total 7[illegible]

DIPTERA 153 ?

Simuliidae	15	
Empididae Genus 1	3	
Antocha sp.	10	
Pericoma sp.	17	
Tanytarsus sp.	18	
Orthocladius sp. 2 (in Nostoc)	41	
Brillia sp.	7	
Metriocnemius sp.	22	
Cardiocladius sp.	[illegible]	
Unknown Chironomidae	34	Total 1[illegible]

COLEOPTERA 118 ?

Zaitzevia sp. adults-5, larvae-52	57	
Optioservus sp. adults-9, larvae-42	51	
Cleptelmis ornata adults-2	2	
Narpus concolor larvae-4	4	Total 11[illegible]

NEMATODA 3 ?

Nematoda	3	Total 3

Original Total 1436 Final Total 140[illegible]

Identified and enumerated by
Patricia Ann Mitchell
Dept. Entomology
University of Alberta, Edmonton March 6 1973

APPENDIX P CONTINUED

BLACKFOOT RIVER AT HOGUM CREEK ROAD BRIDGE # 1
11/1/71

EPHEMEROPTERA 208 0.1		
<u>Baetis</u> spp. (seems to be 2)	57	
<u>Cinygmula</u> sp.	74	
<u>Ephemerella infrequens</u>	124	
<u>Paraleptophlebia</u> sp.	6	Total 261
PLECOPTERA 128 0.1		
<u>Nemoura cinctipes</u>	17	
<u>Capnia</u> sp.	3	
<u>Isoperla</u> sp.	6	
<u>Isogenus</u> sp.	3	
<u>Alloperla</u> sp.	44	
<u>Acroneuria</u> sp. (too small to distinguish species)	1	Total 74
TRICHOPTERA 478 0.8		
<u>Hydropsyche</u> sp.	336	
<u>Glossosoma</u> sp.	64	
<u>Brachycentrus</u> sp.	9	
<u>Rhyacophila acropedes</u> or <u>vao</u>	16	
<u>Rhyacophila coloradensis</u>	8	
Limnephilid #2	7	
Limnephilidae (one species, tiny)	5	
<u>Lepidostoma</u> sp.	25	
pupae (probably same species as above)	2	Total 472
DIPTERA 2120 1.1		
<u>Antocha</u> sp.	69	
<u>Pericoma</u> sp.	113	
<u>Empididae</u> #1	7	
Tanytarsini (type of Chironomid)	1	
Orthoclad #2 (Nostoc-type)	1898	
Other Orthoclad Chironomids	7	Total 2095
COLEOPTERA 62 0.1		
<u>Optioservus</u> sp.	43	
<u>Zaitzevia</u> sp.	19	Total 62
NEMATODA 4 T		
Nematoda	4	Total 4

Original Total 3000 Final Total 2968

/s/ Patricia Ann Mitchell
May 22, 1974

BLACKFOOT RIVER AT HOGUM CREEK ROAD BRIDGE #2
11-1-71

1 sq. ft. ~~L. Spence~~

EPHEMEROPTERA 705 0.6		
<u>Baetis</u> sp.	147	
<u>Cinygmula</u> sp.	328	
<u>Rhithrogena</u> sp.	10	
<u>Ephemerella infrequens</u>	208	
<u>E. grandis ingens</u>	2	
<u>E. hystrix</u>	1	
<u>Paraleptophlebia</u> sp.	4	Total 700
PLECOPTERA 177 0.9		
<u>Nemoura cinctipes</u>	12	
<u>Capnia</u> sp.	2	
<u>Isogenus</u> sp.	3	
<u>Isoperla</u> sp.	12	
<u>Claassenia sabulosa</u>	14	
<u>Acroneuria</u> sp. (may be 2 species - very small, prob. <u>pacifica</u>)	17	
<u>Alloperla</u> sp.	112	Total 172
TRICHOPTERA 784 1.9		
<u>Hydropsyche</u> sp.	584	
<u>Arctopsyche grandis</u>	1	
<u>Glossosoma</u> sp.	106	
<u>Brachycentrus</u> sp.	20	
<u>Rhyacophila coloradensis</u> (in former samples called <u>Rhyacophila</u> sp.)	10	
<u>R. acropedes</u> or <u>vao</u>	5	
<u>Lepidostoma</u> sp.	38	
Limnephilid #2	12	
Limnephilid #1	1	
Other Limnephilidae (all same species but not #1 or #2)	5	
pupae	5	Total 787
DIPTERA 735 1.2		
<u>Hexatoma</u> sp.	2	
<u>Antocha</u> sp.	28	
Simuliidae	1	
Emphididae #1	1	
<u>Pericoma</u> sp.	140	
Orthoclad #2 (including those in alga <u>Nostoc</u>)	774	
Tanytarsini (chironomidae)	1	
Tanypodinae (chironomidae)	1	
Orthoclad chironomidae	4	Total 952
COLEOPTERA 110 0.1		
<u>Optioservus</u> sp.	59	
<u>Zaitzevia</u> sp.	43	
<u>Heterlimnius</u> sp.	5	
<u>Narpus</u> sp.	4	Total 111
NEMATODA 1 T		
Nematoda	1	Total 1

Original Total 2512 Final Total 2723 (including 219 in <u>Nostoc</u>)

/s/ Patricia Ann Mitchell

BLACKFOOT RIVER AT HOGUM CREEK ROAD #3

1 sq. ft. 11-1-71 L. Spence

EPHEMEROPTERA 381 0.2		
<u>Baetis</u> spp. (2 species)	54	
<u>Cinygmula</u> sp.	126	
<u>Rhithrogena</u> sp.	2	
<u>Ephemerella infrequens</u>	197	
<u>E. grandis ingens</u>	2	Total 381
PLECOPTERA 95 0.2		
<u>Nemoura cinctipes</u>	9	
<u>Capnia</u> sp.	3	
<u>Isogenus</u> sp.	7	
<u>Isoperla</u> sp.	3	
<u>Claassenia sabulosa</u>	1	
<u>Acroneuria</u> sp.	9	
<u>Alloperla</u> sp.	61	Total 93
TRICHOPTERA 750 1.7		
<u>Hydropsyche</u> sp.	478	
<u>Arctopsyche grandis</u>	8	
<u>Glossosoma</u> sp.	159	
<u>Brachycentrus</u> sp.	57	
<u>Rhyacophila coloradensis</u>	3	
<u>R. acropedes</u> or <u>vao</u>	5	
Limnephilid #2	10	
other Limnephilidae	5	
<u>Lepidostoma</u> sp.	20	Total 745
DIPTERA 999 0.4		
<u>Hexatoma</u> sp.	3	
<u>Dicranota</u> sp.	1	
Simuliidae	1	
<u>Antocha</u> sp.	54	
<u>Pericoma</u> sp.	73	
Orthoclad #2	860	
Orthoclads	5	
Tanytarsini	1	Total 998
COLEOPTERA 83 0.1		
<u>Optioservus</u> sp.	59	
<u>Zaitzevia</u> sp.	16	
<u>Heterlimnius</u> sp.	2	
<u>Cleptelmis ornata</u>	1	Total 78
NEMATODA 6 T		
Nematoda	6	Total 6

Original Total 2301 Final Total 2301

APPENDIX P CONTINUED

BLACKFOOT RIVER BETWEEN LANDER'S FORK AND LINCOLN #1
8-23-71

1 sq. ft. L. Spence

EPHEMEROPTERA 469 1.4		D = 2.2571 DMIN = 9.73545E-2 = .0973545 DMAX = 3.45943 R= 0.35464
Baetis sp.	88	
Cinygmula sp.	41	
Epeorus deceptivus	50	
Ephemerella doddsi	96	
Ephemerella coloradensis	8	
Ephemerella tibialis	26	
Ephemerella infrequens	2	
Ephemerella grandis ingens	1	
Ephemerella hystrix	1	
Rhithrogena sp.	151	Total 464
PLECOPTERA 54 0.1		
Nemoura cinctipes	3	
Pteronarcella badia	4	
Capnia sp. ?	1	D = 1.29781 DMIN = 0.336599 DMAX = 3.16993 R= 0.672641
Acroneuria pacifica	4	
Claassenia sabulosa	1	
Alloperla sp.	33	
Perlodidae (too small)	5	
Isogenus sp.	3	Total 54
TRICHOPTERA 118 0.8		
Rhyacophila acropedes	2	
Glossosoma sp.	40	D = 1.75232 DMIN = 0.23529 DMAX = 3. R= 0.451129
Brachycentrus sp.	7	
Arctopsyche grandis	52	
Tinodes sp.	14	
Pupae	4	Total 119
DIPTERA 65 0.1		
Hexatoma sp.	2	
Empididae #2	1	
Pericoma sp.	1	
Simuliidae	2	D = 2.66771 DMIN = 0.651362 DMAX = 3.45943 R= 0.234933
Cardiocladius sp.	24	
Metriocnemius sp	3	
Tanytarsus sp.	12	
Brillia sp.	3	
Unknown Chironomidae	15	Total 63
COLEOPTERA 9 T		S=1 No diversity Computed
Optioservus sp. lar-1, ad-8	9	Total 9

Original Total 715, Final Total 709

Enumerated and Identified by
Patricia Ann Mitchell
April 30, 1973
Patricia Ann Mitchell

Station D.I.

D = 3.37[illegible] DMIN = 0.0311[illegible]
DMAX = 5.321[illegible] R= [illegible].34[illegible]

BLACKFOOT RIVER BETWEEN LANDER'S FORK AND LINCOLN #2
8-23-71

1 sq. ft. L. Spence

EPHEMEROPTERA 300 0.4		
Baetis sp.	50	
Cinygmula sp.	6	
Rhithrogena sp.	116	
Epeorus longimanus	2	
Epeorus deceptivus	31	
Ephemerella doddsi	74	
Ephemerella tibialis	7	
Ephemerella coloradensis	3	
Ephemerella infrequens	1	
Ephemerella grandis	1	Total 291
PLECOPTERA 62 0.1		
Nemoura cinctipes	3	
Pteronarcella badia	4	
Acroneuria pacifica	2	
Arcynopteryx sp.	1	
Alloperla sp.	51	Total 61
TRICHOPTERA 68 0.2		
Glossosoma sp.	27	
Rhyacophila acropedes	3	
Brachycentrus sp.	1	
Tinodes sp.	5	
Arctopsyche grandis	24	
Pupae	4	Total 64
DIPTERA 23 T.		
Simuliidae	12	
Hexatoma sp.	1	
Cardiocladius sp.	6	
Brillia sp.	1	
Metriocnemius sp.	2	
Unkown Chironomidae	3	Total 25
COLEOPTERA 3 T		
Optioservus sp. adults	3	Total 3

Original Total 456 Final Total 444

Identified and Enumerated by
Patricia Ann Mitchell
MS, Univ. of Montana, 1968
April 30, 1973
Patricia Ann Mitchell

Blackfoot River between Lander's Fork and Lincoln #3
8-23-71

1 sq. ft. L. Spence

EPHEMEROPTERA 456 0.3		
Baetis spp.	60	
Cinygmula sp.	5	
Rhithrogena sp.	246	
Ephemerella doddsi	93	
Ephemerella coloradensis	3	
Ephemerella grandis ingens	5	
Ephemerella tibialis	5	
Ephemerella infrequens	1	
Epeorus deceptivus	25	Total 443
PLECOPTERA 68 0.1		
Alloperla sp.	61	
Pteronarcella badia	3	
Acroneuria pacifica	1	
Acroneuria sp.? (too small)	2	
Nemoura cinctipes	5	Total 72
TRICHOPTERA 116 0.3		
Arctopsyche grandis	26	
Hydropsyche sp.	5	
Glossosoma sp.	73	
Rhyacophila acropedes or vao	1	
Brachycentrus sp.	3	
Limnephilidae	1	
Unknown - Psychomiidae?	1	
Pupae	4	Total 114
DIPTERA 39 0.3		
Hexatoma sp.	5	
Simuliidae	1	
Muscidae larva?	1	
Cardiocladius sp.	17	
Tanytarsus sp.	5	
Brillia sp.	1	
Metriocnemius sp.	1	
Orthocladius sp. 1 (= Hydrobaenus)	3	Total 34
COLEOPTERA 6 T		
Optioservus sp.	6	Total 6
NEMATODA 3 T		
Nematoda	3	Total 3

Original Total 688 Final Total 672

APPENDIX P CONTINUED

BLACKFOOT RIVER BETWEEN LANDER'S FORK AND LINCOLN #1
10-26-71

1 sq. ft. L. Spence

ROPTERA 620 0.9		
inygmula sp.	76	
hithrogena spp.(prob.more than 1)	416	
aetis sp.	32	
phemerella doddsi	57	
phemerella infrequens	34	Total 615
TERA 111 0.4		
emoura cinctipes	4	
apnia sp.	14	
rachyptera sp.	21	
sogenus sp.	3	
erlodidae	1	
croneuria californica	2	
croneuria theodora (probably)	1	
lloperla sp.	63	Total 109
OPTERA 162 0.5		
Arctopsyche grandis	10	
lossosoma sp.	109	
Hydropsyche sp.	50	
Limnephilidae Genus 1	3	Total 172
A 27 0.3		
Simuliidae	3	
Hexatoma spp.	6	
Dicranota sp.	1	
Antocha sp.	1	
Empididae Genus 1	1	
Pericoma sp.	12	
Cardiocladius sp.	1	
Chironomidae unknowns	2	Total 27
PTERA 2 T		
Optioservus sp. adults	2	Total 2
IDA 3 T		
Oligochaetes	3	Total 3

D = 1.35968 DMIN = 0.034497
DMAX = 2.58496 R= 0.2379

D = 2.25964 DMIN = 0.525126
DMAX = 3.90639 R= 0.48457

D = 1.28745 DMIN = 9.23443E-2 = .0928443
DMAX = 3.16993 R= 0.611774

D = 2.1321 DMIN = 3.672346
DMAX = 3.45943 R= 2.453303

D = 1.37695 DMIN = 1.37695
DMAX = 1.58496 R= 1.

Original Total 925 Final Total 928

tified and Enumerated by
Patricia Ann Mitchell
MS Univ. Of Montana, 1968

June 14, 1973
Patricia Ann Mitchell

Station D.I.

D = 3.57669 DMIN = 0.21645
DMAX = 5.45943 R= [illegible]

BLACKFOOT RIVER BETWEEN LANDER'S FORK AND LINCOLN #2
10-26-71

1 sq. ft. L. Spence

EPHEMEROPTERA 565 1.2		
Baetis sp.	42	
Cinygmula sp.	67	
Rhithrogena sp.	342	
Ephemerella doddsi	55	
Ephemerella grandis ingens	2	
Ephemerella infrequens	67	Total 575
PLECOPTERA 65 0.7		
Pteronarcella badia	2	
Brachyptera sp.	17	
Capnia sp.	9	
Arcynopteryx curvata or parallela	1	
Arcynopteryx signata	1	
Isogenus sp.	1	
✓Perlodidae (too small)	1	
Acroneuria californica	1	
Acroneuria pacifica	4	
Claassenia sabulosa	1	
Alloperla sp.	21	
Paraperla frontalis	2	Total 61
TRICHOPTERA 292 0.5		
Glossosoma sp.	186	
Arctopsyche grandis	21	
Hydropsyche sp.	84	
Rhyacophila acropedes or vao	1	Total 292
DIPTERA 42 0.6		
Hexatoma sp.	10	
Antocha sp.	2	
Empididae #2	5	
Simuliidae	1	
Pericoma sp.	25	Total 43
COLEOPTERA 1 T		
Zaitzevia sp. lar.	1	Total 1
✓NEMATODA 1 T		
Nematoda	1	Total 1

Original Total 966 ~~967~~ Final Total 973

Identified and Enumerated by
Patricia Ann Mitchell, M.S.
Department of Zoology
University of Alberta
Edmonton, Alberta, Canada
July 27, 1973
Patricia Ann Mitchell

BLACKFOOT RIVER BETWEEN LANDER'S FORK AND LINCOLN #3
10-26-71

1 sq. ft. L. Spence

EPHEMEROPTERA 582 1.0		
Baetis sp.	119	
Cinygmula sp.	78	
Rhithrogena sp.	257	
Ephemerella doddsi	42	
Ephemerella grandis ingens	2	
Ephemerella infrequens	85	Total 583
PLECOPTERA 84 0.2		
Brachyptera sp.	4	
Capnia sp.	12	
Nemoura cinctipes	10	
Arcynopteryx curvata or parallela	1	
Isogenus aestivalis	2	
Isogenus sp.	3	
Acroneuria pacifica	1	
Claassenia sabulosa	1	
Alloperla sp.	45	
✓Plecoptera too small to identify	4	Total 83
TRICHOPTERA 515 1.1		
Glossosoma sp.	331	
Arctopsyche grandis	37	
Hydropsyche sp.	142	
Rhyacophila acropedes of vao	1	
Rhyacophila sp.	1	
Tinodes sp.	1	
Brachycentrus sp.	1	
Limnephilidae Genus 2	2	Total 516
DIPTERA 54 0.2		
Hexatoma spp.	6	
Empididae #4	1	
Empididae #5	1	
Pericoma sp.	25	
Cardiocladius sp.	1	
Unknown Orthoclad Chironomidae	20	Total 54
COLEOPTERA 2 T		
Narpus concolor adult	1	
Optioservus sp. lar.	1	Total 2
✓NEMATODA 3 T		
Nematoda	3	Total 3
✓COTTUS SP. 3	3	Total 3

Original Total 1243 Final Total 1244

Enumerated and Identified by
Patricia Ann Mitchell
July 27, 1973
Patricia Ann Mitchell

APPENDIX P CONTINUED

POORMAN CREEK #1
4/14/71
1 sq. ft. sample from right edgedof stream. L. Spence.

EPHEMEROPTERA 373 0.6

Baetis parvus type (tricaudatus?)	48	
Baetis sp.	75	
Cinygmula sp.	103	
Epeorus longimanus	35	
Rhithrogena sp.	52	
Ephemerella infrequens	6	
Ephemerella flavilinea	58	
Ephemerella doddsi	5	
Ephemerella hystrix	5	
Paraleptophlebia sp. prob. heteronea	6	Total 393

PLECOPTERA 72 0.4

Acroneuria pacifica	15	
Alloperla sp.	11	
Hastaperla brevis	13	
Isogenus sp.	7	
Isoperla sp.	7	
Nemoura cinctipes	5	Total 58

TRICHOPTERA 30 0.3

Arctopsyche grandis	6	
Hydropsyche sp.	1	
Hydroptila sp.	1	
Glossosoma sp.	9	
Rhyacophila vepulsa	10	
Limnephilidae	3	Total 30

DIPTERA 54 0.1

Simuliidae	3	
Dicranota sp.	2	
Antocha sp.	6	
Hexatoma sp.	1	
Pericoma sp.*	49	
Empididae #1	16	
Calopsectra sp.	3	
Hydrobaenus sp. 2	4	
~~Cricotopus sp. (?)~~ orthocladius sp. 1	9	
Metriocnemus sp.	3	
Brillia sp.	1	Total 97

COLEOPTERA 73 0.1

{ Heterlimnius sp. larvae	23 }	
{ Heterlimnius sp. adult	1 }	Total 24

✓ANNELIDA 16 0.5

Oligochaeta	17	Total 17

riginally counted with Coleoptera

Original Total 618
Final Total 619

POORMAN CREEK # 2
4/14/71
1 sq. ft. sample from left side of stream. L. Spence.

Station D.I.
D = 4.28354 DMIN = 0.223731
DMAX = 5.49185 R= 0.228495

Ephemeroptera 661 1.3
D = 2.64?36 DMIN = 0.5?217E-2 = .0056917
DMAX = 3.32193 R= 0.251713

Baetis parvus type	291	
Baetis spp.	122	
Cinygmula sp.	113	
Epeorus longimanus	66	
Rhithrogena sp.	13	
Paraleptophlebia sp.	8	
Ephemerella infrequens	18	
Ephemerella hystrix	20	
Ephemerella flavilinea	25	Total ~~675~~ 676

Plecoptera 98 2.5
D = 2.32253 DMIN = 0.314553
DMAX = 2.80735 R= 0.187741

Acroneuria pacifica	46	
Nemoura cinctipes	20	
Isoperla sp.	11	
Alloperla sp.	7	
Isogenus sp.	6	
Hastaperla brevis?	1	
Pteronarcella badia	1	Total 92

Trichoptera 98 1.5
D = 1.39477 DMIN = 0.251847
DMAX = 3. R= 0.402171

Arctopsyche grandis	54	
Rhyacophila acropedes or vao	23	
Rhyacophila vepulsa	4	
Glossosoma sp.	18	
Limnephilidae	1	Total 100

Diptera 141 0.2
D = 3.16911 DMIN = 0.307399
DMAX = 4. R= 0.242577

Antocha sp.	13	
Dicranota sp.	1	
Pericoma sp.	32	
Simuliidae	5	
Empididae, species #1	26	
Empididae, species #2	5	
Empididae, species #3	1	
Hydrobaenus sp. 1	16	
Hydrobaenus sp. 2	3	
Hydrobaenus sp. 4 } orthocladius sp. 1	15 }	
Hydrobaenus sp. 5 }	2 }	
{ Metriocnemus sp.	9	
{ Metriocnemus sp. pupae	5	
Brillia sp.	6	
Cardiocladius sp.	1	
Calopsectra sp.	5	
Unknown tendipedids	9	Total 154

Coleoptera 76 T
D = 1.00273 DMIN = 0.212677
DMAX = 2. R= 0.53727

{ Optioservus sp. adults	2 }	
{ Optioservus sp. larvae	3 }	
{ Heterlimnius corpulentus larvae	36	Total 41

✓Annelida 19 0.9

Oligochaeta	17	Total 17

Original Total 1093
Final Total ~~1077~~ 1080

POORMAN CREEK #3
4/14/71
1 sq. ft. from center of stream. L. Spence.

EPHEMEROPTERA 567 0.8

Baetis parvus type (may be tricaudatus)	147	
Baetis spp.	173	
Cinygmula spp.	101	
Epeorus longimanus	59	
Rhithrogena sp.	5	
Paraleptophlebia sp.	8	
Ephemerella infrequens	15	
Ephemerella hystrix	27	
Ephemerella sp. prob. flavilinea	59	Total 594

PLECOPTERA 130 1.0

Nemoura cinctipes	44	
Pteronarcella badia	1	
Isoperla sp.	20	
Isogenus sp.	3	
Alloperla sp.	7	
Hastaperla brevis (probably)	4	
Acroneuria pacifica	36	Total 115

TRICHOPTERA 133 2.5

Arctopsyche grandis	80	
Glossosoma sp.	8	
Brachycentrus sp.	1	
Rhyacophila acropedes or vao	29	
Rhyacophila vepulsa	12	
Limnephilidae	3	Total 133

DIPTERA 163 0.1

Antocha sp.	15	
Dicranota sp.	1	
Empididae #1	39	
Empididae #2	1	
Simuliidae	5	
*Pericoma sp.	66	
Calopsectra sp.	18	
Brillia sp.	12	
Hydrobaenus sp. 2	1	
~~Cricotopus sp.~~ orthocladius sp. 1	15	
Metriocnemus sp.	13	
Hydrobaenus sp. (slide 25) } orthocladius sp. 1	8 }	
Hydrobaenus sp. (slide 26) }	11 }	
Unknown Chironomidae (Tendipedidae)	16	Total 221

✓ANNELIDA 7 0.5

Oligochaeta	9	Total 9

COLEOPTERA 117 0.1

Heterlimnius corpulentus larvae	51	
Brychius sp.	1	Total 52

✓NEMATODA 1 T

Nematoda	1	Total 1

Original Total 1118
Final Total 1125

* Originally counted with Coleoptera

Identified and Counted by:

Patricia Ann Mitchell
MS, University of Montana, Zoology, 1968
May 2, 1972
Patricia Ann Mitchell

APPENDIX P CONTINUED

POORMAN CREEK #1
8-23-71
L. Spence 1 sq. ft.

[EPH]EMEROPTERA 353 0.2 cc		
Baetis spp.	175	
Cinygmula sp.	139	
Rhithrogena sp.	6	D = 1.87155 DMIN = 0.109735
Epeorus deceptivus	8	DMAX = 3.32193 R= 0.449342
Epeorus longimanus	4	
Ephemerella doddsi	2	
Ephemerella hystrix	6	
Ephemerella grandis	1	
Paraleptophlebia sp.	4	Total 345
[PLEC]OPTERA 159 0.9 cc		
Nemoura cinctipes	135	D = 1.95558 DMIN = 0.104372
Acroneuria pacifica	14	DMAX = 2.58496 R= 0.61654
Alloperla sp.	3	
Eucapnopsis brevicauda (probably)	9	Total 161
[TRI]CHOPTERA 86 T		
Arctopsyche grandis	41	
Tinodes sp. (Psychomyiidae)	36	D = 1.33205 DMIN = 0.255927
Rhyacophila acropedes or vao	4	DMAX = 2.80735 R= 0.332409
Rhyacophila sp.	1	
Glossosoma sp.	1	
Pupa	1	Total 84
		D = 1.61119 DMIN = 7.85321E-2 = .0785301
		DMAX = 3.70044 R= 0.576836
[DIP]TERA 290 0.1 cc		
Simuliidae	110	
Empididae Genus 1	2	
Pericoma sp.	14	
Orthocladius sp. 2	18	
Tanytarsus sp.	7	
Cardiocladius sp.	2	
Brillia sp.	69	
Metriocnemius sp.	21	
Unknown Chironomidae	62	Total 305
[COLE]OPTERA 38 T		
Heterlimnius sp. larvae 14, adults 2	16	D = 1.39399 DMIN = 0.039134
Optioservus sp. larvae 2, adults 3	5	DMAX = 2.30735 R= 0.502398
Zaitzevia sp. larvae 1	1	
Brychius sp. (Haliplidae) larvae	3	Total 25
[ANN]ELIDA 6 T		
Oligochaeta	14	Total 14

Original Total 932 Final Total 934

[Iden]tified and Enumerated by
Patricia Ann Mitchell
University of Alberta
March 19, 1973

Station D.I.

D = 3.47679 [illegible]
DMAX = 5.48[illegible]

POORMAN CREEK #2
8-23-71
L. Spence ~~1 sq. ft.~~

EPHEMEROPTERA 281 0.2 cc		
Baetis spp.	145	
Cinygmula sp.	55	
Rhithrogena sp.	36	
Epeorus deceptivus	7	
Epeorus longimanus	7	
Ephemerella doddsi	3	
Ephemerella hystrix	6	
Ephemerella grandis	1	
Ephemerella tibialis	1	
Paraleptophlebia sp.	4	Total 265
PLECOPTERA 64 T		
Nemoura cinctipes	53	
Alloperla sp.	12	
Acroneuria pacifica	10	
Eucapnopsis brevicauda (probably)	1	Total 76
TRICHOPTERA 60 0.4 cc		
Arctopsyche grandis	38	
Tinodes sp.	10	
Rhyacophila acropedes or vao	2	
Rhyacophila sp.	8	
Glossosoma sp.	2	Total 60
DIPTERA 1065 0.8 cc		
Antocha sp.	1	
Simuliidae	989	
Empididae Genus 1	8	
Orthocladius sp. 2	1	
Cardiocladius sp.	1	
Brillia sp.	21	
Metriocnemius sp.	8	
Unknown Chironomidae	29	
Pericoma sp.	1	Total 1059
COLEOPTERA 31 T		
Heterlimnius sp.	29	
Narpus concolor	2	Total 31
ANNELIDA 13 T		
Oligochaeta	13	Total 13

Original Total 1514 Final Total 1504

Enumerated and Identified by
Patricia Ann Mitchell
University of Alberta, Edmonton
March 20, 1973

POORMAN CREEK #3
8-23-71
1 sq. ft. L. Spence

EPHEMEROPTERA 342 0.2 cc		
Baetis spp.	187	
Cinygmula sp.	64	
Epeorus deceptivus	4	
Epeorus longimanus	3	
Rhithrogena sp.	18	
Paraleptophlebia sp.	6	
Ephemerella doddsi	3	
Ephemerella grandis	7	
Ephemerella tibialis	5	
Ephemerella hystrix	19	Total 316
PLECOPTERA 334 0.5 cc		
Pteronarcella sp.	2	
Acroneuria pacifica	34	
Nemoura cinctipes	208	
Alloperla sp.	13	
Isogenus sp.	3	
Eucapnopsis brevicauda ?	1	Total 261
TRICHOPTERA 78 0.3 cc		
Rhyacophila sp.	6	
Rhyacophila acropedes or vao	8	
Arctopsyche grandis	23	
Tinodes sp.	27	
Limnephilidae Genus 2	6	
Hydroptilidae	1	
pupae	2	Total 73
DIPTERA 516 0.2 cc		
Simuliidae	200	
Empididae Genus #1	20	
Empididae Genus #2	3	
Empididae Genus #3	1	
Antocha sp.	1	
Pericoma sp.	9	
Orthocladius sp. 2	20	
Brillia sp.	67	
Metriocnemius sp.	26	
Tanytarsus sp.	8	
Cardiocladius sp.	2	
Pentaneura sp.	1	
Unknown Chironomidae	160	Total ~~508~~ 518
COLEOPTERA 74 T		
Narpus sp. larvae	9	
Optioservus sp. lar-3, ad-3	6	
Zaitzevia sp. adult	1	
Heterlimnius sp. ad-2, lar-50	52	
Brychius sp.	3	Total 71
ANNELIDA 6 T		
Oligochaeta	16	Total 16

Original Total 1250 Final Total ~~1244~~ 1255

APPENDIX P CONTINUED

POORMAN CREEK #1

1 sq. ft. 11-2-71 L. Spence

MEROPTERA 990 0.8		
Baetis spp. (2 species)	367	
Cinygmula sp.	502	
Rhithrogena so.	53	
Ameletus sp.	1	
Paraleptophlebia sp.	5	
Ephemerella doddsi	2	
Ephemerella grandis ingens	2	
Ephemerella hystrix	40	
Ephemerella infrequens	6	Total 978
COPTERA 839 3.0		
Nemoura cinctipes	756	
Brachyptera sp.	4	
Pteronarcella badia	1	
Capnia sp.	2	
Isogenus sp.	8	
Isoperla sp.	7	
Acroneuria pacifica	31	
Alloperla sp.	43	Total 852
ICHOPTERA 199 1.9		
Hydropsyche sp.	2	
Arctopsyche grandis	98	
Glossosoma sp.	52	
Brachycentrus sp.	1	
Rhyacophila acropedes or vao	19	
Rhyacophila vepulsa	17	
Limnephilidae unknown	1	
Lepidostoma sp.	4	
Tinodes sp.	1	Total 195
PTERA 227 0.2		
Antocha sp.	91	
Simuliidae	2	
Empididae #1	14	
Dicranota sp.	2	
Pericoma sp.	52	
Orthoclad #2 (Nostoc-type)	25	
Metriocnemius sp.	5	
Orthoclad Chironomidae	29	Total 220
OLEOPTERA 80 0.1		
Optioservus sp.	3	
Heterlimnius sp.	77	
Zaitzevia sp.	1	
Narpus sp.	2	
Brychius sp. (Hydrophilid beetle larvae)	9	Total 92
NNELIDA 16 0.1		
Oligochaeta	10	
Nematoda	6	Total 16
NKNOWN 10 T		
moved to Coleoptera		

Original Total 2361 Final Total 2353

POORMAN CREEK #2

1 sq. ft. 11-2-71 L. Spence

EPHEMEROPTERA 823 0.9		
Baetis spp.	332	
Cinygmula sp.	361	
Rhithrogena sp.	36	
Paraleptophlebia sp.	17	
Ephemerella doddsi	5	
Ephemerella grandis ingens	4	
Ephemerella hystrix	43	
Ephemerella infrequens	14	Total 812
PLECOPTERA 780 2.1		
All Plecoptera dried up		Total 780
TRICHOPTERA		
Hydropsyche sp.	3	
Arctopsyche grandis	116	
Glossosoma sp.	47	
Brachycentrus sp.	3	
Rhyacophila acropedes or vao	29	
Rhyacophila vepulsa	18	
Hydroptila sp.	4	Total 220
DIPTERA 431 0.5		
Antocha sp.	150	
Dicranota sp.	3	
Simuliidae	5	
Empididae #1	24	
Empididae #2	1	
Pericoma sp.	72	
Orthoclad #2	139	
Brillia sp.	6	
Metriocnemius sp.	3	
Orthoclad Chironomidae (other than #2)	23	Total 426
COLEOPTERA 41 0.1		
Heterlimnius sp. (prob. corpulentus)	40	
Optioservus sp.	1	
Narpus concolor	2	
Brychius sp.	7	
ANNELIDA 49 0.3		
Lumbriculidae } Oligochaeta	5	
Naididae	44	Total 49
UNKNOWN 9 T		
Moved to Coleoptera		

Original Total 2355 Final Total 2337

Patricia Ann Mitchell

POORMAN CREEK #3

1 sq. ft. 11-2-71 L. Spence

EPHEMEROPTERA 1006 1.1		
Baetis spp.	338	
Cinygmula sp.	518	
Rhithrogena sp.	55	
Paraleptophlebia sp.	37	
Epeorus longimanus	1	
Ephemerella doddsi	7	
Ephemerella grandis ingens	2	
Ephemerella hystrix	42	
Ephemerella infrequens	13	Total 1013
PLECOPTERA 848 2.0		
Nemoura cinctipes	748	
Capnia sp.	4	
Pteronarcella badia	1	
Isogenus sp.	7	
Isoperla sp.	9	
Acroneuria pacifica	31	
Alloperla sp.	36	Total 836
TRICHOPTERA 272 2.2		
Arctopsyche grandis	145	
Glossosoma sp.	65	
Brachycentrus sp.	5	
Rhyacophila acropedes or vao	32	
Rhyacophila vepulsa	18	
Hydroptila sp.	1	Total 266
DIPTERA 237 0.3		
Antocha sp.	99	
Dicranota sp.	2	
Empididae #1	17	
Empididae #2	2	
Simuliidae	2	
Pericoma sp.	59	
Brillia sp.	1	
Orthoclad #2	26	
Metriocnemius sp.	6	
Pentaneurini Chironomidae	2	
Orthoclad Chironomidae	14	Total 230
COLEOPTERA 69 T		
Heterlimnius sp. (prob. corpulentus)	64	
Optioservus sp.	3	
Zaitzevia sp.	1	
Narpus concolor	3	
Brychius sp.	5	Total 76
ANNELIDA 36 0.4		
Lumbriculidae } Oligochaeta	15	
Naididae	21	Total 36
UNKNOWN 7 T		
Moved to Coleoptera		

Original Total 2475 Final Total 2457

/s/ Patricia Ann Mitchell

Blackfoot at Dalton Mountain Road Bridge 7/16/68

APPENDIX P CONTINUED

Plecoptera 17 .9cc

Acroneuria pacifica Banks
Claassenia sabulosa Banks
Isogenus (Kogotus) sp.
Pteronarcys californica (prob.)
Alloperla or Kathroperla sp.
Nemoura cinctipes Banks

Trichoptera 24 .2 cc

Rhyacophila acropedes Banks or vao Milne
Brachycentrus sp.
Limnephilidae

Ephemeroptera 432 1.6 cc

Rhithrogena sp. prob. undulata (Banks)
Ephemerella doddsi Needham
Ephemerella flavilinea McDunnough
Ephemerella tibialis McDunnough
Ephemerella infrequens McDunnough
Epeorus longimanus (Eaton)
Baetis spp. (Two easily distinguishable species)
Cinygmula sp.

Coleoptera 12 .05 cc

Cleptelmis ornata (Schaeffer)
Heterlimnius corpulentus (Le Conte)
Optioservus prob. quadrimaculatus

Diptera 443 .9 cc

Protoplasa fitchii Osten Sacken
Atherix variegata Walker
Hexatoma spp.
Simuliidae
Tendipedidae

Station D.I.

D = 1.26881 DMIN = 3.19399E-2 = .0319399
DMAX = 2.32193 R= 0.463375

Blackfoot River at Dalton Mountain Road Bridge 10/1/69

Plecoptera 69

Pteronarcella badia Hagen
Alloperla sp.
Acroneuria pacifica Banks
Pteronarcys californica Newport
Arcynopteryx parallela Frison (probably)
Isogenus (Cultus) sp. prob. tostonus or aestivalis

Trichoptera 211

Brachycentrus sp.
Arctopsyche sp.
Rhyacophila vao Milne or acropedes Banks
Glossosoma sp.
Hydropsyche sp.
Limnephilidae

Ephemeroptera 229

Ephemerella grandis
Rhithrogena robusta Eaton ?
Ephemerella doddsi Needham
Baetis sp.
Ephemerella infrequens McDunnough

Coleoptera 5

Cleptelmis ornata (Schaeffer)
Narpus concolor Le Conte
Optioservus sp.

Diptera 26

Atherix variegata Walker
Simuliidae
Protoplasa fitchii Osten Sacken
Tendipedidae

Station D.I.

D = 1.79711 DMIN = 7.79826E-2 = .0779826
DMAX = 2.32193 R= 0.273976

Oligochaeta

APPENDIX P CONTINUED

BLACKFOOT RIVER AT DALTON MTN. ROAD BRIDGE #1

3/19/71

1 sq. ft. sample from right bank of riffle above bridge. L. Spence. 1000

meroptera 274 0.5

Baetis parvus type	4	
Baetis spp.	14	
Cinygmula sp.	10	
Rhithrogena sp.	197	
Paraleptophlebia sp.	2	
Ephemerella infrequens	45	
Ephemerella doddsi	1	
Ephemerella sp.- prob. flavilinea	10	Total 283

coptera 42 0.4

Acroneuria pacifica	9	
Nemoura besametsa	1	
Isoperla sp.	8	
Isogenus sp.	2	
Alloperla sp.	10	
Hastaperla brevis	2	
Pteronarcella badia	1	
Claassenia sabulosa	1	
Unknown	2	Total 36

choptera 140 0.8

Arctopsyche grandis	26	
Hydropsyche sp.	19	
Brachycentrus sp.	10	
Glossosoma sp.	81	
Limnephilidae	1	
✓Pupa	1	Total 138

ptera 24 0.1

Antocha sp.	5	
Atherix variegata	3	
Empididae, species #4	1	
Pericoma sp.	3	
Cardiocladius sp.	4	
Metriocnemus sp.	3	
Brillia sp.	1	
Hydrobaenus sp. 6	6	
Tendipedidae (slides 19A, 20A)	3	Total 29

leoptera 33 T

Heterlimnius sp. prob. corpulentus larvae 2

Optioservus sp. larvae	20
Optioservus sp. adults	3
Cleptelmis ornata larvae	4
Cleptelmis ornata adults	1
	30

nelida and Nematodes 74 0.1

Oligochaeta 69

ttus 1

Original Total ~~578~~ 587
Final Total 585

BLACKFOOT RIVER AT DALTON MT. ROAD BRIDGE #2
3/19/71
1 sq. ft. sample from left bank of riffle above bridge. L. Spence.

Ephemeroptera 219 0.4

Ephemerella grandis ingens 2
Ephemerella doddsi 2
Ephemerella infrequens 4
✓Ephemerella sp. (too small to identify) 7
Rhithrogena sp. (undulata?) 103
Baetis spp. 45
Cinygmula mimus or kootenai 9

$D = 1.39193$ DMIN $= 0.154334$
DMAX $= 3.45943$ R= 0.472741

Total 172

Plecoptera 16 0.1

Pteronarcella badia 1
Alloperla sp. 15
Isoperla sp. 1

$D = 2.37367$ DMIN $= 0.648717$
DMAX $= 3.32193$ R= 0.465081

Total 17

Trichoptera 256 0.4

Glossosoma sp. 176
Hydropsyche sp. 62
Arctopsyche grandis 8
Brachycentrus sp. 5
Limnephilidae 3

$D = 1.64303$ DMIN $= 7.70141E-2 = .0770141$
DMAX $= 2.50496$ R= 0.375573

Total 254

Diptera 20 0.1

Hexatoma sp. 3
Atherix variegata 8
Dicranota sp. 1
Cardiocladius sp. 3
Small Tendipedidae 4

$D = 3.25441$ DMIN $= 1.15912$
DMAX $= 3.70044$ R= 0.175511

Total 19

Coleoptera

Heterlimnius sp. larva 1

✓Oligochaeta 1 T

✓Nematoda 1 T

$D = 1.07312$ DMIN $= 0.419633$
DMAX $= 1.53496$ R= 0.432944

Station O.I.

Original total ~~565~~ 514
Final total 565

$D = 3.41393$ DMIN $= 0.318321$
DMAX $= 5.40629$ R= 0.379353

BLACKFOOT River at DALTON ROAD BRIDGE #3
3/19/71
1 sq. ft. sample from left side of riffle above bridge. L. Spence.

EPHEMEROPTERA 295 0.5

Ephemerella sp. prob. flavilinea	27	
Ephemerella infrequens	6	
Ephemerella doddsi	2	
Ephemerella grandis ingens	5	
Cinygmula sp.	6	
Rhithrogena spp. including undulata	142	
Rhithrogena robusta	1	
Baetis parvus type	30	
Baetis sp.	39	Total 258

PLECOPTERA 63 0.2

Pteronarcella badia	3	
Capnia spp.	4	
Isogenus sp.	1	
Isoperla sp.	4	
Hastaperla brevis?	4	
Alloperla sp.	43	
Acroneuria pacifica	2	Total 61

TRICHOPTERA 283 1.3

Brachycentrus sp.	65	
Glossosoma sp.	160	
Hydropsyche sp.	47	
Arctopsyche grandis	23	
Rhyacophila sp. 1	1	
Limnephilidae	1	Total 217

DIPTERA 33 0.1

Atherix variegata	6	
Empididae #4	1	
Simuliidae	1	
Hexatoma spp.	4	
Dicranota sp.	1	
Cardiocladius sp.	2	
Brillia sp.	2	
Metriocnemus sp.	12	
Pentaneura sp.	1	
Unknown tendipedid - on slide	1	Total 31

OLIGOCHAETA 1 Total 1

Original Total ~~666~~ 675
Final Total 668

Identified and Counted by
Patricia Ann Mitchell
March 20, 1972
Patricia Ann Mitchell

APPENDIX P CONTINUED

BLACKFOOT RIVER AT DALTON MOUNTAIN ROAD BRIDGE #1
8-20-71

1 sq. ft. left bank — L. Spence

EPHEMEROPTERA 180 0.2			
Baetis spp.	154		D = 1.34794 DMIN = 0.102447
Rhithrogena sp.	17		DMAX = 2.62735 R= 0.539147
Epeorus deceptivus	1		
Ephemerella doddsi	4		
Ephemerella grandis	5	Total 181	
PLECOPTERA 4 T			
Isogenus sp.	1		D = 2.02229 DMIN = 0.350178
Alloperla sp.	1		DMAX = 2.53496 R= 0.324346
Paraperla frontalis	2	Total 4	
TRICHOPTERA 59 T			
Glossosoma sp.	33		
Tinodes sp.	2		D = 1.92379 DMIN = 0.215831
Arctopsyche grandis	4		DMAX = 2.58496 R= 0.273935
Brachycentrus sp.	19		
Limnephilid Genus 1	1	Total 59	
DIPTERA 111 0.2			
Atherix variegata	8		D = 1.74933 DMIN = 0.279371
Simuliidae	99		DMAX = 3.45943 R= 0.537753
Unknown Chironomidae	4		
Tipulidae	2	Total 113	
COLEOPTERA 2 T			D = 1.34886 DMIN = 0.344193
Zaitzevia sp. adult	1		DMAX = 2.32193 R= 0.579939
Optioservus sp. larva	1	Total 2	
✓NEMATODES 2 T			
None			
✓Cottus sp.	1	Total 1	

Original Total 359 Final Total 360

Identified and Enumerated by
Patricia Ann Mitchell
University of Alberta, Edmonton
May 23, 1973
Patricia Ann Mitchell

station D.I.

D = 3.22331 DMIN = 0.3[illegible]
DMAX = [illegible] R= 0.37[illegible]

BLACKFOOT RIVER AT DALTON MOUNTAIN ROAD BRIDGE #2
8-20-71

1 sq. ft. right bank — L. Spence

EPHEMEROPTERA 220 0.1		
Baetis spp.	147	
Cinygmula sp.	5	
Rhithrogena sp.	47	
Ephemerella tibialis	6	
Ephemerella grandis	12	
Ephemerella doddsi	5	Total 222
PLECOPTERA 21 T		
Alloperla sp.	9	
Pteronarcella badia	6	
Nemoura cinctipes	1	
Acroneuria pacifica	1	Total 17
TRICHOPTERA 103 0.1		
Brachycentrus sp.	60	
Glossosoma sp.	12	
Arctopsyche grandis	17	
Limnephilid Genus 1	1	
Limnephilid Genus 2	4	
Tinodes sp.	7	Total 101
DIPTERA 68 0.1		
Atherix variegata	3	
Hexatoma sp.	1	
Simuliidae	5	
Empididae Genus #1	4	
Empididae Genus #2	1	
Metriocnemius sp.	14	
Cardiocladius sp.	1	
Tanytarsus sp. (= Calopsectra)	2	
Brillia sp.	1	
Unkown Chironomidae	32	Total 64
COLEOPTERA 22 T		
Narpus sp. larva	1	
Heterlimnius sp. larva	1	
Optioservus sp. lar-12, ad-3	15	
Cleptelmis ornata lar-4, ad-1	5	Total 22
✓NEMATODES 38 T		
Oligonhaeta	38	Total 38

Original Total 472, Final Total ~~463~~ 464

Enumerated and Identified by
Patricia Ann Mitchell
MS, Univ. Montana, 1968
University of Alberta, Edmonton
May 26, 1973
Patricia Ann Mitchell

BLACKFOOT RIVER AT DALTON MOUNTAIN ROAD BRIDGE #3
8-20-71

1 sq. ft. right bank — L. Spence

EPHEMEROPTERA 242 0.2		
Baetis spp.	146	
Rhithrogena sp.	68	
Cinygmula sp.	1	
Ephemerella doddsi	7	
Ephemerella tibialis	4	
Ephemerella grandis	14	Total 240
PLECOPTERA 16 T		
Pteronarcella badia	6	
Alloperla sp.	7	
Nemoura cinctipes	2	
Acroneuria pacifica	3	Total 18
TRICHOPTERA 53 T		
Brachycentrus sp.	27	
Glossosoma sp.	8	
Arctopsyche grandis	8	
Limnephilid Genus 1	3	
Limnephilid Genus 2	3	
Tinodes sp.	4	Total 53
DIPTERA 198 0.2		
Atherix variegata	9	
Simuliidae	118	
Empididae #1	2	
Cardiocladius sp.	3	
Metriocnemius sp.	16	
Tanytarsus sp.	1	
Unknown Chironomidae	28	Total 177
COLEOPTERA 21 T		
Cleptelmis ornata lar-4, ad-1	5	
Heterlimnius sp. ad.	1	
Optioservus sp. lar-9, ad-3 and 3 empty exuviae	12	Total 18
✓OLIGOCHAETA		
Oligochaetes	19	Total 19

Original Total 530, Final Total 525

Identified and Enumerated by
Patricia Ann Mitchell
University of Alberta, Edmonton
May 26, 1973
Patricia Ann Mitchell

APPENDIX P CONTINUED

BLACKFOOT RIVER AT DALTON MOUNTAIN ROAD BRIDGE #1

1 sq. ft. 10-26-71 L. Spence

EPHEMEROPTERA 540 1.2		
Baetis spp. (2 species)	76	
Cinygmula sp.	39	
Rhithrogena sp.	433	
Ephemerella doddsi	8	
Ephemerella grandis ingens	8	
Ephemerella infrequens	8	Total 552
PLECOPTERA 125 0.9		
Nemoura cinctipes	8	
Pteronarcella badia	22	
Isogenus sp.	2	
Capnia sp.	2	
Isoperla sp.	2	
Paraperla frontalis	4	
Alloperla sp.	63	
Brachyptera sp.	3	
Acroneuria pacifica	8	
Acroneuria californica	1	Total 115
TRICHOPTERA 198 0.7		
Hydropsyche sp.	22	
Arctopsyche grandis	18	
Brachycentrus sp.	6	
Glossosoma sp.	148	
Limnephilid #2	2	
Rhyacophila coloradensis	1	Total 197
DIPTERA 35 0.1		
Antocha sp.	5	
Empididae #1	1	
Atherix variegata	3	
Simuliidae	23	
Orthoclad Chironomidae	4	Total 36
COLEOPTERA 4 T		
Optioservus sp.	4	Total 4
NEMATODA 6 T		
Oligochaeta	1	
Nematoda	4	Total 5
COTTUS	1	

Original Total 908 Final Total 909

Patricia Ann Mitchell

BLACKFOOT RIVER AT DALTON MOUNTAIN ROAD BRIDGE #2

1 sq. ft. 10-26-71 L. Spence

EPHEMEROPTERA 512 0.5		
Baetis spp.	39	
Cinygmula sp.	32	
Rhithrogena sp.	421	
Paraleptophlebia sp.	2	
Ephemerella doddsi	2	
Ephemerella grandis ingens	4	
Ephemerella hystrix	2	
Ephemerella infrequens	12	Total 514
PLECOPTERA 122 0.7		
Nemoura cinctipes	12	
Pteronarcella badia	13	
Capnia sp.	2	
Isogenus sp.	1	
Isoperla sp.	6	
Brachyptera sp.	2	
Acroneuria pacifica	19	
Alloperla sp.	63	Total 118
TRICHOPTERA 150 1.1		
Hydropsyche sp.	28	
Arctopsyche grandis	39	
Glossosoma sp.	55	
Brachycentrus sp.	18	
Limnephilid sp. 2	5	
Rhyacophila coloradensis	3	Total 148
DIPTERA 17 T		
Antocha sp.	7	
Hexatoma sp.	1	
Empididae #1	3	
Simuliidae	5	
Orthoclad Chironomidae	1	Total 17
ANNELIDA 17 T		
Oligochaeta	17	Total 17

Original Total 818 Final Total 814

Patricia Ann Mitchell

BLACKFOOT RIVER AT DALTON MOUNTAIN ROAD BRIDGE #3

1 sq. ft. 10-26-71 L. Spence

EPHEMEROPTERA 680 0.9		
Baetis spp. (2)	35	
Cinygmula sp.	59	
Rhithrogena sp.	552	
Ephemerella doddsi	7	
Ephemerella grandis ingens	3	
Ephemerella hystrix	3	
Ephemerella infrequens	10	
Ameletus sp.	1	Total 670
PLECOPTERA 97 0.8		
Nemoura cinctipes	9	
Brachyptera sp.	1	
Pteronarcella badia	5	
Isoperla sp.	9	
Acroneuria pacifica	22	
Paraperla frontalis	1	
Alloperla sp.	48	Total 95
TRICHOPTERA 163 1.0		
Hydropsyche sp.	20	
Arctopsyche grandis	35	
Glossosoma sp.	91	
Brachycentrus sp.	5	
Rhyacophila coloradensis	2	
Limnephilid #2	6	Total 159
DIPTERA 43 0.1		
Antocha sp.	19	
Atherix variegata	3	
Simuliidae	10	
Empididae #1	3	
Pericoma sp.	3	
Orthoclad Chironomidae	3	Total 41
COLEOPTERA 2 T		
Optioservus sp.	1	
Heterlimnius sp.	1	Total 2
NEMATODA 5 T		
Nematoda	5	Total 5
COTTUS 2		

Original Total 992 Final Total 972

Patricia Ann Mitchell

APPENDIX P CONTINUED

Blackfoot River at Blackfoot Canyon Camp 7/16/68

Plecoptera 7 .05 cc

Acroneuria pacifica Banks
Pteronarcys californica Newport
Hastaperla brevis (probably) or Alloperla sp.

Trichoptera 6 .1 cc

Station D.I.

Hydropsyche sp.
Brachycentrus sp.
Lepidostoma sp.

D = 2.974237 DMIN = 7.22575E-2 = .0722575
DMAX = 2.32193 D= [illegible].332177

Ephemeroptera 475 1.9 cc

Epeorus longimanus (Eaton)
Cinygmula sp.
Baetis spp. (2 types)
Rhithrogena sp. prob. undulata (Banks)
Ephemerella flavilinea McDunnough
Ephemerella infrequens McD.
Ephemerella tibialis McD.

Coleoptera 9 T

Optioservus sp. prob. quadrimaculatus

Diptera 92 .6 cc

Atherix variegata Walker
Hexatoma spp. (3 spp.)
Simuliidae
Empididae
Tendipedidae

Hydrobaenus sp.

Aquatic insect eggs .1 cc

Nematoda 1 T

Gastropoda ?1 T

Blackfoot River at Blackfoot Canyon Camp 10/1/69

Plecoptera 78

Acroneuria pacifica Banks
Claassenia sabulosa Banks
Pteronarcella badia (Hagen)
Alloperla sp. or Hastaperla sp.
Pteronarcys californica Newport
Arcynopteryx parallela (Frison) or curvata Hanson
Paraperla frontalis
Nemoura sp.

Trichoptera 139

Arctopsyche sp.
Hydropsyche sp.
Brachycentrus sp.
keys to Limnephilid Genus C
Glossosoma sp.

Ephemeroptera 401

Rhithrogena hageni or undulata
Baetis spp. (2 types)
Ephemerella tibialis McD.
Ephemerella grandis ingens
Ephemerella sp.

Coleoptera 13

Heterlimnius corpulentus (Le Conte)
Optioservus prob. quadrimaculatus (Horn)

Diptera 39

Hexatoma sp.
Atherix variegata Walker
Protoplasa fitchii Osten Sacken
Simuliidae
Empididae
Tendipedidae

Hydrobaenus sp.

Station D.I.

Oligochaeta 2 spp.

Planaria

D = 1.62434 DMIN = 6.46350E-2 = .0646350
DMAX = 2.32193 D= 0.309236

APPENDIX P CONTINUED

BLACKFOOT RIVER AT BLACKFOOT CANYON CAMP #1
3/18/71
miles above Arrastra Creek. 1 sq. ft. 5' from rt. bank.
L. Spence. 1420

[illegible]ROPTERA 347 0.6		
Baetis parvus type	21	
Baetis sp.	27	
Paraleptophlebia sp. prob. heteronea	4	
Ephemerella infrequens	45	
Ephemerella grandis ingens	2	
Ephemerella sp. prob. flavilinea	17	
Ephemerella hystrix	1	
Rhithrogena sp.	227	
Cinygmula sp.	4	
Epeorus longimanus	1	Total 349
[illegible]COPTERA 64 0.7		
Pteronarcella badia	5	
Nemoura besametsa	4	
Capnia spp.	2	
Isoperla sp.	12	
Arcynopteryx parallela or curvata	1	
Acroneuria pacifica	4	
Acroneuria sp.	2	
Claassenia sabulosa	5	
Alloperla sp.	22	Total 57
[illegible]CHOPTERA 161 0.5		
Glossosoma sp.	62	
Brachycentrus sp.	29	
Hydropsyche sp.	66	
Arctopsyche grandis	1	
Lepidostoma sp.	2	Total 160
[illegible]TERA 232 0.3		
Simuliidae	185	
Atherix variegata	20	
Hexatoma spp.	13	
Empididae #4	1	
Rhabdomastix sp.	1	
Empididae #1	1	
Brillia sp.	8	
Hydrobaenus sp. 1	2	
Unknown tendipedid (like Brillia)	1	Total 232
[illegible]LEOPTERA 5 T		
Optioservus adult	2	
Optioservus sp. larvae	3	Total 5

Original Total - 629
Final Total - 623

[illegible]unted and Identified by
[illegible]tricia Ann Mitchell
[illegible]ril 1[illegible], 1972
Teresa Ann Mitchell

BLACKFOOT RIVER AT BLACKFOOT CANYON CAMP #2
3/18/71
3.5 miles above Arrastra Creek
1 sq. ft. sample 4' from R. bank downstream from bridge. L. Spence. 1435

Ephemeroptera 326 0.6	
Rhithrogena sp. (undulata?) 233	
Baetis spp. 49	
Ephemerella infrequens 18	
✓Ephemerella sp. (too small to identify) 7	
Paraleptophlebia sp. 3	
Cinygmula sp. 3	
Ephemerella grandis ingens 1	Total ~~313~~ 314
Plecoptera 46 1.0	
Alloperla sp. 14	
Pteronarcella badia 7	
Isoperla sp. 10	
Acroneuria pacifica 5	
Arcynopteryx parallela or curvata 4	
Claassenia sabulosa 4	
Capnia spp. 4	
Nemoura sp. prob. besametsa 2	
Brachyptera sp. 1	Total 51
Trichoptera 166 0.6	
Glossosoma sp. 105	
Brachycentrus sp. 36	
Hydropsyche sp. 20	
Arctopsyche ~~[illegible]~~ grandis 2	
Limnephilidae 1	Total 164
Diptera 158 0.3	
Simuliidae 136	
Hexatoma sp. 4	
Dicranota sp. 3	
Metriocnemus sp. 2 3	
Hydrobaenus sp. 1 1	
Hydrobaenus sp. 2 1	
Atherix variegata 2	Total 150
Coleoptera 1 T	
Optioservus larva 1	Total 1
✓Cottus 3	

Original Total 697
Final Total ~~[illegible]~~ 680

Station R.I.

D = 3.30792 DMIN = 0.227217
DMAX = 5.45943 R= 0.405471

BLACKFOOT R. AT BLACKFOOT CANYON CAMP #3
3/18/71
3.5 miles above Arrastra Cr. 1 sq. ft. sample 4' from left bank downstream from bridge. L. Spence. 1450.

Original Total 912
Final Total 913

Ephemeroptera 555 0.9		
Baetis parvus type	16	
Baetis sp.	20	
Cinygmula sp.	14	
Epeorus longimanus	2	D = 1.45334 DMIN = 0.11[illegible]34
Rhithrogena sp.	455	DMAX = 3.58496 R= 0.3[illegible]9
Ameletus sp.	1	
Paraleptophlebia sp.	2	
Ephemerella infrequens	27	
Ephemerella sp. prob. flavilinea	21	
Ephemerella grandis ingens	1	Total 559
Plecoptera 107 0.5		
Nemoura besametsa	3	
Capnia sp.	2	
Pteronarcella badia	3	
Isoperla sp.	22	D = 2.6322 DMIN = [illegible]
Alloperla sp.	46	DMAX = 3.45943 R= 0.256641
Hastaperla brevis?	19	
Acroneuria pacifica	8	
Claassenia sabulosa	1	Total 104
Trichoptera 212 0.8		
Arctopsyche grandis	5	
Hydropsyche sp.	55	
Brachycentrus sp.	35	
Glossosoma sp.	108	
Limnephilidae	8	Total 211

D = 1.64613 DMIN = 9.53672E-2 = .0954 ~ .1
DMAX = 2.58496 R= 0.377835

Diptera 17 0.6		
Hexatoma spp. (3 species)	12	
Antocha sp.	1	
Rhabdomastix sp.	1	
Empididae species #1	1	
Empididae species #3	1	D = 1.26927 DMIN = [illegible]
Atherix variegata	6	DMAX = 3.[illegible] R= [illegible]
Simuliidae	3	
✓Tendipedidae pupa	1	Total 26
Coleoptera 1 T		S=1 No diversity computed
Optioservus sp. adult	1	Total 1
✓Oligochaeta 20 T	12	Total 12

APPENDIX P CONTINUED

BLACKFOOT RIVER AT BLACKFOOT CANYON CAMP #1
8-20-71
1 sq. ft. with round sampler — L. Spence

EPHEMEROPTERA 186 0.1			D = 1.15179 DMIN = 7.23368E-2 ? .0722836 DMAX = 2.53491 R= 0.573503
Baetis spp.	60		
Rhithrogena sp.	112		
Ephemerella tibialis	11		
Paraleptophlebia sp.	1	Total 184	
PLECOPTERA 28 0.1			
Acroneuria pacifica	2		
Arcynopteryx parallela or curvata	10		D = 1.97392 DMIN = 2.314212
Nemoura cinctipes	2		DMAX = 2.30735 R= 0.418152
Paraperla frontalis	1		
Alloperla sp.	13	Total 28	
TRICHOPTERA 9 T			
Brachycentrus sp.	2		
Hydropsyche sp.	1		D = 2.03009 DMIN = 1.44251
Arctopsyche grandis	4		DMAX = 2.53496 R= 0.435637
Tinodes sp.	1		
Limnephilid Genus 1	1	Total 9	
DIPTERA 42 0.1			
Hexatoma sp.	33		
Empididae Genus #1	1		
Empididae Genus #2	1		D = 2.24914 DMIN = 0.591439
Atherix variegata	2		DMAX = 3. R= 0.394735
Tanytarsus sp.	4		
Brillia sp.	2		
Unknown Chironomidae	3	Total 46	
	S=1	No diversity computed	
COLEOPTERA 1 T			
Optioservus sp. larva	1	Total 1	
NEMATODES 28 T			
Oligochaetes	23	Total 23	

Original Total 294 Final Total 291

Identified and Enumerated by
Patricia Ann Mitchell
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May 27, 1973
Patricia Ann Mitchell

Station D.I.

D = 2.24571 DMIN = 0.337332
DMAX = 4.80735 R= 0.575137

BLACKFOOT RIVER AT BLACKFOOT CANYON CAMP #2
8-20-71
1 sq. ft. from center of riffle — L. Spence

EPHEMEROPTERA 370 0.2		
Baetis spp.	127	
Rhithrogena sp.	236	
Ephemerella tibialis	3	
Ephemerella grandis	1	Total 367
PLECOPTERA 16 T		
Nemoura cinctipes	1	
Alloperla sp.	11	
Arcynopteryx curvata or parallela	1	
Acroneuria pacifica	1	Total 14
TRICHOPTERA 6 T		
Glossosoma sp.	4	
Arctopsyche grandis	2	Total 6
DIPTERA 32 0.1		
Hexatoma spp.	13	
Atherix variegata	5	
Empididae Genus #2	1	
Simuliidae	4	
Chironomidae unknowns	7	Total 30
COLEOPTERA 1 T		
Optioservus sp. adult	1	Total 1

Original Total 425 Final Total 418

Identified and Enumerated by
Patricia Ann Mitchell
University of Alberta, Edmonton
May 28, 1973
Patricia Ann Mitchell

BLACKFOOT RIVER AT BLACKFOOT CANYON CAMP #3
8-20-71
1 sq. ft. from left side of riffle — L. Spence

EPHEMEROPTERA 202 0.1		
Baetis spp.	111	
Rhithrogena sp.	89	
Ephemerella tibialis	2	
Ephemerella doddsi	1	
Paraleptophlebia sp.	1	Total 204
PLECOPTERA 11 0.2		
Pteronarcella badia	3	
Alloperla sp.	4	
Claassenia sabulosa	1	
Acroneuria pacifica	2	Total 10
TRICHOPTERA 4 T		
Arctopsyche grandis	3	
Glossosoma sp.	1	Total 4
DIPTERA 18 0.3		
Atherix variegata	8	
Chironomidae unknowns	3	
Hexatoma spp.	5	
Simuliidae	2	Total 18
NEMATODA 5 T		
Nematoda	1	
Oligochaeta	2	Total 3
plus 2 chironomid sand tubes		

Original Total 240 Final Total 239

Identified and Enumerated by
Patricia Ann Mitchell
University of Alberta, Edmonton
May 28, 1973
Patricia Ann Mitchell

APPENDIX P CONTINUED

BLACKFOOT RIVER AT BLACKFOOT CANYON CAMP #1

1 sq. ft. 10-26-71 L. Spence

EPHEMEROPTERA 520 0.8		
Baetis sp. (one species)	36	
Cinygmula sp.	125	
Rhithrogena sp.	319	
Ephemerella doddsi	2	
Ephemerella infrequens	42	
Paraleptophlebia sp.	2	Total 526
PLECOPTERA 72 0.4		
Nemoura cinctipes	2	
Capnia sp.	2	
Isoperla sp.	18	
Brachyptera sp.	4	
Pteronarcella badia	6	
Arcynopteryx curvata or parallela	4	
Acroneuria pacifica	4	
Alloperla sp.	32	Total 72
TRICHOPTERA 122 0.2		
Hydropsyche sp.	67	
Arctopsyche grandis	3	
Glossosoma sp.	43	
Brachycentrus sp.	2	
Limnephilidae #1	7	Total 122
DIPTERA 24 0.1		
Hexatoma sp.	9	
Antocha sp.	1	
Atherix variegata	7	
Simuliidae	3	
Orthoclad #2	2	
Other Orthocladinae	2	Total 24
COLEOPTERA 1 T		
Optioservus sp.	1	Total 1
UNKNOWN 3 T		
Nematoda	3	Total 3
ANNELIDA 26 T		
Oligochaeta	26	Total 26
COTTUS 1 T		

Original Total 769 Final Total 774

/ Patricia Ann Mitchell

BLACKFOOT RIVER AT BLACKFOOT CANYON CAMP #2

1 sq. ft. 10-26-71 L. Spence

EPHEMEROPTERA 575 0.9		
Baetis sp.	53	
Cinygmula sp.	151	
Rhithrogena sp.	278	
Ephemerella doddsi	1	
E. grandis ingens	1	
E. infrequens	76	
Paraleptophlebia sp.	4	
Sub-adult (prob. one of above species)	1	Total 565
PLECOPTERA 104 0.7		
Nemoura cinctipes	19	
Capnia sp.	4	
Brachyptera sp.	8	
Pteronarcella badia	9	
Isoperla sp.	29	
Acroneuria pacifica	8	
Alloperla sp.	30	Total 107
TRICHOPTERA 324 1.0		
Hydropsyche sp.	234	
Arctopsyche grandis	25	
Glossosoma sp.	44	
Brachycentrus sp.	14	Total 317
DIPTERA 30 0.2		
Hexatoma sp.	7	
Atherix variegata	10	
Simuliidae	8	
Orhtoclad #2	1	
Other Chironomidae	3	Total 29
COLEOPTERA 2 T		
Zaitzevia sp.	1	
Optioservus sp.	1	Total 2
ANNELIDA 23 T		
Oligochaeta	23	Total 23
UNKNOWN 3 T		
Nematoda	3	Total 3

Original Total 1061 Final Total 1046

Patricia Ann Mitchell

BLACKFOOT RIVER AT BLACKFOOT CANYON CAMP #3

1 sq. ft. 10-26-71 L. Spence

EPHEMEROPTERA 344 0.5		
Baetis sp.	37	
Cinygmula sp.	71	
Rhithrogena sp.	170	
Ephemerella infrequens	52	
Paraleptophlebia sp.	1	Total 331
PLECOPTERA 71 0.4		
Nemoura cinctipes	3	
Pteronarcella badia	8	
Brachyptera sp.	9	
Isoperla sp.	18	
Paraperla frontalis	2	
Alloperla sp.	26	
Acroneuria pacifica	4	Total 70
TRICHOPTERA 223 0.4		
Hydropsyche sp.	154	
Arctopsyche grandis	20	
Brachycentrus sp.	4	
Glossosoma sp.	45	
Lepidostoma sp.	1	Total 224
DIPTERA 31 0.2		
Hexatoma sp.	9	
Antocha sp.	3	
Atherix variegata	11	
Dicranota sp.	1	
Simuliidae	5	
Orthoclad #2	1	Total 30
NEMATODA 9 T		
Nematoda	2	Total 2
OLIGOCHAETA	7	Total 7
COTTUS SP. 1 T		

Original Total 679 Final Total 664

Patricia Ann Mitchell

Blackfoot River at Rainbow Bend 7/18/68

Plecoptera 23 5.5 cc

Pteronarcys californica Newport
Claassenia sabulosa Banks

Trichoptera 76 .7 cc

Glossosoma sp.
Hydropsyche sp.
Arctopsyche sp.

Station D.I.

D = 1.38433 DMIN = 0.174355
DMAX = 2.32193 R= 0.241046

Ephemeroptera 85 .25 cc

Epeorus longimanus (Eaton)
Baetis spp. (2 types)
Ephemerella flavilinea McD.
Ephemerella tibialis McD.
Ephemerella hecuba (Eaton)
Rhithrogena undulata (Banks) (prob.)

Coleoptera 1 T

Optioservus sp.

Gastropoda 3 .15 cc

Physa sp.

Oligochaeta 5 T

Diptera 24 .30 cc

Antocha sp.
Protoplasa fitchii Osten Sacken
Atherix variegata Walker
Hexatoma sp.
Tendipedidae

APPENDIX P CONTINUED

BLACKFOOT RIVER AT RAINBOW BEND #1
11-2-71
1 sq. ft. L. Spence

EMEROPTERA 181 0.2

Baetis sp. (probably bicaudatus)	6		
Ameletus sp.	8	D = 1.26137 DMIN = ?.??0997	
Paraleptophlebia sp.	1	DMAX = 3.16993 R= 0.403305	
Cinygmula sp.	3		
Rhithrogena sp.	28		
Epeorus sp. (too small to ident. further)	19		
Ephemerella lacustris? (similar to infrequens)	112		Total 177

COPTERA 75 0.3

Eucapnopsis brevicauda (probably)	28		
Pteronarcys californica	1	D = 2.3301 DMIN = 0.653403	
Arcynopteryx curvata or parallela	1	DMAX = 3.32193 R= 0.371676	
Isoperla sp.	28		
Acroneuria californica	8		
Alloperla sp.	8		Total 74

HOPTERA 80 0.3

Hydropsyche sp.	74	D = 0.232336 DMIN = 0.150397	
Psychomyia sp.	1	DMAX = 2.53496 R= 0.945785	
Agraylea sp.	2		Total ~~#~~ 77

TERA 47 0.4

Hexatoma sp.	1		
Empididae #3	1	D = 1.6919 DMIN = 0.795246	
Pentaneura sp.	2	DMAX = 3. R= 0.593309	
Metriocnemius sp.	1		
Unknown orthoclad #6	15		
Unknown Chironomidae	26		Total 46

EOPTERA 4 T

Kaitzevia sp. lar.	S=1 4	No diversity computed	Total 4

IATODA 10 T

Oligochaeta	9	
Nematoda	1	Total 10

Original Total 397 Final Total ~~387~~ 388

ntified and Enumerated by
Patricia Ann Mitchell
Department of Zoology
University of Alberta
Edmonton, Alberta, Canada
July 30, 1973
Patricia Ann Mitchell

Station D.I.
D = 3.11452 DMIN = 0.416179
DMAX = 5.08746 R= 0.482355

BLACKFOOT RIVER AT RAINBOW BEND #2
11-2-71
1 sq. ft. L. Spence

EPHEMEROPTERA 103 0.1

Baetis spp.	4	
Paraleptophlebia sp.	2	
Cinygmula sp.	2	
Rhithrogena sp.	32	
Epeorus sp.	18	
Ephemerella lacustris or infrequens	42	
Ephemerella doddsi	3	Total 103

PLECOPTERA 22 0.5

Pteronarcys californica	3	
Eucapnopsis brevicauda	2	
Isogenus aestivalis	1	
Isoperla sp.	8	
Acroneuria californica	1	
Alloperla sp.	2	
✓Perlodidae (small)	2	Total 19

TRICHOPTERA 150 0.4

Hydropsyche sp.	144	
Parapsyche elsis Milne	1	
Rhyacophila sp.	1	Total 146

DIPTERA 11 T

Pentaneura sp.	2	
Antocha sp.	1	
Unknown Chironomidae	8	Total 11

✓OLIGOCHAETA 3 T

Oligochaetes	3	Total 3

Original Total 289 Final Total 282

Identified and Enumerated by
Patricia Ann Mitchell
MS, Univ. Of Montana, 1968
July 30, 1973
Patricia Ann Mitchell

BLACKFOOT RIVER AT RAINBOW BEND #3
11-2-71
1 sq. ft. L. Spence

EPHEMEROPTERA 104 T

Baetis sp.	14	
Rhithrogena sp.	30	
Epeorus sp.	15	
Heptagenia elegantula	1	
Ephemerella lacustris or infrequens	41	Total 101

PLECOPTERA 21 0.5

Eucapnopsis brevicauda?	1	
Pteronarcys californica	1	
Nemoura cinctipes	1	
Isogenus aestivalis	2	
Isoperla sp.	8	
Cleassenia sabulosa	1	
Acroneuria californica	7	
Acroneuria pacifica	1	Total 22

TRICHOPTERA 104 0.8

Hydropsyche sp.	96	
Parapsyche elsis	4	
Glossosoma sp.	1	
Rhyacophila sp.	1	Total 102

DIPTERA 8 T

Dolichopodidae larva (probably)	1	
Metriocnemius sp.	1	
Chironomidae unknowns	6	Total 8

COLEOPTERA 1 T

Zaitzevia sp. larva	1	Total 1

✓Nematoda 1

Oligochaeta	1	Total 1

Original Total 239 Final Total 235

Identified and Enumerated by
Patricia Ann Mitchell
MS, University of Montana, 1968
July 31, 1973
Patricia Ann Mitchell

Appendix Q

DIVERSITY INDEX COMPUTATION PROCEDURE
By
Don O. Loftsgaarden

These comments refer to a paper by Wilhm and Dorris, Bioscience 18(6), 477-481, June 1968 entitled "Biological Parameters for Water Quality Criteria." In particular, comments refer to columns 2 and 3 on page 478.

The value of $\bar{d}$ (referred to as D in the program) used for the calculations is given at the top of column 3.

$$\bar{d} = -\sum_{i=1}^{s} \left(\frac{n_i}{n}\right) \log_2 \left(\frac{n_i}{n}\right) \qquad (1)$$

This $\bar{d}$ value follows from the last $\bar{H}$ value at the bottom of column 2 by substituting sample values for population values (i.e., n_i for N_i, n for N, etc.).

This last $\bar{H}$ value follows from the first $\bar{H}$ value in column 2 by approximating the factorials.

$\bar{d}_{min}$ and $\bar{d}_{max}$ are given at the top of column 3 but still have factorials in them, making them impossible to use when n_i and n are large. However, the maximum $\bar{d}$ value occurs when all s species occur equally often, i.e., when

$$n_i = \frac{n}{s} \qquad i = 1, 2, \ldots\ldots, s.$$

But this implies that

$$\frac{n_i}{n} = \frac{\frac{n}{s}}{n} = \frac{1}{s} \quad \text{for } i = 1, 2, \ldots\ldots, s.$$

If we make this substitution for $\frac{n_i}{n}$ in formula (1) above, we find that $\bar{d}_{max}$ is as follows:

$$\bar{d}_{max} = -\log_2\left(\frac{1}{s}\right) \qquad (2)$$

This is the formula used in the program.

The minimum $\bar{d}$ value occurs when s-1 of the species have $n_i = 1$ and the other species has all of the rest of the insects or a total of n-(s-1). Substituting these values in (1) above we arrive at

$$\bar{d}_{min} = -\left(\frac{s-1}{n}\right) \log_2\left(\frac{1}{n}\right) - \frac{n-s+1}{n} \log_2 \frac{n-s+1}{n} \qquad (3)$$

This is the formula used in the program.

Reviewing, in the program $\bar{d}$ = D, d_{max} = D MAX, and d_{min} = D MIN. Formulas (1), (2), and (3) above are used to do the computations. The redundancy is computed using the formula given in the paper, i.e.,

$$R = \frac{DMAX - D}{DMAX - DMIN}$$

Note: A copy of the program used in the computations is attached.

LIST

DINDEX 08:03 17-APR-74

```
5 REM STATION 9
10 REM PUT N,S,AND N(I) IN DATA LINES 340,341,ETC
100 READ A,M,S
105 IF M=999 GO TO 400
110 MAT READ N(S)
120 DEF FNL(A) = LN(A)/LN(2)
130 LET D=0
150 FOR I=1 TO S
160 LET X=N(I)/M
170 LET D = D-X*FNL(X)
180 NEXT I
200 LET X=(S-1)/M
210 LET Y=1/M
220 LET Z =(M-S+1)/M
230 LET U = X*FNL(Y) +Z*FNL(Z)
240 LET V = (-1)*U
260 LET Q = (-1)*FNL(1/S)
280 LET R=(Q-D)/(Q-V)
290 PRINT "PROBLEM I.D. = "A,"D ="D,"DMIN ="V
291 PRINT ,,"DMAX = "Q;"R= "R
295 PRINT
310 GO TO 100
340 DATA 9,540,5
341 DATA 69,211,229,5,26
360 DATA 10,999,10
400 END

READY
```

A=9= Problem I.D., N=540 = TOTAL No. BUGS, S= 5=No. species
N(1)=69= No. bugs species 1, N(2)=211 = No. bugs Species 2, ETC
(Actually for the example shown species should be read order).

This is an A, M, S used to tell program to stop. If M=999 program Stops. See line 110 in program.

Data from more than one problem can be run at the same time. Data for the additional problems is put in program lines 342-359 using the format prescribed in lines 340 and 341 above.

APPENDIX R

Summary of kinds and abundance of bottom fauna identified from the Blackfoot River and certain tributaries from 1968-1971.

Collection methods are explained in Appendix P.

Numbers in each species were not determined in 1968 or 1969, but were determined in 1971.

Volumes given were determined by order in the Pollution Control Laboratory, Helena.

Final totals were determined by Ms. Patricia Ann Mitchell during species identification and are the same as those given in Appendix P.

Numbers in parentheses following the number of individuals in a genus show the number of species which were identified within that genus at the station. (In 1968 and 1969 data, these numbers are in parentheses after an (x), which simply indicates the presence of a genus.) Numbers given in 1968 and 1969 data are total number of individuals in the order.

Volumes less than 0.01 cc are shown as T (trace). Each T represents the volume less than 0.01 cc in a one square foot sample.

APPENDIX R continued

Number and Kinds of Major Aquatic Insects Collected with Kick Screen ($\pm$ 4 ft^2 Sample) from Blackfoot River in 1968 and 1969

Location	Pop's			Flesher			Hogum			Dalton			Canyon			Rainbow		
Month/Yr	7/68	4/69	10/69	7/68	4/69	10/69	7/68	4/69	10/69	7/68	4/69	10/69	7/68	4/69	10/69	7/68	4/69	10/69
No. of Samples	2	1	1	1	1	1	1	1	1	1	None	1	1	None	1	1	None	None
<u>Plecoptera</u> (Stoneflies)	4	UN	95	22	8	42	53	65	49	17		69	7		78	23		
Nemoura	x	x	x	x	x(2)	x	x	x(2)	x	x					x			
Capnia								x(2)	x									
Pteronarcys										x		x	x		x	x		
Pteronarcella												x			x			
Arcynopteryx									x			x			x			
Isogenus			x		x					x		x						
Isoperla			x					x										
Alloperla	x?			x	x	x	x	x		x?		x			x			
Hastaperla			x	x					x				x					
Paraperla	x					x									x			
Acroneuria				x		x	x	x	x	x		x	x		x			
Claassenia				x	x	x	x	x		x					x	x		
Kathroperla							x			x?								
<u>Ephemeroptera</u> (Mayflies)	0	2		10	1	UN	508	254	32	432		229	475		401	85		
Heptagenia																		
Cinygmula		x		x		x	x	x	x	x			x					
Epeorus				x	x		x	x		x			x			x		
Rhithrogena								x		x		x	x		x	x		
Baetis				x			x	x		x		x	x		x	x		
Paraleptophlebia							x	x	x									
Ameletus																		
Ephemerella							x(2)	x(3)	x(2)	x(4)		x(3)	x(3)		x(3)	x(3)		
<u>Tricoptera</u> (Caddis flies)	12		4	24	7	8	155	62	399	24		211	6		139	76		
Rhyacophila	x		x	x			x	x	x	x		x						
Glossosoma								x				x			x	x		
Anagapetus							x											
Sortosa																		
Tinodes																		

APPENDIX R continued

Number and Kinds of Major Aquatic Insects Collected from Blackfoot River in 1968 and 1969

Location	Pop's			Flesher			Hogum			Dalton			Canyon			Rainbow		
Month/Yr	7/68	4/69	10/69	7/68	4/69	10/69	7/68	4/69	10/69	7/68	4/69	10/69	7/68	4/69	10/69	7/68	4/69	10/69
No. of Samples	2	1	1	1	1	1	1	1	1	1	None	1	1	None	1	1	None	None
Hydropsyche	x				x		x	x	x			x	x		x	x		
Arctopsyche	x		x			x						x			x	x		
Psychomyia							x											
Parapsyche			x															
Ochrotrichia							x											
Lepidostoma					x		x	x	x				x					
Brachycentrus	x			x		x	x	x	x	x		x	x		x			
Limnephilidae							x	x	x	x		x						
<u>Coleoptera</u> (Beetles)	8			32	UN		124	14	50	12		5	9		13	1		
Zaitzevia	x			x	x		x		x									
Narpus				x			x	x				x						
Lara				x			x											
Optioservus				x			x	x	x	x		x	x		x	x		
Heterlimnius							x	x	x	x		x			x			
Cleptelmis										x								
<u>Diptera</u> (True flies)	51			91	10	24	813	91	44	443		26	92		39	24		
Hexatoma				x		x	x		x	x			x		x	x		
Antocha					x	x	x		x							x		
Rhabdomastix							x		x									
Chelifera																		
Pericoma								x	x									
Protoplasa										x		x			x	x		
Atherix										x		x	x		x	x		
Tanytarsus							x											
Pentaneura							x											
Metriocnemus								x										
Hydrobaenus	x												x		x			
Brillia					x													
Cardiocladius								x										
Diamesa								x										
Simulidae					x	x	x	x	x	x			x		x			
Tendipedidae						x				x					x	x		
Emphididae													x					

UN = Unknown
? = Identity not positive
( ) = Indicates more than one species

Number and Volume of Major Aquatic Insects Collected from Blackfoot River with Kick Screen in 1968 and 1969 by Order.

Location	Pop's		Flesher		Hogum		Dalton		Canyon		Rainbow	
Year 1/	1968	1969	1968	1969	1968	1969	1968	1969	1968	1969	1968	1969
No. of Samples	2	2	1	2	1	2	1	1	1	1	1	None
Plecoptera												
No.	4	95	22	50	53	114	17	69	7	78	23	
Vol. 2/	T	0.3+	0.4	-	0.7	-	0.9	-	0.05	-	5.5	
Ephemeroptera												
No.	0	2	10	1	508	32	432	229	475	401	85	
Vol.	-	-	0.1	T	1.4	-	1.6	-	1.9	-	0.25	
Tricoptera												
No.	12	4	24	15	155	399	24	211	6	139	76	
Vol.	0.4	0.1	0.2	UN-0.1	1.3	-	0.2	-	0.1	-	0.7	
Coleoptera												
No.	8		32		124	50	12	5	9	13	1	
Vol.	T-0.05		0.05		0.05	-	0.05	-	T	-	T	
Diptera												
No.	51	2	91	34	813	44	443	26	92	39	24	
Vol.	T-0.1	T	0.4	UN-T	2.0	-	0.9	-	0.6	-	0.3	

1/Each sample is ±4 square feet
2/Volume in cc
T = Trace (< .01)
- = Vol. not known
UN = Vol. not given for one sample

March/April 1971

Location No. sq. ft. sampled	Flesher 3	Alice Creek 2 1/	Hogum 3	Poorman Creek 3	Dalton 3	Canyon 3
PLECOPTERA			Number of Individuals			
Pteronarcella	-	-	-	2	5	15
Nemoura	248(2)	446(2)	501(2)	69	1	9
Capnia	38	78	161	-	4	8
Isoperla	-	-	40	38	13	44
Arcynopteryx	3	1	1	-	-	5
Acroneuria	3	1	7	97	11	19(2)
Claassenia	2	-	6	-	1	10
Alloperla	105	135	221	25	68	82
Brachyptera	4	1	-	-	-	1
Isogenus	19	9	9	16	3	-
Hastaperla	-	-	5	18	6	19
Paraperla	2	-	-	-	-	-
Eucapnopsis	10	-	-	-	-	-
Chloroperlidae	-	-	3	-	-	-
Unknown	3	3	-	-	2	-
Final Total	436	674	954	265	114	212
Total Volume (cc)	1.1	1.2	2.4	3.9	0.7	2.2
Ave. no./sq. ft	146	337	318	88	38	71
Ave. vol./sq. ft (cc)	0.4	0.6	0.8	1.3	0.2	0.7

1/ 1 sample (1 sq. ft.) lost prior to identification

March/April 1971

Location No. sq. ft. sampled	Flesher 3	Alice Creek 2	Hogum 3	Poorman Creek 3	Dalton 3	Canyon 3
EPHEMEROPTERA						
Baetis	107	320	461(2)	856(2)	132(2)	133(3)
Paraleptophlebia	-	17	64	22	2	9
Ephemerella	-	199(3)	538(3)	238(4)	81(4)	140(4)
Rhithrogena	-	14	3	70	343(2)	915
Cinygmula	43	210	1461	317	25(2)	21
Epeorus	24	27	219	160	-	3
Ameletus	-	-	4	-	-	1
Total	174	787	2750	1663	583	1222
Total Volume (cc)	0.2+T	1.3	1.3	2.7	1.4	2.1
Ave. no./sq. ft	58	394	917	554	194	407
Ave. vol./sq. ft (cc)	0.07+T	0.65	0.43	0.9	0.47	0.7

TRICOPTERA						
Glossosoma	1	81	235	35	419	295
Brachycentrus	20	20	34	1	100	100
Hydropsyche	38	307	849	1	128	141
Arctopsyche	3	9	3	140	55	8
Rhyacophila	4	31(2)	88(3)	78(2)	1	-
Psychoronia	-	1	-	-	-	-
Lepidostoma	-	-	188	-	-	2
Hydroptila	-	-	-	1	-	-
Limnephilidae	2	12	15	7	5	9
Total	68	461	1412	263	708	555
Total Volume (cc)	0.3+T	1.1	2.1	4.3	2.5	1.9
Ave. no./sq. ft	23	231	471	88	236	185
Ave. vol./sq. ft (cc)	0.1+T	0.55	0.7	1.4	0.83	0.6

March/April 1971

Location No. sq. ft. sampled	Flesher 3	Alice Creek 2	Hogum 3	Poorman Creek 3	Dalton 3	Canyon 3
DIPTERA						
Simuliidae	131	5	45	8	1	324
Atherix	-	-	-	-	17	28
Hexatoma	1	2	8	1	7	29(3)
Empididae	2	-	9(3)	88(3)	2	4(3)
Brillia	22	1	66(2)	19	3	8
Rhabdomastix	-	-	-	-	-	2
Hydrobaenus (Orthocladius)*	165(2)	284(3)	469(3)	60(3)	6	4(2)
Dicranota	1	-	3	4	2	3
Metriocnemus	1	53	10	30	15	3
Antocha	37	58	42	34	5	1
Cardiocladius	3	86	30	1	9	-
Pericoma	24	63	118	147	3	-
Calopsectra (Tanytarsus)*	1	-	2	26	-	-
Pentaneura	-	1	3	-	3	-
Diamesa	-	11	-	-	-	-
Cricotopus (Orthocladius)*	-	-	1	24	-	-
Heleinae	-	3	-	-	-	-
Chironomidae	-	50	57	25	8	2
Total	388	617	863	467	81	408
Total Volume (cc)	0.4	2.0	0.8	0.4	0.3	1.2
Ave. no./sq. ft.	129	309	288	156	27	136
Ave. vol./sq. ft. (cc)	0.13	1.0	0.27	0.13	0.1	0.4

*Names in parentheses are the most recent Genus names, and are used in August 1971 data.

Location No. sq. ft. sampled	Flesher 3	Alice Creek 2	Hogum 3	Poorman Creek 3	Dalton 3	Canyon 3
COLEOPTERA						
Optioservus	-	25	59	5	23	7
Heterlimnius	-	8	2	111	3	-
Zaitzevia	-	2	10	-	-	-
Cleptelmis	-	-	-	-	5	-
Brychius	-	-	-	1	-	-
Total	0	35	71 2/	117	31	7
Total Volume (cc)	-	T	0.2	0.2+T	T	T
Ave. no./sq. ft.	-	17	35	39	10	2
Ave. vol./sq. ft. (cc)	-	T	0.1	0.07+T	T	T

2/ one vial missing from sample

March/April 1971

Location No. sq. ft. sampled	Flesher 3	Alice Creek 2	Hogum 3	Poorman Creek 3	Dalton 3	Canyon 3
OLIGOCHAETA and NEMATODA	0	1	0	44	71	12
Total Volume (cc)		T		1.9+T	0.1+T	T
Grand Total	1066	2576	6050	2863	1600	2652
Volume (cc)	2.0	5.6+T	6.8	11.5+T	5.0+T	7.4+T
Ave. no./sq. ft.	355	1288	2017	954	533	854
Ave. vol./sq. ft. (cc)	0.67	2.80+T	2.24	3.84	1.66	2.47+T

August 1971

Station No. sq. ft. sampled	Pop's 3	Flesher 3	Alice Creek @ 200 3	Alice Creek @ N.F. Bndy 3	Hogum 3	Below Landers Fork 3	Poorman Creek 3	Dalton 3	Canyon 3
				Number of Individuals					
PLECOPTERA									
Pteronarcella	-	-	-	-	-	11	2	12	5
Nemoura	88	663	113	24	174	11	396	3	3
Capnia	-	5	6	-	-	1	-	-	-
Isoperla	-	-	-	-	-	-	-	-	-
Arcynopteryx	-	2	39(2)	17(2)	3	1	-	-	11
Acroneuria	1	1	15(2)	1	10(2)	9	58	4	5
Classenia	-	2	-	-	25	1	-	-	1
Alloperla	21	192	256	-	366	145	28	17	28
Brachyptera	-	-	-	-	-	-	-	-	-
Isogenus	13	2	5(2)	-	2	3	3	1	-
Hastaperla	-	-	-	-	-	-	-	-	-
Paraperla	4	-	-	-	-	-	-	2	1
Eucapnopsis	-	-	-	204	-	-	11	-	-
Chloroperlidae	-	-	-	-	-	-	-	-	-
Perlodidae		1	-	-	-	5	-	-	-
Unknown		3	-	2	-	-	-	-	-
Final Total	127	872	434	248	580	187	498	39	52
Total Volume (cc)	3T	1.1	0.8	0.2+T	2.0	0.3	1.4+T	3T	0.3+T
Ave no./sq. ft.	42	291	145	83	193	62	166	13	17
Ave vol./sq. ft. (cc)	T	0.37	0.27	.07+T	0.67	0.1	.47+T	T	0.1+T
EPHEMEROPTERA									
Baetis	1	70	267	171	204	198	507	447	298
Paraleptophlebia	-	-	54	-	-	-	14	-	2
Ephemerella	-	1	143(6)	88(6)	157(5)	327(6)	54(4)	57(3)	18(3)
Rhithrogena	-	-	33	-	5	513	60	132	437
Cinygmula	-	-	344	537	390	52	258	6	-
Epeorus	-	-	2	91(2)	-	108(2)	33(2)	1	-
Ameletus	-	-	-	3	-	-	-	-	-
Final Total	1	71	843	890	756	1198	926	643	755
Total Volume (cc)	T	0.1+2T	0.4	2.2	0.3	2.1	0.6	0.5	0.4
Ave no./sq. ft.	0.3	24	281	297	252	399	309	214	252
Ave vol./sq. ft. (cc)	T	0.03+T	0.13	0.73	0.1	0.7	0.2	0.17	0.13
TRICOPTERA									
Glossosoma		-	41	2	53	140	3	53	5
Brachycentrus	-	34	17	-	169	11	-	106	2
Hydropsyche	-	49	283	-	1790	5	-	-	1
Arctopsyche	-	50	72	-	68	102	102	29	9
Rhyacophila	1	7	20(3)	1	46(2)	6	29(2)	-	-
Psychoronia	-	-	-	-	-	-	-	-	-
Lepidostoma	-	1	29	-	17	-	-	-	-
Hydroptila	-	-	-	-	-	-	1	-	-
Limnephilidae	-	17(2)	62(2)	-	120	1	6	12(2)	1
Parapsyche	1	-	-	-	3	-	-	-	-
Tinodes	-	1	-	-	-	19	73	13	1
Chimarra	-	-	1	-	1	-	-	-	-
Ochrotrichia	-	-	1	-	-	-	-	-	-
Psychomyiidae	-	-	-	2	4	-	-	-	-
Anagapetus	-	-	-	-	1	-	-	-	-
Unknown	2	2	37	-	16	13	3	-	-
Final Total	4	161	563	5	2288	297	217	213	19
Total Volume (cc)	2T	0.5	1.1	2T	3.2	1.3	0.7+T	0.1+2T	3T
Ave no./sq. ft.	1.3	54	188	1.7	763	99	72	71	6.3
Ave vol./sq. ft. (cc)	T	0.17	0.37	T	1.07	0.43	0.23+T	0.03+T	T

August 1971

Station No. sq. ft. sampled	Pop's 3	Flesher 3	Alice Creek @ 200 3	Alice Creek @ N.F. Bndy 3	Hogum 3	Below Landers Fork 3	Poorman Creek 3	Dalton 3	Canyon 3
				Number of Individuals					
DIPTERA									
Simuliidae	4	14	50	-	96	15	1299	222	6
Atherix	-	-	-	-	-	-	-	20	15
Hexatoma	-	1	9	-	4	8	-	1	51
Empididae	-	-	3	-	4	1	34(3)	7(2)	3(2)
Brillia	6	25	13	24	22	5	157	1	2
Rhabdomastix	-	-	-	-	-	-	-	-	-
Orthocladius[1]	12	27	158(3)	30(2)	95(2)	3	39	-	-
Dicranota	-	-	-	-	-	-	-	-	-
Metriocnemus	-	11	68	11	79	6	55	30	-
Antocha	-	47	162	-	11	-	2	-	-
Cardiocladius	4	-	31	3	18	47	5	4	-
Pericoma	-	55	158	-	49	1	24	-	-
Tanytarsus[2]	-	25	6	-	130	17	15	3	4
Pentaneura	-	1	-	-	-	-	1	-	-
Diamesa	-	-	-	-	-	-	-	-	-
Heleinae	-	-	-	-	-	-	-	-	-
Chironomidae	-	189	49	-	34	18	251	64	13
Helidae	-	2	-	-	-	-	-	-	-
Polymeda	-	-	-	2	-	-	-	-	-
Muscidae	-	-	-	-	-	1	-	-	-
Tipulidae	-	-	-	-	-	-	-	2	-
Final Total	26	397	707	70	542	122	1882	354	94
Total Volume (cc)	3T	3T	1.1	2T	0.2+T	0.4+T	1.1	0.5	0.5
Ave no./sq. ft.	8.7	132	236	23	181	41	627	118	31
Ave vol./sq. ft. (cc)	T	T	0.37	T	0.07+T	0.13+T	0.37	0.17	0.17

1/ Formerly called Hydrobaenus

2/ Formerly called Calopsectra

COLEOPTERA									
Optioservus	1	1	75	1	184	18	11	28	2
Heterlimnius	3	-	28	-	7	-	97	2	-
Zaitzevia	1	26	19	2	181	-	2	1	-
Cleptelmis	-	-	-	-	7	-	-	10	-
Brychius	-	-	1	-	-	-	6	-	-
Lara	-	1	-	-	-	-	-	-	-
Narpus	-	-	-	-	11	-	11	1	-
Final Total	5	28	123	3	390	18	127	42	2
Total Volume (cc)	2T	3T	0.1+2T	T	0.1+2T	3T	3T	3T	2T
Ave no./sq. ft.	1.7	9.3	41	1	130	6	42	14	0.7
Ave vol./sq. ft. (cc)	T	T	0.03+T	T	0.03+T	T	T	T	T

OLIGOCHAETA and NEMATODA	-	4	2	38	4	3	43	57	26
Total Volume (cc)	-	T	2T	2T	T	T	3T	2T	T
Ave no./sq. ft.	-	1.3	0.67	13	1.3	1	14	19	9
Ave vol./sq. ft. (cc)	-	T	T	T	T	T	T	T	T

Grand Total									
No.	163	1533	2672	1254	4560	1825	3693	1348	948
Vol.	11T	1.7+9T	3.5+4T	2.4+8T	5.8+4T	4.1+5T	3.8+8T	1.1+10T	1.2+7T
Ave no./sq. ft.	54	511	891	418	1520	608	1231	449	316
Ave vol./sq. ft. (cc)	$\frac{11}{3}T$	0.57+3T	$1.17+\frac{4}{3}T$	$0.8+\frac{8}{3}T$	$1.93+\frac{4}{3}T$	$1.37+\frac{5}{3}T$	$1.27+\frac{8}{3}T$	$0.37+\frac{10}{3}T$	$0.4+\frac{7}{3}T$

October/November 1971

Station No. sq. ft. sampled	Pop's 3	Flesher 3	Alice Creek @ 200 3	Bogum 3	Below Landers Fork 3	Poorman Creek 3	Dalton 3	Canyon 3	Rainbow Bend 3
					Number of Individuals				
PLECOPTERA									
Pteronarcys	-	-	-	-	-	-	-	-	5
Pteronarcella	-	-	-	-	2	2	40	23	-
Nemoura	62	81	77	38	14	1504	29	24	1
Capnia	-	28	25	8	35	6	4	6	-
Isoperla	-	2	-	21	-	16	17	65	44
Arcynopteryx	-	3	5	-	3(2)	-	-	4	1
Acroneuria	-	7(2)	9(2)	27	9(3)	62	50(2)	16	17(2)
Claassenia	-	4	-	15	2	-	-	-	1
Alloperla	54	243	186	217	129	79	174	88	10
Brachyptera	-	-	-	-	42	4	6	21	-
Isogenus	24	15	43	13	9(2)	15	3	-	3
Hastaperla	-	-	-	-	-	-	-	-	-
Paraperla	5	6	-	-	2	-	5	2	-
Eucapnopsis	18	-	-	-	-	-	-	-	31
Chloroperlidae	-	-	5	-	-	-	-	-	-
Perlodidae	-	-	-	-	2	-	-	-	2
Leuctra	-	46	-	-	-	-	-	-	-
Unknown	-	-	-	-	4	-	-	-	-
Final Total	163	435	350	339	253	2468 1/	328	249	115
Total Volume (cc)	0.4	1.2	0.9	1.2	1.3	7.1	2.4	1.5	1.3
Ave. no./sq. ft.	54	145	117	113	84	823	109	83	38
Ave. vol./sq. ft. (cc)	0.13	0.40	0.30	0.40	0.43	2.37	0.8	0.5	0.43

1/ Total includes 780 Plecoptera which dried up in one square foot sample and were not identified.

Station	Pop's	Flesher	Alice Creek @ 200	Bogum	Below Landers Fork	Poorman Creek	Dalton	Canyon	Rainbow Bend
EPHEMEROPTERA									
Baetis	-	157	173(2)	258(2)	193	1037(2)	150(2)	126	24
Paraleptophlebia	-	-	36	10	-	59	2	7	3
Ephemerella	-	3	268(5)	534(3)	344(3)	180(4)	67(4)	174(3)	198(2)
Rhithrogena	-	-	30	12	1015	144	1386	767	90
Cinygmula	-	57	268	528	221	1381	130	347	5
Epeorus	-	-	-	-	-	1	-	-	52
Ameletus	-	-	-	-	-	1	1	-	8
Heptagenia	-	-	-	-	-	-	-	-	1
Unknown	-	-	-	-	-	-	-	1	-
Final Total	-	217	775	1342	1773	2803	1736	1422	381
Total Volume (cc)	-	3T	1.4	0.9	3.1	2.8	2.6	2.2	0.3+T
Ave. no./sq. ft.	-	72	258	447	591	934	579	474	127
Ave. vol./sq. ft. (cc)	-	T	0.47	0.3	1.0	0.93	0.87	0.73	0.1+T/3
TRICOPTERA									
Glossosoma	-	2	237	329	626	164	294	132	1
Brachycentrus	-	102	133	86	1	9	29	20	-
Hydropsyche	1	30	420	1398	276	5	70	455	314
Arctopsyche	2	2	30	9	68	359	92	48	-
Rhyacophila	-	8(2)	54(2)	47(2)	3(2)	133(2)	6	-	2
Psychoronia	-	-	-	-	-	-	-	-	-
Lepidostoma	-	-	-	83	-	4	-	1	-
Hydroptila	-	1	-	-	-	5	-	-	-
Limnephilidae	-	3	5(2)	45(3)	5(2)	1	13	7	-
Parapsyche	1	-	-	-	-	-	-	-	5
Tinodes	-	-	-	-	1	1	-	-	-
Chimarra	-	-	9	-	-	-	-	-	-
Ochrotrichia	-	-	-	-	-	-	-	-	-
Psychomyiidae	-	-	-	-	-	-	-	-	1
Anagapetus	-	-	-	-	-	-	-	-	-
Agraylea	-	-	-	-	-	-	-	-	2
Unknown	-	-	7	7	-	-	-	-	-
Final Total	4	148	895	2004	980	681	504	663	325
Total Volume (cc)	2T	0.3	3.6	4.4	2.1	6.3	2.8	1.6	1.5
Ave. no./sq. ft.	1.3	49	298	668	327	227	168	221	108
Ave. vol./sq. ft. (cc)	2T/3	0.1	1.2	1.47	0.7	2.1	0.93	0.53	0.5

October/November 1971

Station	Pop's	Flesher	Alice Creek @ 200	Hogum	Below Landers Fork	Poorman Creek	Dalton	Canyon	Rainbow Bend
No. sq. ft. sampled	3	3	3	3	3	3	3	3	3
				Number of Individuals					
DIPTERA									
Simuliidae	-	-	62	2	4	9	38	16	-
Atherix	-	-	-	-	-	-	6	28	-
Hexatoma	-	5	9	5	22	-	1	25	1
Empididae	-	1	7	8	8(4)	58(2)	7	-	1
Brillia	-	-	5	-	-	7	-	-	-
Rhabdomastix	-	-	-	-	-	-	-	-	-
Orthocladius	-	32(several)	774(several)	3548(several	22	256(several)	8	6	15
Dicranota	-	4	-	1	1	7	-	1	-
Metriocnemus	1	-	2	-	-	14	-	-	2
Antocha	1	351	418	151	3	340	31	4	1
Cardiocladius	-	-	-	-	2	-	-	-	-
Pericoma	-	208	481	326	62	183	3	-	-
Tanytarsus	-	-	-	-	-	-	-	-	-
Pentaneura	-	-	-	-	-	-	-	-	4
Diamesa	-	-	-	-	-	-	-	-	-
Helainae	-	-	-	-	-	-	-	-	-
Chironomidae	25	-	-	-	-	-	-	3	40
Dolichopodidae	-	-	-	-	-	-	-	-	1
Tanypodinae	-	8	-	1	-	-	-	-	-
Tanytarsini	-	1	2	3	-	-	-	-	-
Pentaneurini	-	-	-	-	-	2	-	-	-
Final Total	27	610	1760	4045	124	876	94	83	65
Total Volume (cc)	3T	0.6	0.4 + T	2.7	1.1	1.0	0.2 + T	0.5	0.4 + 2T
Ave No/sq ft	9	203	587	1348	41	292	31	28	22
Ave Vol/sq ft (cc)	T	0.2	$0.13 + \frac{T}{3}$	0.9	0.37	0.33	$0.06 + \frac{T}{3}$	0.17	$0.13 + \frac{2T}{3}$
COLEOPTERA									
Optioservus	-	-	107	161	3	7	5	2	-
Heterlimnius	-	-	38	7	-	181	1	-	-
Zaitzevia	1	-	26	78	1	2	-	1	5
Cleptelmis	-	-	-	1	-	-	-	-	-
Brychius	-	-	-	-	-	21	-	-	-
Lara	-	-	-	-	-	-	-	-	-
Narpus	-	-	-	4	1	7	-	-	-
Final Total	1	0	171	251	5	218	6	3	5
Total Volume (cc)	T	0	0.1+2T	0.3	3T	0.2+T	2T	3T	2T
Ave. no./sq. ft.	0.3	0	57	84	1.7	73	2	1	1.7
Ave. vol./sq. ft. (cc)	$\frac{T}{3}$	0	$0.03+\frac{2T}{3}$	0.10	T	$0.06+\frac{T}{3}$	$\frac{2T}{3}$	T	T
OLIGOCHAETA and NEMATODA	-	4	3	11	7	101	27	64	14
Final Total	0	4	3	11	7	101	27	64	14
Total Volume (cc)	0	2T	3T	3T	3T	0.9	3T	3T	3T
Ave. no./sq. ft.	0	1.3	1	3.7	2.3	34	9	21	4.7
Ave. vol./sq. ft.	0	$\frac{2T}{3}$	T	T	T	0.3	T	T	T
Grand Total									
No.	195	1414	3954	7992	3142	7147 2/	2695	2484	905
Vol.	0.4+6T	2.1+5T	6.4+6T	9.5+3T	7.6+5T	18.3+T	8.0+6T	5.8+6T	3.5+8T
Ave. no./sq. ft.	65	471	1318	2664	1047	2382	898	828	302
Ave. vol./sq. ft. (cc)	0.13+2T	$0.7+\frac{5T}{3}$	2.1+2T	3.17+T	$2.53+\frac{5T}{3}$	$6.1+\frac{T}{3}$	2.67+2T	1.93+2T	$1.17+\frac{8T}{3}$

2/ Includes 780 Plecoptera which were not identified. See footnote 1/.

Appendix S

Summary of numbers and volumes (by order) of bottom fauna collected from the Blackfoot River and tributarues in 1971, 1972 and 1973 which were not identified to species. Volume in cc. T = trace

Date		Pop's	Flesher	Alice Cr. @ N. F.	Alice Cr. @ 200	Hogum	Landers	Below Landers	Poorman Creek	Dalton	Canyon	Rainbow Bend
						PLECOPTERA						
Feb/ Mar 1972	No.		912		2282	942		309	482	225	368	241
	Vol.		2.4		4.4	1.9		1.0+T	2.5	2.7	1.7	7.4
May 1972	No.	50	133		168	234	84	143	164	154	51	
	Vol.	3T	0.4		0.2+T	0.9	0.3+T	0.7	5.2	1.2	0.1+2T	
Aug 1972	No.	75	964	93	551	484		294	231	212	195	173
	Vol.	0.1+2T	1.7	0.1+2T	1.4	1.8		1.4	1.5	0.5	2.2	9.7
Oct/ Nov 1972	No.	233	881		477	463	255	362	708	158	391	278
	Vol.	0.6	3.3		1.1	4.0	0.1+2T	0.8	2.6	2.2	3.8	6.2
May 1973	No.	63	75		292		89				141	
	Vol.	3T	3T		1.4		0.2+T				1.1	
						EPHEMEROPTERA						
Feb/ Mar 1972	No.		571		1541	1789		179	1893	1000	1214	1359
	Vol.		0.3+T		2.2	1.4		0.8+T	2.7	2.6	2.2	2.7
May 1972	No.	0	30		347	94	391	671	1439	546	301	
	Vol.	0	3T		0.9	0.2+T	3.9	2.2	6.0	1.3	2.3	
Aug 1972	No.	0	166	788	783	621		1894	1645	595	1052	851
	Vol.	0	0.1+2T	2.6	1.0	0.9		4.2	1.0	0.7	0.8	0.8
Oct/ Nov 1972	No.	0	89		716	574	796	1621	1265	758	1510	1129
	Vol.	0	3T		1.2	0.9	1.2	2.8	2.3	2.2	2.6	1.5
May 1973	No.	3	5		889		1204				1738	
	Vol.	3T	2T		2.6		11.0				3.3	

TRICOPTERA

Date		Pop's	Flesher	Alice Creek @ N. F.	Alice Creek @ 200	Hogum	Landers	Below Landers	Poorman Creek	Dalton	Canyon	Rainbow Bend
Feb/ Mar 1972	No.		296		786	1164		90	506	779	628	740
	Vol.		1.4		3.8	2.5		0.6	3.5	1.0	1.6	2.7
May 1972	No.	0	9		377	136	688	16	316	422	134	
	Vol.	0	3T		1.9	0.7	6.7	0.1+2T	6.7	1.3	0.2+T	
Aug 1972	No.	1	173	11	406	681		281	218	82	93	808
	Vol.	T	0.7	3T	2.7	1.4		2.4	0.3	0.1+2T	0.2+T	3.6
Oct/ Nov 1972	No.	4	180		961	354	192	253	431	379	311	766
	Vol.	2T	0.4		3.0	1.9	0.8	2.9	5.5	1.5	1.1	4.4
May 1973	No.	0	34		665		36				505	
	Vol.	0	0.2+T		3.0		1.7				2.0	

DIPTERA

Date		Pop's	Flesher	Alice Creek @ N. F.	Alice Creek @ 200	Hogum	Landers	Below Landers	Poorman Creek	Dalton	Canyon	Rainbow Bend
Feb/ Mar 1972	No.		402		2642	5483		41	607	169	94	448
	Vol.		1.0		3.2	2.1		1.5	1.1	1.1+T	0.5	0.6
May 1972	No.	0	384		778	700	62	476	1991	472	174	
	Vol.	0	0.5		1.5	1.5	0.2+T	1.5	4.3	2.4	0.1+2T	
Aug 1972	No.	11	1000	68	571	716		5715	800	496	234	129
	Vol.	3T	1.8	0.2+T	1.4	0.2+T		8.7	0.6	1.3+T	0.8	0.2+T
Oct/ Nov 1972	No.	17	144		640	508	7	104	284	81	320	131
	Vol.	3T	0.1+2T		2.0	0.5	3T	0.9	0.9	0.5	1.1	0.4+T
May 1973	No.	0	104		329		473				116	
	Vol.	0	0.1+2T		0.9		1.0				0.7	

COLEOPTERA

Date		Pop's	Flesher	Alice Creek @ N. F.	Alice Creek @ 200	Hogum	Landers	Below Landers	Poorman Creek	Dalton	Canyon	Rainbow Bend
Feb/Mar 1972	No.		2		102	159		5	141	38	2	2
	Vol.		2T		0.2+T	0.3		2T	0.3	0.1	2T	2T
May 1972	No.	0	0		71	49	0	2	314	4	1	
	Vol.	0	0		3T	3T	0	T	0.4	3T	T	
Aug 1972	No.	0	30	1	79	181		11	240	120	13	11
	Vol.	0	2T	T	0.2+T	0.1+2T		2T	0.1+2T	0.1+2T	3T	3T
Oct/Nov 1972	No.	0	4		83	119	0	8	86	3	5	16
	Vol.	0	2T		3T	0.1+2T	0	3T	0.2+T	2T	3T	3T
May 1973	No.	0	31		21		0				14	
	Vol.	0	0.1+2T		3T		0				2T	

OLIGOCHAETA, NEMATODA & OTHERS

Date		Pop's	Flesher	Alice Creek @ N. F.	Alice Creek @ 200	Hogum	Landers	Below Landers	Poorman Creek	Dalton	Canyon	Rainbow Bend
Feb/Mar 1972	No.		7		15	0		1	44	25	32	58
	Vol.		2T		2T	0		T	0.6	3T	3T	3T
May 1972	No.	0	0		9	4	40	1	91	2	0	
	Vol.	0	0		0.1+3T	2T	4T	T	2.4+2T	2T	0	
Aug 1972	No.	0	16	123	19	5		20	61	12	7	0
	Vol.	0	3T	1.0+T	3T	2T		4T	3T	4T	2T	0
Oct/Nov 1972	No.	1	3		6	6	0	11	11	3	48	80
	Vol.	T	2T		3T	2T	0	4T	0.3+2T	2T	5T	5T
May 1973	No.	0	36		7		5				0	
	Vol.	0	0.1+3T		0.2+3T		2T				0	

APPENDIX T

Species composition, size, and relative abundance of game and nongame fish from stream surveys, 1971-1973.

Fish were collected from larger waters with a Fisher-Shocker electrofishing unit mounted in a boat. Small streams were sampled with a Smith-Root Type IV backpack electrofisher. Total length of fish was measured to the nearest .10 inch, and weight to the nearest .01 pound.

Common and scientific names for the fish found in the study area and the abbreviations used are given below. Sculpin refers to the slimy sculpin, and Dace to the longnose dace.

Abr.	Common Name	Scientific Name 1/
Ct	cutthroat trout	Salmo clarki Richardson
Rb	rainbow trout	Salmo gairdneri Richardson
LL	brown trout	Salmo trutta Linnaeus
Eb	brook trout	Salvelinus fontinalis (Mitchell)
DV	Dolly Varden	Salvelinus malma (Walbaum)
Wf	mountain whitefish	Prosopium williamsoni (Girard)
FSu	longnose sucker	Catostomus catostomus (Forster)
CSu	large scale sucker	Catostomus macrocheilus Girard
Sculpin	slimy sculpin	Cottus cognatus Richardson
Dace	longnose dace	Rhinichthys cataractae (Valenciennes)

1/ In accordance with "Common and Scientific Names of Fishes from the United States and Canada", 3rd ed., American Fisheries Society Special Publication No. 6, 1970.

APPENDIX T continued

Stream	Location T R S	Section Length (ft)	Species	No. in Sample	Length (in) Range	Length (in) Average	Weight (lbs) Total	Weight (lbs) Average	Age Classes Present
Blackfoot River at Pop's Place August, 1973	15N 6W 19	1200	Ct	9	1.6-6.7	5.2	.49	.05	
			Eb	57	1.9-7.9	3.9	1.96	.03	
			Sculpin	4	3.1-4.7	3.7	.10	.03	
Blackfoot River - below Pop's Place section 1/ Sept-Oct, 1971	15N 6W 19, 15N 7W 24	3486	Ct	219	1.8-9.8	4.4	9.81	.04	0 - III
			Eb	134	2.2-10.4	5.0	9.44	.07	0 - III
			FSu	2	5.7-6.7	-	.21	.10	
			Sculpin	6	not recorded		not recorded		
Blackfoot River - Flesher section 1/ Aug-Sept, 1973	15N 7W 35	2455	Ct	185	1.5-10.9	3.7	6.55	.04	
			Eb	108	2.0-9.1	3.8	3.81	.04	
			Wf	10	2.7-3.3	3.0	.10	.01	
			FSu	8	4.5-6.5	5.4	.53	.07	
			Sculpin	43	1.2-4.3	3.1	.66	.02	
Blackfoot River - below Willow Creek Section 1/ Aug-Sept, 1973	15N 7W 34, 35	1500	Ct	69	1.6-11.7	4.8	4.53	.06	
			Eb	102	2.0-11.0	4.4	5.30	.05	
			Wf	1	2.6		.01		
			FSu	14	4.3-7.1	5.7	1.06	.08	
			Sculpin	64	1.7-5.3	2.5	.59	.01	
			Dace	1	4.3		.04		

1/ See population estimate results in Appendix U .

Stream	Location T R S	Section Length (ft)	Species	No. in Sample	Length (in) Range	Length (in) Average	Weight (lbs) Total	Weight (lbs) Average	Age Classes Present
Blackfoot River -			Ct	131	1.7-13.5	3.7	8.05	.06	0 - IV
Hogum section 1/	14N 7W 5	4100	Eb	74	2.7-9.9	5.2	5.18	.07	0 - II
			Rb(H)*	3	9.4-10.6	10.1	1.25	.42	
			LL	1	6.5		.08		II
Aug-Sept, 1972			DV	7	6.5-16.8	9.6	2.99	.43	II - IV
			Wf	106	2.6-15.9	10.0	52.24	.49	0 - V
			FSu	9	4.7-6.7	5.8	.66	.07	
			CSu	5	5.3-11.6	8.1	1.30	.26	
			Sculpin	422	1.1-4.8	(only smallest and largest measured)			
			Dace	19	2.5-5.6	4.3	.61	.03	
* * *									
	14N 7W 5	4100	Ct	87	1.7-13.6	4.4	5.84	.07	0 - III
			Eb	84	2.6-8.1	3.8	2.67	.03	0 - II
			Rb(H)*	18	10.8-12.3	11.4	10.35	.58	
			DV	3	6.8-13.6	11.2	1.98	.66	I, II, IV
Sept, 1973 1/			Wf	31	2.7-13.5	3.8	2.05	.07	0, III, IV
			FSu	6	2.5-6.4	4.7	.32	.05	
			Dace	6	3.0-5.0	4.1	.17	.03	
			Sculpin	numerous	not measured		not measured		

*Hatchery raised to catchable size before stocking

APPENDIX T continued

Stream	Location T R S	Section Length (ft)	Species	No. in Sample	Length (in) Range	Length (in) Average	Weight (lbs) Total	Weight (lbs) Average	Age Classes Present
Blackfoot River at Stemple Bridge in Lincoln 1/	14N 9W 24	800	Ct	37	2.1-9.3	5.5	2.91	.08	
			Eb	2	5.0-7.7		.19	.10	
April, 1971			DV	7	6.3-17.2	9.8	2.73	.39	
			LL	26	2.8-18.0	13.5	18.66	.72	
			Wf	3	3.6-4.4	4.1	.04	.01	
			FSu	1		5.4	not weighed		
			Sculpin	5		not measured			
Blackfoot River - Poorman-Dalton Section 1/	14N 9W 26	5350	Ct	11	3.5-11.6	7.4	3.40	.31	0 - III
			Eb	84	2.4-11.2	4.2	4.11	.05	0 - II
			Rb	6	6.9-10.9	9.0	1.87	.31	I, II
			LL	364	2.2-17.8	7.6	117.42	.32	0 - V
Aug-Sept, 1971 1/			Sculpin	present but not tallied					
* * *									
	14N 9W 26	5700	Ct	51	3.4-11.8	5.2	4.31	.08	0 - II
			Eb	127	2.3-11.8	5.4	10.15	.08	0 - II
			Rb	2	6.4-7.2		.23	.12	
			DV	7	6.3-13.3	8.0		.20	
Aug-Sept, 1972			LL	407	1.9-20.3	9.6	135.13	.33	0 - IV
			Wf	present but not tallied					
			FSu	present but not tallied					
			Sculpin	present but not tallied					
Blackfoot River - Canyon section 1/	14N 10W 26, 27,34	10,725	Ct	1		7.5		.12	
			Eb	1		5.7		.07	
Sept, 1971			DV	4	7.2-7.8	7.4	.45	.11	
			LL	221	2.4-18.3	9.4	126.54	.57	0 - V
			Wf	79	2.3-16.6	11.9	50.56	.64	

APPENDIX T continued

Stream	Location T R S	Section Length (ft)	Species	No. in Sample	Length (in) Range	Length (in) Average	Weight (lbs) Total	Weight (lbs) Average	Age Classes Present
Beartrap Creek									
(1) above White Hope Mine August 16, 1972	15N 6W 27 two sections combined	400	Ct	13	2.9-4.4	3.5	.25	.02	
(2) between tailings dam and Mike Horse Creek July 26, 1972	15N 6W 27	300	Ct	36	4.0-9.4	6.9	4.74	.13	
(3) below Mike Horse Creek July 26, 1972	15N 6W 27	400	No fish caught or observed. Mine drainage enters from Mike Horse Creek.						
Blackfoot River below confluence of Beartrap and Anaconda Creeks August 16, 1972	15N 6W 28	350	No fish caught or observed. Mine drainage still prevails in this section.						

APPENDIX T continued

Stream	Location T R S	Section Length (ft)	Species	No. in Sample	Length (in) Range	Length (in) Average	Weight (lbs) Total	Weight (lbs) Average	Age Classes Present
Anaconda Creek July 26, 1972	15N 6W 27	250	Ct	37	1.7-7.0	4.8	1.95	.05	
			Eb	2	5.5-6.9		.21	.11	
Shoue (Shave) Gulch July 26, 1972	15N 6W 21	800	Ct	116	2.2-6.7	4.3	4.17	.04	0 - II
Pass Creek July 27, 1972	15N 6W 16	920	Ct	83	1.4-6.4	3.1	1.30	.02	0 - II
	two sections combined		Eb	30	3.5-6.6	3.5	1.58	.05	0 - II
			Sculpin	3	1.5-3.0	2.3	.02	.01	
Cadotte Creek August 29, 1973	15N 7W 13	shocked in scattered pools and beaver dams only	Eb	13	7.1-10.7	8.5	3.73	.29	
Willow Creek (Flesher)									
(1) above Sandbar Creek August 21, 1973	14N 6W 8	1400	Ct	224	2.6-7.7	4.2	7.72	.03	
			Eb	102	1.9-8.6	3.9	3.06	.03	
			Sculpin	167	1.5-4.5	2.8	1.03	.01	
* * *									
(2) below Sandbar Creek August 22, 1973	14N 7W 1	900	Ct	82	1.6-9.0	4.9	4.30	.05	
			Eb	58	2.3-7.9	4.9	3.00	.05	
			Sculpin	166	1.8-4.6	2.6	1.09	.01	
* * *									

APPENDIX T continued

Stream	Location T R S	Section Length (ft)	Species	No. in Sample	Length (in) Range	Length (in) Average	Weight (lbs) Total	Weight (lbs) Average	Age Classes Present
(3) at mouth August 24, 1973	15N 7W 35	1028	Ct	48	1.8-11.3	5.1	2.93	.06	
			Eb	36	2.3-11.3	5.5	3.15	.09	
			FSu	2	4.6-7.0		.17	.08	
			Sculpin	38	1.8-4.3	2.7	.21	.00+	
Alice Creek									
(1) at USFS Guard Station July 25, 1972	16N 7W 14	790 (.21 acre)	Ct	94	2.0-8.6	5.7	6.85	.07	0 - II
			Eb	1		9.0		.39	
			Sculpin	16	3.0-4.3	3.8	.43	.03	
* * *									
(2) below Wildcat Gulch $\frac{1}{4}$ mile August 1, 1972	16N 7W 22	500	Ct	1		4.5		.05	
			Eb	1		8.2		.22	
			Sculpin	23	2.5-4.2	3.3	.40	.02	
* * *									
(3) above National Forest Boundary $\frac{1}{2}$ mile August 1, 1972	16N 7W 27	490 two sections combined	Ct	54	2.1-9.0	3.9	1.93	.03	0 - II
			Eb	15	5.1-10.0	6.5	2.02	.13	I - III
			Sculpin	5	2.4-3.8	3.0	.08	.02	
* * *									
(4) on Fickler Ranch August 17, 1972	15N 7W 4	700	Ct	12	3.0-8.3	4.8	.58	.05	0 - II
			Eb	73	1.9-11.3	5.6	7.64	.10	0 - III
			Wf	4	7.8-12.9	10.7	1.97	.49	I,II,V
			FSu	5	3.2-10.0	5.4	.40	.08	
			Sculpin	25	1.7-4.1	3.0	.40	.02	

APPENDIX T continued

Stream	Location T R S	Section Length (ft)	Species	No. in Sample	Length (in) Range	Length (in) Average	Weight (lbs) Total	Weight (lbs) Average	Age Classes Present
(5) Bartlett	15N 7W 27	1880	Ct	353	1.7-9.7	4.8	18.74	.05	0 - III
Section 1/			Eb	163	2.5-12.5	4.8	9.66	.06	0 - II
September, 1971			DV	1		6.8		.10	
			Wf	77	2.5-10.2	4.6	4.19	.05	0 - III
			FSu	1		4.3		.04	
			Sculpin	214	?-5.0	only largest measured			
* * *									
(6) Bartlett	15N 7W 27	2779	Ct	271	1.6-10.5	4.9	16.69	.06	0 - III
Section 1/			Eb	166	2.1-10.3	4.8	10.61	.06	0 - III
August, 1972			DV	2	5.4-7.1		.15	.08	
			Wf	7	2.3-7.1	3.9		.03	
			FSu	10	5.0-7.3	5.8		.07	
			CSu	1		8.5		.23	
			Sculpin	numerous-not counted or measured					
* * *									
(7) Bartlett	15N 7W 27	2295	Ct	384	1.6-10.5	4.4	16.85	.04	0 - III
Section 1/			Eb	273	2.1-12.0	4.1	12.16	.04	0 - III
September, 1973			DV	2	6.8-9.9		.47	.24	II, II
			Wf	10	2.5-3.5	3.1		.04	all age 0
			FSu	19	3.8-6.1	4.7		.04	
			CSu	26	3.7-6.9	5.1		.06	
			Sculpin	numerous	4.4-5.8	4.7 (only six were measured)			
Hardscrabble Creek									
(1) at Spencer Bar	15N 7W 21	450	Eb	1		9.6		.36	
July 31, 1972			FSu	15	1.4-5.5	3.6	.33	.02	
* * *									

APPENDIX T continued

Stream	Location T R S	Section Length (ft)	Species	No. in Sample	Length (in) Range	Length (in) Average	Weight (lbs) Total	Weight (lbs) Average	Age Classes Present
(2) up Alice Creek road ½ mile (below beaver dams) August 1, 1972	15N 7W 28, 33	400	Ct	2	3.5-3.7		.03	.02	
			Eb	93	1.5-6.7	5.1	2.90	.03	
			Wf	3	2.4-5.1	4.0	.06	.02	
			FSu	20	3.5-5.8	4.6	.74	.04	
			Sculpin	203	1.5-4.6	(only largest and smallest measured)			
			Many additional small sculpins not collected.						
* * *									
(3) near mouth (north of highway) July 31, 1972	15N 7W 33	430	Eb	64	1.8-7.6	3.9	1.95	.03	0 - II
			Wf	6	2.4-5.4	3.7	.10	.02	0 , I
			FSu	8	3.7-5.3	4.5	.24	.03	
			Sculpin	154	1.6-4.0	2.6	1.44	.01	
Hogum Creek September 10, 1973	14N 7W 8	1051	Ct	52	1.9-8.4	4.8	2.67	.05	
			Eb	34	2.3-8.3	5.6	2.81	.08	
			DV	2	5.5-7.7		.21	.10	
			FSu	1		5.0		.05	
			Sculpin	59	1.6-4.2	2.7	.43	.01	
Copper Creek									
(1) at Sucker Creek Road August 23, 1973	15N 8W 25, 26	1225	Ct	5	4.7-11.5	8.1	1.44	.29	
			DV	9	4.0-8.3	5.3	.47	.05	
			Sculpin	25	2.3-4.7	3.2	.37	.01	
* * *									
(2) near mouth August 22, 1973	15N 8W 36	2100	Ct	2	3.2-3.4		.02	.01	
			Eb	3	2.4-3.0	2.6	.01	.00+	
			DV	10	2.4-6.0	3.6	.19	.02	
			Wf	1		2.9		.00+	
			Sculpin	23	2.3-3.7	3.0	.26	.01	

APPENDIX T continued

Stream	Location T R S	Section Length (ft)	Species	No. in Sample	Length (in) Range	Length (in) Average	Weight (lbs) Total	Weight (lbs) Average	Age Classes Present
Landers Fork									
(1) below Copper Creek road bridge September 10, 1973	15N 8W 36	1500		No fish caught or observed. Habitat water present only in pools, with very little flow in between. Stream dry at end of section.					
* * *									
(2) at Highway 200 September 10, 1973	14N 8W 12	2500	Ct	15	2.9-7.3	4.9	.85	.06	
			Eb	7	3.4-8.6	6.9	1.19	.17	
			DV	2	2.9-6.5		.08	.04	
			Sculpin	12	2.2-4.4	3.0	.17	.01	
Poorman Creek									
(1) Circle City Section 1/ September, 1972	13N 8W 6	1760	Ct	570	1.6-10.3	4.8	30.31	.05	0 - III
			Eb	77	2.6-11.2	4.5	4.08	.05	0 - II
			DV	2	7.1-11.3		.68	.34	both age II
			Wf	36	3.7-13.9	10.6	20.65	.57	0 - III and older
			LL	1		4.8		.04	
			Sculpin	112	1.3-5.4	(only largest and smallest measured)			
* * *									
(2) at Circle City September 13, 1973	13N 8W 6	500	Ct	80	1.6-11.3	4.8	4.67	.06	
			Eb	42	2.0-8.0	3.3	.96	.02	
			DV	5	12.3-16.4	14.6	5.58	1.12	
			Wf	1		9.1		.25	
			Sculpin	numerous - not collected					
Arrastra Creek July 24, 1972	15N 10W 24	±200	Ct	15	5.0-8.7	6.7	2.02	.13	
			DV	2	8.8-12.0		.76	.38	
				(5 Ct and 1 DV caught by hook and line)					

APPENDIX U

Population estimates were derived by the Petersen mark-recapture technique using the method described by Vincent (1971 and 1974). Estimates made prior to September 28, 1973 were derived from the following formula using a computer program:

$$N = \frac{(M+1)\ (C+1)}{R+1}$$

Where
- N = Population estimate
- M = Number of fish marked
- C = Number of fish in recapture sample
- R = Number of marked fish in recapture sample (C)

Estimates made subsequent to September 28, 1973 were derived by using Chapman's (1951) modification of the Petersen formula in the computer program as follows:

$$N = \frac{(M+1)\ (C+1)}{R+1} - 1$$

In this study, however, scales were collected at 1.0 inch length intervals instead of 1/10 inch intervals as described by Vincent (1974).

When possible, the population was divided into more than one length group for purposes of making the estimate. Whether this was possible depended on the number of marked recoveries (R) obtained for the various sizes of fish.

Where recoveries were low, length groups often had to be combined to obtain a reliable estimate of the total fish population. The purpose of this procedure was to obtain the most reliable estimate of the total population. Consequently length group breakdown is not necessarily consistent for the same station for different years because of differences in efficiency of sampling the various sizes of fish each year. Twenty scales were collected for each inch-class whenever possible.

Confidence limits are given at the 80 percent probability level. Figures in parentheses are the confidence limits in percent. The level of accuracy sought was 25 percent.

Confidence limits for the total are not the sum of the confidence limits for each component; rather they are approximately the square root of the sum of their squares.

Total-number figures are only for those fish species and age classes which could be estimated. In some cases other game fish were present in the population but were too few in number to be reliably estimated, or they were not thought to be permanent residents of the stream section.

Species	Age Class	Average Length (in)	Average Weight (lbs)	Number Estimate	Weight Estimate (lbs)
Blackfoot River below Pop's Place, 1971 (Section Length 3486 feet)					
Ct	0	Present, but recoveries insufficient for estimate			
	I	4.4	.03	131	3.87
	II	6.2	.09	89	8.32
	III and older	7.5	.18	13	2.27
Total				233	14.46
Total per 1000 feet				67	4.15
Eb	0	Present, but recoveries insufficient for estimate			
	I	4.7	.04	50	1.96
	II	6.4	.11	112	12.29
	III and older	7.9	.20	22	4.31
Total				184±45 (24%)	18.56±5 (27%)
Total per 1000 feet				53	5.32
Grand Total - yearlings and older				417	33.02
Grand Total per 1000 feet - yearlings and older				120	9.47

Species	Age Class	Length Group	Number Estimate	Weight Estimate (lbs)
Blackfoot River, Flesher Section, 1973 (Section Length 2455 feet)				
Ct	not	1.5 - 4.9	380	6
	aged	5.0 - 10.9	58	6
Total			438±99 (23%)	12±2 (17%)
Total per 1000 feet			178	4.89
Eb	not	2.0 - 4.9	231	3
	aged	5.0 - 9.1	35	3
Total			266±84 (32%)	6±2 (33%)
Total per 1000 feet			108	2.44
Grand Total			704±130 (18%)	18±3 (17%)
Grand Total per 1000 feet			287	7.33
Blackfoot River, below Willow Creek Section, 1973 (Section Length 1500 feet)				
Ct	not	1.6 - 4.9	60	1
	aged	5.0 - 11.7	39	5
Total			99±20 (20%)	6±1 (17%)
Total per 1000 feet			66	4
Eb	not	2.0 - 4.9	193	4
	aged	5.0 - 11.0	42	5
Total			235±74 (31%)	9±2 (22%)
Total per 1000 feet			157	6
Grand Total			334±77 (23%)	15±2 (13%)
Grand Total per 1000 feet			223	10

Species	Age Class	Average Length (in)	Average Weight (lbs)	Number Estimate	Weight Estimate (lbs)
Alice Creek - Bartlett Section, 1971 (Section Length 1880 feet)					
Ct	0	3.0	.01	295	3.52
	I	4.7	.04	360	14.07
	II	6.8	.12	102	12.27
	III and older	9.0	.28	6	1.71
Total				763±131 (17%)	31.57±4 (13%)
Total per 1000 feet				406	16.79
Eb	0	3.2	.01	105	1.55
	I	5.1	.06	204	11.22
	II and older	7.4	.19	41	7.97
Total				350±74 (21%)	20.74±4 (19%)
Total per 1000 feet				186	11.03
Grand Total				1113±150 (13%)	52.31±6 (11%)
Grand Total per 1000 feet				592	27.82
Grand Total - yearlings and older				713	47.24
Grand Total per 1000 feet - yearlings and older				379	25.12
Alice Creek - Bartlett Section, 1972 (Section Length 2779 feet)					
Ct	0	3.5	.02	338	6.52
	I	5.4	.06	190	11.41
	II	7.7	.18	54	9.54
	III and older	9.4	.32	10	3.18
Total				592±114 (19%)	30.65±5 (16%)
Total per 1000 feet				213	11.03
Eb	0	2.7	.01	119	1.27
	I	5.0	.05	141	6.85
	II	7.3	.17	37	6.39
	III and older	8.8	.29	9	2.60
Total				306±65 (21%)	17.11±3 (15%)
Total per 1000 feet				110	6.16
Grand Total				898±131 (15%)	47.76±6 (13%)
Grand Total per 1000 feet				323	17.19
Grand Total - yearlings and older				441	39.97
Grand Total - yearlings and older per 1000 feet				159	14.38

APPENDIX U continued

Species	Age Class	Average Length (in)	Average Weight (lbs)	Number Estimate	Weight Estimate (lbs)
Alice Creek - Bartlett Section, 1973 (Section Length 2295 feet)					
Ct	0	Present, but recoveries insufficient for estimate			
	I	5.5	.06	155	9.11
	II and older	7.5	.17	45	7.71
Total				209±20 (10%)	16.82±2 (12%)
Total per 1000 feet				91	7.33
Eb	0	2.9	.01	427	3.73
	I	5.4	.06	107	6.37
	II	8.3	.26	19	4.89
	III and older	12.0	.81	1	0.88
Total				554±109 (20%)	15.87±2 (13%)
Total per 1000 feet				241	6.92
Grand Total				763±111 (14%)	32.69±3 (9%)
Grand Total per 1000 feet				332	14.24
Grand Total - yearlings and older				336	28.96
Grand Total - yearlings and older per 1000 feet				146	12.62
Blackfoot River - Hogum Section, 1972 (Section Length 4100 feet)					
Ct	0	2.6	.01	203	2.99
	I	6.8	.13	19	2.60
	II and older	10.6	.55	9	4.79
Total				231±52 (22%)	10.38±1 (10%)
Total per 1000 feet				56	2.53
Eb	0	3.5	.02	46	0.89
	I	6.4	.10	57	5.76
	II and older	9.2	.33	2	0.71
Total				105±20 (19%)	7.36±1 (14%)
Total per 1000 feet				26	1.80
Grand Total				336±55 (16%)	17.74±1 (7%)
Grand Total per 1000 feet				82	4.33
Grand Total - yearlings and older				28	13.86
Grand Total - yearlings and older per 1000 feet				7	3.38

Species	Age Class	Average Length (in)	Average Weight (lbs)	Number Estimate	Weight Estimate (lbs)
Blackfoot River - Hogum Section, 1973 (Section Length 4100 feet)					
Ct	0	2.8	.01	90	1.18
	I	5.3	.07	59	4.08
	II	9.2	.34	3	1.15
	III and older	13.6	1.12	1	1.28
Total				153±42 (27%)	7.69±1 (13%)
Total per 1000 feet				37	1.88
Eb	0	3.3	.01	178	2.55
	I	6.8	.13	22	2.95
	II and older	8.1	.21	5	1.00
Total				205±69 (34%)	6.50±2 (31%)
Total per 1000 feet				50	1.58
Grand Total				358±81 (23%)	14.19±2 (14%)
Grand Total per 1000 feet				87	3.46
Grand Total - yearlings and older				90	10.46
Grand Total - yearlings and older per 1000 feet				22	2.55
Poorman Creek - Circle City Section, 1972 (Section Length 1760 feet)					
Ct	0	3.8	.02	743	16.32
	I	6.0	.08	314	24.39
	II	7.7	.18	54	9.75
	III and older	9.6	.35	13	4.52
Total				1124±123 (11%)	54.98±6 (11%)
Total per 1000 feet				639	31.24
Total - yearlings and older				381	38.66
Total - yearlings and older per 1000 feet				216	21.96

APPENDIX U continued

Species	Age Class	Average Length (in)	Average Weight (lbs)	Number Estimate	Weight Estimate (lbs)
		Blackfoot River, Poorman-Dalton Section, 1971 (Section Length 5350 feet)			
Eb	0	3.4	.02	219	3.89
	I	6.5	.11	58	6.42
	II and older	9.6	.36	10	3.73
Total				287±122 (42%)	14.04±6 (43%)
Total per 1000 feet				54	2.62
LL	0	3.1	.02	530	8.01
	I	6.3	.10	576	58.96
	II	8.0	.21	106	21.91
	III	11.8	.65	116	75.13
	IV and older	14.2	1.07	147	157.40
Total				1475±408 (28%)	321.41±70 (22%)
Total per 1000 feet				275	60.08
Grand Total				1762±426 (24%)	335.45±70 (21%)
Grand Total per 1000 feet				329	62.70
Grand Total - yearlings and older				1013	323.55
Grand Total - yearlings and older per 1000 feet				189	60.47
		Blackfoot River, Poorman-Dalton Section, 1972 (Section Length 5700 feet)			
Ct	0	4.3	.03	74	2.32
	I	8.8	.25	9	2.18
	II and older	11.3	.56	5	2.89
Total				88±24 (27%)	7.39±2 (27%)
Total per 1000 feet				15	1.30
Eb	0	Present, but recoveries insufficient for estimate			
	I	6.5	.10	93	9.69
	II and older	9.7	.36	15	5.50
Total				108±27 (25%)	15.19±4 (26%)
Total per 1000 feet				19	2.66
LL	0	Present, but recoveries insufficient for estimate			
	I	5.7	.07	434	32.54
	II	10.0	.38	84	32.05
	III and older	14.1	1.14	198	224.93
Total				716±111 (16%)	289.52±45 (16%)
Total per 1000 feet				126	50.79
Grand Total				912±117 (13%)	312.10±45 (14%)
Grand Total per 1000 feet				160	54.75
Grand Total - yearlings and older				838	309.78
Grand Total - yearlings and older per 1000 feet				147	54.35

Species	Age Class	Average Length (in)	Average Weight (lbs)	Number Estimate	Weight Estimate (lbs)
		Blackfoot River, Canyon Section, 1971 (Section Length 10725 feet)			
LL	0	Present, but recoveries insufficient for estimate			
	I	4.2	.04	193	6.88
	II	7.3	.16	116	18.08
	III and older	14.6	1.19	277	329.49
Total - yearlings and older				586±139 (24%)	354.45±84 (24%)
Total - yearlings and older per 1000 feet				55	33.05

METALS IN SAMPLES OF FISH FROM BLACKFOOT RIVER DRAINAGE

Lab. No.	Station and Date	Species	Length (in)	Weight (lbs)	Cd	Cu	Pb	Hg	Ni	Zn	As
33001	Poorman Creek	Wf	11.7	.53	.24	3.61	4	.23	4.8	17	.13
33002	(Circle City)	Wf	11.7	.40	.30	1.88	2	.06	3.5	12	.16
33003	4-25-72	Ct	11.1	.46	.15	1.67	1	.03	1.3	6	.23
33004	"	Ct	10.6	.46	.10	1.38	1	.02	1.6	15	.14
33005	"	Ct	8.3	.18	.24	6.59	3	.04	3.8	28	.62
33006	"	Ct	7.8	.17	.25	1.58	2	.03	5.4	26	.15
33007	Alice Creek	Wf	11.9	.58	.10	1.36	< 1	.02	1.8	7	.08
33008	(below Bartlett	Wf	10.6	.40	.10	.78	1	.02	.9	9	.18
33009	Creek)	Ct	8.9	.29	.15	1.27	2	.04	1.6	21	.14
33010	4-25-72	Ct	7.8	.20	.20	1.68	2	.03	3.6	22	.15
33011	"	Ct	9.0	.30	.15	1.98	2	.04	1.7	14	.14
33012	"	Ct	9.0	.31	.15	1.48	2	.04	1.0	22	.11
33013	"	Ct	6.7	.11	.30	2.77	2	.02	3.8	26	.19
33014	Blackfoot River	II	14.3	1.11	.15	.78	1	.02	.8	7	.25
33015	(Poorman-Dalton)	II	11.3	.58	.10	.79	1	.03	1.5	7	.16
33016	9-1-72	II	12.8	.77	.10	.59	1	.02	1.3	6	.40
33017	"	II	13.9	.98	.10	.79	< 1	.03	.8	7	.25
33018	"	II	14.9	1.29	.10	.49	1	.02	.6	6	.14
33019	"	Wf	11.7	.61	.10	.69	< 1	.02	.7	6	.13
33020	"	Wf	11.4	.61	.10	.89	1	.01	1.3	8	.58
33021	Blackfoot River	Ct	13.3	1.20	.10	1.28	1	.02	2.5	7	.11
33022	(Hogum Section)	Wf	12.6	.81	.10	.79	1	.03	3.0	5	.02
33023	9-14-72	Wf	14.5	1.16	.10	1.09	< 1	.02	.9	8	.16
33024	"	Wf	12.4	.75	.10	1.98	< 1	.03	2.6	6	.15
33025	Pass Creek 7-27-72 (composite of 7 fish)	Ct	4 - 5	-	.15	.89	1	.02	.6	13	.09

Concentrations expressed in micrograms per gram, wet weight.

APPENDIX V

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION X
1200 SIXTH AVENUE
SEATTLE, WASHINGTON 98101

REPLY TO ATTN OF: Concentration of Metals in Samples of Fish from Blackfoot River drainage

U. S. Environmental Protection Agency
Region X Laboratory
15345 N. E. 36th Street
Redmond, Washington 98052

November 2, 1973

Mr. Liter E. Spence, Jr.,
Environmental Planning Ecologist
Department of Fish and Game
State of Montana
Box 27
Ovanda, Montana 59854

Dear Mr. Spence:

In the attached table are results for metal determinations on fish tissue sent to us about the middle of August.

Please note that the last three digits in the laboratory number correspond to your sample number. Since the size of the fish was relatively small and upon thawing the tissue tended to be in a disintegrated state, it was not possible to determine metals in the various organs.

It is hoped that this information will assist you in your study.

Very truly yours,

Arnold R. Gahler

Arnold R. Gahler
Supervisory Chemist

arg/jp

Attachment

cc: F. Nelson
G. O'Neal

ENVIRONMENTAL PROTECTION AGENCY

REGION X

1200 SIXTH AVENUE
SEATTLE, WASHINGTON 98101

U.S. Envoronmental Protection Agency
Region X Laboratory
15345 N.E. 36th Street
Redmond, Washington 98052

January 28, 1974

Mr. Liter E. Spencer, Jr.
Planning Ecologist
Department of Fish and Game
State of Montana
Ovando, Montana 59854

Dear Mr. Spence,

In reply to your letter concerning the iron values on fish tissue samples, no iron values were obtained by the laboratory. When the samples were being digested prior to analysis by atomic absorption, the chemist unfortunately placed some acid not specially purified for iron in the digestion mixture so that the iron values would not have been reliable.

We apologize that this occurred, but the other values should be reliable.

Very truly yours,

Arnold R. Gahler
Supervisory Chemist

AG:jn

U.S. ENVIRONMENTAL PROTECTION AGENCY

REGION X

1200 SIXTH AVENUE
SEATTLE, WASHINGTON 98101

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REPLY TO
ATTN OF:

Region X Laboratory
1555 Alaskan Way South
Seattle, Washington 98134
May 15, 1975

Liter E. Spence
Habitat Evaluation Leader
State of Montana
Department of Fish & Game
Helena, Montana 59601

Dear Mr. Spence:

In response to your letter of May 6, 1975 we reviewed the bench data sheets. Each fish sample was homogenized thoroughly in a Waring blender and then dried in an oven at 60°C. After the samples were dried, they were mixed thoroughly again. A 5.00 gram portion of dried fish was digested with concentrated nitric and hydrochloric acids until all organic matter was digested. This solution was then diluted to a known volume with deionized water and analyzed directly with an Atomic Absorption Spectrophotometer for cadmium, copper, lead, nickel, and zinc (EPA). Half of this solution, which represented 2.50 grams of dried fish, was redigested with concentrated sulfuric acid to remove all nitric acid and was analyzed for arsenic by the Gutzeit method (Standard Methods.) A 1.00 gram portion of the dried fish was digested and analyzed for mercury by the cold-flame technique (EPA).

The following table summarizes both wet-weight and dry-weight results for all parameters requested:

The following references were used:
(EPA) Methods for Chemical Analysis of Water and Wastes, 1971

(Standard Methods) Standard Methods for the Examination of Water and Wastewater, 13th Edition, 1971.

If we can be of further assistance, please let us know.

Sincerely,

Robert H. Rieck
Chemist

cc: Mr. Arnold Gahler
Mr. Francis Nelson

APPENDIX V continued

	Lead		Mercury		Nickel		Zinc		Arsenic		Cadmium		Copper	
Lab Number	Wet Wt Basis	Dry Wt Basis	Wet Wt Basis	Dry Wt Basis	Wet Wt Basis	Dry Wt Basis	Wet Wt Basis	Dry Wt Basis	Wet Wt Basis*	Dry Wt Basis*	Wet Wt Basis	Dry Wt Basis	Wet Wt Basis	Dry Wt Basis
33001	4	16	.23	.89	4.8	19.4	17	68	.13	.51	.24	.99	3.61	14.62
33002	2	9	.06	.23	3.5	14.0	12	49	.16	.64	.30	1.20	1.88	7.60
33003	1	3	.03	.11	1.3	5.2	6	26	.23	.95	.15	.60	1.67	6.75
33004	1	3	.02	.09	1.6	6.4	15	62	.14	.56	.10	.40	1.38	5.60
33005	3	11	.04	.16	3.8	15.3	28	112	.62	2.51	.24	.98	6.59	26.67
33006	2	9	.03	.12	5.4	22.0	26	104	.15	.60	.25	1.00	1.58	6.40
33007	< 1	2	.02	.09	1.8	7.1	7	29	.08	.35	.10	.39	1.36	5.49
33008	1	3	.02	.07	.9	3.5	9	36	.18	.71	.10	.39	.78	3.14
33009	2	6	.04	.14	1.6	6.3	21	83	.14	.56	.15	.60	1.27	5.16
33010	2	8	.03	.12	3.6	14.4	22	90	.15	.60	.20	.80	1.68	6.80
33011	2	6	.04	.14	1.7	6.8	14	57	.14	.56	.15	.60	1.98	8.00
33012	2	6	.04	.15	1.0	4.0	22	90	.11	.44	.15	.60	1.48	5.99
33013	2	9	.02	.07	3.8	15.2	26	104	.19	.76	.30	1.20	2.77	11.20
33014	1	3	.02	.09	.8	3.2	7	30	.25	.99	.15	.60	.78	3.16
33015	1	3	.03	.12	1.5	6.0	7	28	.16	.64	.10	.40	.79	3.20
33016	1	3	.02	.08	1.3	5.2	6	26	.40	1.60	.10	.40	.59	2.40
33017	< 1	2	.03	.12	.8	3.2	7	28	.25	1.00	.10	.40	.79	3.19
33018	1	3	.02	.08	.6	2.4	6	23	.14	.56	.10	.40	.49	2.00
33019	< 1	2	.02	.08	.7	2.8	6	26	.13	.51	.10	.40	.69	2.80
33020	1	3	.01	.05	1.3	5.2	8	33	.58	2.31	.10	.40	.89	3.59
33021	1	3	.02	.09	2.5	10.0	7	30	.11	.44	.10	.40	1.28	5.20
33022	1	3	.03	.12	3.0	12.0	5	22	.02	.08	.10	.40	.79	3.20
33023	< 1	2	.02	.09	.9	3.6	8	32	.16	.64	.10	.40	1.09	4.40
33024	< 1	3	.03	.10	2.6	10.4	6	24	.15	.60	.10	.40	1.98	8.00
33025	1	3	.02	.10	.6	2.4	13	54	.09	.35	.15	.60	.89	3.59

* Results are expressed as micrograms per gram.

APPENDIX W

Location of Elk Observed From Aircraft, 1971-1974

Year	Flight Date	Number Observed and Classification[1/]	Drainage	TN	RW	S	¼ Sec.
1971	1-13	4 Cc	Pass Creek	15	6	8	
		30 BCc	Alice Creek	16	7	13	
		14	Green Creek	16	7	13	
		20 BCc	Green Creek	16	6	7,18	
		136 BCc	Bedrock Creek	16	6	3	
			Hardgrove Creek	17	6	34,35	
		2 B	Tom's Gulch	16	7	6	
	2-9	1 C	M. Fk Dearborn	16	6	30	
		2 B, 19 C, 8 c	Telephone Gulch	16	7	24	
		1 B	Bedrock Creek	16	6	5	
		34 B, 134 C, 27 c	Bedrock Creek	16	6	3	
		2 C, 2 c	Tom's Gulch	15	7	6	
	3-2	24	Telephone Gulch	16	7	23	NE
		9	Green Creek	16	7	13	NE
		117	Bedrock Creek	16	6	3	NW
		25	Green Creek	16	6	4	SW
		12 B	Bedrock Creek	16	6	5	SE
		6	Landers Fork	15	7	6	SW
		1 B	Landers Fork	15	7	6	SE
	4-2	33	Alice Creek	16	7	13	NW
		8	N. Fk Green Creek	16	6	7	NE
	4-8	5	Tom's Gulch	15	7	5	NE
		12	Green Creek	16	7	13	NE
		4	Alice Creek	16	7	14	NE
		9	Green Creek	16	6	16	NE
		35	Green Creek	16	6	9	NE
		6	Bedrock Creek	17	6	31	SE
		8	Bedrock Creek	17	6	30	SW
		2	Bedrock Creek	17	6	30	SE
	4-13	9	Telephone Gulch	16	7	23	NE
		4	Tom's Gulch	15	7	5	SE
		6	N. Fk Green Creek	16	6	12	SE
		13	N. Fk Green Creek	16	6	7	NE
		2	N. Fk Green Creek	16	6	6	SE

Year	Flight Date	Number Observed and Classification[1/]	Drainage	TN	RW	S	¼ Sec.
1971	4-13 cont.	6	Bedrock Creek	16	6	5	SW
		11	Bedrock Creek	17	6	31	NW
		8	Bedrock Creek	17	6	32	NW
		3	Bedrock Creek	17	6	32	center
		1	Little Skunk Creek	17	6	30	NW
		11	Little Skunk Creek	17	6	19	NW
		8	Little Skunk Creek	17	6	20	SE
		36	Green Creek	16	6	16	SW
		14	M. Fk. Dearborn	16	6	15	NW
		95	M. Fk. Dearborn	16	6	15	NE
	5-12	1	Tom's Gulch	15	7	6	SW
		4	Blackfoot	15	7	31	SE
		2	Hardscrabble Creek	15	7	8	SE
		13	Hardscrabble Creek	15	7	17	NE
		1	Bartlett Creek	15	7	2	NW
		3	Tom's Gulch	16	7	32	SW
		4	Alice Creek	16	7	27	NW
		1	Alice Creek	16	7	10	SW
		2	Alice Creek	16	7	13	NW
		2	M. Fk. Dearborn	16	6	29	SE
		14	M. Fk. Dearborn	16	6	15	SW
		2	M. Fk. Dearborn	16	6	15	SE
		17	M. Fk. Dearborn	16	6	10	SW
		9	M. Fk. Dearborn	16	6	10	SE
		10	Green Creek	16	6	17	SW
		2	Green Creek	16	6	17	NE
		1	Green Creek	16	6	8	SE
		2	Green Creek	16	6	6	SW
		8	Green Creek	16	7	12	SW
		1	Green Creek	16	7	1	NW
		2	E. Fk. Falls Creek	17	7	36	NE
		17	Big Skunk Creek	17	6	18	NW
		3	Big Skunk Creek	17	6	18	SE
		3	Big Skunk Creek	17	6	7	SE
	5-24	59	Hardscrabble Creek	15	7	8, 17, 20	
		1	Landers Fork	15	7	18	SW
		3	Landers Fork	15	7	7	SW
		2	Landers Fork	15	8	12	SE
		16	Landers Fork	15	8	12	SE
		1	Landers Fork	15	8	1	SW
		6	Landers Fork	15	7	31	NW

1/ B = Bull   C = Cow   c = calf   ©' = newborn calf

no symbol by number = unclassified

APPENDIX W continued

Year	Flight Date	Number Observed and Classification 1/	Drainage	Location TN	RW	S	1/4 Sec.
1971	5-24 cont.	2	Tom's Gulch	15	7	6	NW
		3	Tom's Gulch	15	7	6	center
		8	Hogum Creek	14	7	16 or 22	
		2	Black Diamond Creek	14	7	10 or 11	
	5-25	5	Landers Fork	16	9	14	NE
	6-6	1	Hardscrabble Creek	15	7	20	SW
		9	Hardscrabble Creek	15	7	30	center
		2 C, 1 C	Alice Creek	15	7	21	NW
		1	Alice Creek	15	7	22	NW
		5	Hardscrabble Creek	15	7	17	NW
		4	Hardscrabble Creek	15	7	8	SW
		1	Hardscrabble Creek	15	7	8	SW
		1	Hardscrabble Creek	15	7	17	NW
		12, 1 C	Landers Fork	15	7	18	NE
		6	Landers Fork	15	7	18	NW
		1	Landers Fork	15	7	18	center S½
		1	Landers Fork	15	7	7	center W½
		4	Landers Fork	15	7	7	NE
		1	Tom's Gulch	15	7	6	SW
	6-15	7 C, 3 C	Landers Fork	15	7	18	NW
		2	Hardscrabble Creek	15	7	16	SW
	7-1	4 B, 4 C, 2 C	Landers Fork	15	7	31	
		1	Hardscrabble Creek	15	7	17	NW
		2	Landers Fork	15	8	36	NE
		1	Landers Fork	15	7	7	SW
1972	4-19	46	Bedrock Creek	16	6	3	NE
		10	M. Fk. Dearborn	16	6	2	NW
		53	Green Creek	16	6	10	NE
		54	Green Creek	16	6	11	NW
		37	Hardgrove Creek	17	6	35	SW
		37	Big Skunk Creek	17	6	7	
		15	Big Skunk Creek	17	6	17	
		2	Tom's Gulch	15	7	6	
		7	Landers Fork	15	9	14	NE
	5-24	2	Hardscrabble Creek	15	7	8	NW
		3	Hardscrabble Creek	15	7	17	NW
		7	Hardscrabble Creek	15	7	17	NE
		23	Hardscrabble Creek	15	7	17	SW
		1	Hardscrabble Creek	15	7	17	SE
		3	Hardscrabble Creek	15	7	20	NW
		4	Alice Creek	15	7	16	center
		1	Alice Creek	15	7	16	SW
		1	Alice Creek	15	7	22	NW
		1	Hardscrabble Creek	15	7	19	NE
		1	Hardscrabble Creek	15	7	19	SW
1972	5-24 cont.	21	Landers Fork	15	7	18	NE
		12	Landers Fork	15	7	6	SW
		5	Tom's Gulch	15	7	6	NE
		1	Landers Fork	15	8	1	NE
		6	Blackfoot	15	7	30	SE
		1	Landers Fork	15	7	30	SW
		6	Blackfoot	15	7	31	NE
		1	Blackfoot	15	7	31	SE
		2	Alice Creek	16	7	28	center
		10	Telephone Gulch	16	7	23	SW
		4	Alice Creek	16	7	14	NE
		4	Green Creek	16	7	12	SE
		3	N. Fk. Green Creek	16	6	7	NE
		8	Big Skunk Creek	17	6	7	SW
	6-3	7	Landers Fork	15	7	30	SE
		5	Landers Fork	15	7	30	NE
		7	Landers Fork	15	7	30	NE
		1	Hardscrabble Creek	15	7	19	NW
		4 C, 1 C	Landers Fork	15	7	18	NE
		7 C, 2 C	Hardscrabble Creek	15	7	17	NE
		2	Landers Fork	15	7	18	SW
		3	Landers Fork	15	7	18	NW
		9	Landers Fork	15	7	7	SW
		2	Landers Fork	15	8	1	SE
		1	Landers Fork	15	7	1	NW
		1	Hardscrabble Creek	15	7	16	NW
		1	Landers Fork	16	9	11	SE
		8	Alice Creek	16	7	14	NE
	6-7	10 C, 3 C	Hardscrabble Creek	15	7	8	SE
		1	Tom's Gulch	15	7	5	SW
		4	Tom's Gulch	15	7	7	NE
		9 C, 1 C	Landers Fork	15	7	7	SW
		5	Landers Fork	15	7	7	SE
		4 C, 4 C	Landers Fork	15	7	18	NW
		1	Landers Fork	15	8	1	SE
		5	Landers Fork	15	8	1	SW
		4	Alice Creek	16	7	12	SW
		6	Green Creek	16	7	13, 18	center section line
	6-20	1	Alice Creek	15	7	16	SE
		1	Hardscrabble Creek	15	7	17	SW
		10 C, 4 C	Landers Fork	15	7	18	NE
		1	Landers Fork	15	7	7	center

APPENDIX W continued

Year	Flight Date	Number Observed and Classification[1]	Drainage	Location TN	RW	S	¼ Sec.
1972	6-20 cont.	1	Landers Fork	15	7	7	NW
		2 C, 1 C	Alice Creek	16	7	15	SW
		1	Alice Creek	16	7	10	SW
1973	3-7	±100	Alice Creek	16	7	15	SE
				16	7	22	NE
		6	Alice Creek	16	7	14	NW
		3	Alice Creek	16	7	22	SW
		15	Willow Creek	13	9	2	NW
	3-19	±40	Alice Creek	16	7	15	SE
				16	7	22	NE
		3	Alice Creek	16	7	22	SW
		37	Big Skunk Creek	17	6	7	SW
	4-3	58	Blackfoot	14	8	16,17	
		1	Alice Creek	16	7	11	SW
		13	Telephone Gulch	16	7	23	NE
		7	Bedrock Creek	16	6	3	NE
		15	Green Creek	16	6	4	NE
		116	Green Creek	16	6	9,10	
	4-19	20	Alice Creek	16	7	22	center
		5	Green Creek	16	6	4	SW
		7	Bedrock Creek	17	6	33	SW
		136	Bedrock Creek	16	6	3	NE
	5-31	1	Hardscrabble Creek	15	7	30	E½
		5	Hardscrabble Creek	15	7	30	E½
		2	Hardscrabble Creek	15	7	30	SW
		3	Landers Fork	15	7	30	NE
		5	Landers Fork	15	7	30	SE
		1	Alice Creek	15	7	22	NW
		1	Alice Creek	16	7	12	SW
		2	Hardscrabble Creek	15	7	20	SW
		1	Hardscrabble Creek	15	7	20	SE
		4	Landers Fork	15	7	18	SW
		3	Hardscrabble Creek	15	7	17	NE
		1	Landers Fork	15	7	18	NE
		4	Hardscrabble Creek	15	7	8	SW
		1	Landers Fork	15	7	7	NW
		2	Landers Fork	15	7	1	SE

Year	Flight Date	Number Observed and Classification	Drainage	Location TN	RW	S	1/4 Sec
1974[2]	4-30	2	Landers Fork	15	7	7	SW
		8	Hardscrabble Cr.	15	7	17	NW
		1	Hardscrabble Cr.	15	7	20	NE
	5-14	37	Landers Fork	15	8	1	SE
		3	Hardscrabble Cr.	15	7	17	SW
		34	Hardscrabble Cr.	15	7	19	NE
		5	Landers Fork	15	7	29	NW
		11	Blackfoot	15	7	32	NW
		14	Blackfoot	15	7	32	NE
	6- 1	1	Hardscrabble Cr.	15	7	7	NW
		9	Hardscrabble Cr.	15	7	18	NW
		3	Hardscrabble Cr.	15	7	18	NW
		10	Hardscrabble Cr.	15	7	18	SE
		16	Hardscrabble Cr.	15	7	17	SW
		5C, 1C	Hardscrabble Cr.	15	7	17	NE
		5	Hardscrabble Cr.	15	7	16	SW
		3	Hardscrabble Cr.	15	7	28	NW
		6	Hardscrabble Cr.	15	7	29	NW
		1	Hardscrabble Cr.	15	7	29	SW
		1	Hardscrabble Cr.	15	7	31	SW
		1	Hardscrabble Cr.	15	7	31	SW
		11	Landers Fork	15	8	25	SW
		3	Landers Fork	15	8	36	NE

2/Data for 1974 is not considered as complete as 1971-1973 data, since observations in 1974 were made from a Cessna 180 instead of a Supercub. However, the observations actually shown in 1974 are accurate.

APPENDIX X

Additional elk observed with radioed elk CH-2, CH-6 and CH-9 on telemetry flights. Flights which were not completed due to bad weather are not shown.

Elk CH-2

Year	Flight Date	Radioed Elk Seen?	Number of Additional Elk Seen with Radioed Elk1/
1973		Banded on 4-26	
	5- 3	Yes	Not Recorded
	5-11	Yes	13+
	5-14	Yes	10
	5-17	No	
	5-19	Yes	6-10
	5-21	No	Several
	5-24	No	
	5-29	Yes	6
	6- 2	Yes	6
	6- 6	Yes	None
	6- 7	Location Not Attempted	
	6-11	Yes	1
	6-20	No	
	6-22	Yes	None
	6-27	No	
	7- 3	No	4 C, 2 C
	7-10	No	1
	7-14	No	
	7-19	No	
	7-25	No	
	8- 1	No	
	8- 9	No	
	8-20	No	
	8-27	No	1 B, 2 C
	9- 4	No	8 CC, 1B
	9- 7	Yes	4
	9-28	Yes	8-10
	10- 8	No	1 C, 1 C
	10-17	No	4
	11-11	No	
	11-14	No	
	12- 5	No	

1/Includes animals in immediate proximity even though radioed elk may not have been seen.

Elk CH-2 continued

Year	Flight Date	Radioed Elk Seen?	Number of Additional Elk Seen with Radioed Elk1/
1974	1- 3	No	30-40
	2- 7	Yes	Not Recorded
	3- 9	Yes	20
	4- 4	No	15-20
	4-17	Yes	51
	4-30	Yes	43
	5- 4	No	6-8
	5- 7	No	
	5-14	Yes	14
	5-28	Signal Not Located	
	6- 1	Signal Not Located	
	6-12	Location Not Attempted	
	6-27	Yes	20 CC
	7- 6	Yes	4-6+
	7-15	No	
	7-19	Yes	None
	7-26	Yes	3 C, 3 C
	8- 5	Yes	15-20 CC
	8-15	Yes	4 C, 1 C
	9- 3	No	
	9-14	No	
	10- 4	No	
	10-29	No	
	11-14	No	
	12-12	No	
1975	1-15	Yes	20
	1-31	Yes	85
	2-26	Yes	14
	3-28	Yes	63

APPENDIX X continued

Elk CH-6

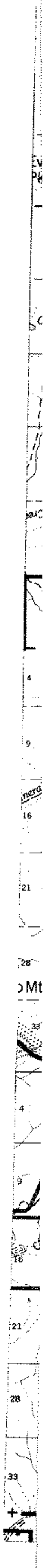
Year	Flight Date	Radioed Elk Seen?	Number of Additional Elk Seen with Radioed Elk
1973	Banded on 4-23		
	5- 3	Yes	Not Recorded
	5-11	Yes	4-5
	5-14	Yes	1
	5-17	Yes	2
	5-19	No	1
	5-21	No	3
	5-24	Yes	2
	5-29	No	2
	6- 2	Yes	8
	6- 6	Yes	None
	6- 7	Location Not Attempted	
	6-11	Yes	8
	6-20	No	5 C, 5 C
	6-22	Yes	18 C, 8 C
	6-27	Yes	6 C, 7 C
	7- 3	Yes	7 C, 2 C
	7-10	Yes	6 C, 4 C
	7-14	Yes	6 C, 3 C
	7-19	Yes	None
	7-25	Yes	9-10
	8- 1	Yes	8 C, 6 C
	8- 9	No	
	8-20	No	
	8-27	Yes	1 C, 1 B
	9- 4	No	
	9- 7	Yes	5 C
	9-28	No	2 B, 1 C
	10- 8	Yes	1 B, 3-4 C
	10-17	Yes	1 C
	11-11	No	
	11-14	No	
	12- 5	Yes	8-10
1974	1- 3	No	30-40
	2- 7	Yes	Not Recorded
	3- 9	Yes	20
	4- 4	No	6
	4-17	Yes	34
	4-30	Yes	30

Elk CH-6 continued

Year	Flight Date	Radioed Elk Seen?	Number of Additional Elk Seen with Radioed Elk
1974	5- 4	No	
	5- 7	No	2
	5-14	Yes	10
	5-28	No	
	6- 1	Yes	1
	6-12	Yes	4
	6-27	No	Several-Numbers Not Recorded
	7- 6	Yes	1
	7-15	Yes	3 C, 1 C
	7-19	Yes	1 C
	7-26	Yes	None
	8- 5	No	
	8-15	Yes	None
	9- 3	No	
	9-14	No	1
	10- 4	Too Windy	
	10-29	Signal not located	
	11-14	Signal not located	
	12-12	Yes	2 C, 1 C
1975	1-15	Yes	3 C, 2 B
	1-31	Signal not located	
	2-26	Yes	53
	3-28	Yes	52

Elk CH-9

Year	Flight Date	Radioed Elk Seen?	Number of Additional Elk Seen with Radioed Elk
1973	Banded on 4-23		
	5- 3	No	
	5-11	Yes	1
	5-14	Yes	2
	5-17	Yes	4
	5-19	Yes	2
	5-21	No	1
	5-24	No	1
	5-29	Yes	1
	6- 2	Yes	3
	6- 6	No	
	6- 7	Lost Radio Signal - Animal Killed by Hunter, October 17 or 18, 1973.	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