AQUATIC BIOLOGY STUDY

Montana Project

LINCOLN & SANDERS COUNTIES, MONTANA

prepared for

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prepared by

Western Resource Development Corporation
711 Walnut St. P.O. Box 467 Boulder, Colorado 80306

June 1989

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Prepared for:

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SUMMARY

INTRODUCTION

A one-year aquatic biology baseline study was conducted between May, 1988, and May, 1989, to meet permitting requirements associated with the Montana Project (MP) in the Cabinet Mountains. The goals of the aquatic program were to assemble a database for physical habitat, benthic macroinvertebrates and periphyton, and fisheries in streams within and adjacent to potential development areas.

A draft aquatic biology study plan was reviewed and revised several times by personnel representing the U.S. Forest Service (FS), Montana Department of State Lands (MDSL), Montana Department of Fish, Wildlife, and Parks (MDFWP), the Montana Department of Health and Environmental Sciences, Water Quality Board, and the proponent. The finalized aquatic biology study plan was then endorsed by the Kootenai National Forest.

A draft fisheries study plan was developed based on site visits and discussions with representatives of the MDFWP, FS, and the proponent. This plan was then modified following reviews from these agencies and subsequent field meetings. Fieldwork for the baseline study was conducted between August and mid-November to meet permitting requirements associated with the MP. All fieldwork was conducted under the supervision of the MDFWP. Objectives of the field program were to determine species composition, age structure, relative numbers, population estimate by age group, approximate level of bull trout and whitefish spawning, and baseline heavy metals content of fish tissues in Libby Creek.

STUDY AREA

The MP aquatic biology and fisheries study areas were located in northwest Montana, south-southwest of Libby and northeast of Noxon in the Kootenai National Forest. When the study plans were developed, the proponent was evaluating facility siting in three drainages, East Fork of Rock Creek, Libby Creek, and Ramsey Creek, and tailings sites in adjacent areas. Impact assessment required that appropriate data be collected in each of these three drainages plus adjacent reaches of Poorman, Little Cherry, and Bear Creeks.

METHODS

Physical habitats were evaluated using the U.S. Forest Service (1985, 1988) General Aquatic Wildlife System (GAWS) level 3 assessment. The level 3 survey is the basic survey for prescriptive planning of stream habitats and Forest Plan implementation. It uses a series of transects stratified by

stream reach and station to measure habitat parameters and is intended for use where non-natural alteration of aquatic habitats is predicted.

Aquatic biology data were collected from 18 reaches in the six study area streams. Locations of sample reaches were based on their relative location to disturbance sites and their suitability as spatial control or treatment reaches. When possible, biological and physical sampling sites were located near hydrology and water quality stations to obtain multiple discipline data for most sites.

Fish populations in Libby, Ramsey, Poorman, Little Cherry, and the East Fork of Rock Creeks and Rock Lake were sampled using backpack electroshockers, an electrofishing boat, gill netting, and hook and line. Spawning was assessed from electroshocking results and from visual searches along Libby Creek. Heavy metals analyses were conducted at Montana State University, Bozeman, and the Department of Health and Environmental Sciences, Helena.

RESULTS AND DISCUSSION

Physical Habitat

Within the study area, 24 stream reaches were identified and classified by major geomorphic features. Most stream reaches were characterized as having moderate to high gradient, predominantly large cobble and boulder substrate, and excellent riparian habitat. Bedrock outcroppings, which delineated stream reaches and controlled bedload transport, were important features throughout the study area. Timber recruited to the stream channel had a major influence on habitat quality since it provided most of the instream cover and pool habitat within the study area.

The principal products of the GAWS level 3 assessment included the riparian habitat condition rating, habitat condition index, and habitat vulnerability index. The three most useful indices generated from the model, riparian habitat condition, habitat condition (HCI), and habitat vulnerability (HVI) are summarized in the draft report. Riparian habitat condition, an index of habitat quality on the banks of streams, is average to excellent for project area streams. All reaches except reach 4 of Libby Creek were rated good or excellent. The habitat condition index is a general measure of fish habitat quality. Values for this index range from average to good for study area streams. The habitat vulnerability index (HVI) is a measure of a stream's susceptibility to damage from management activities. Stream reach HVI's varied from low to high, with the Upper Bear Creek reach (#4), the upper Ramsey Creek

reach (#4), and Rock Creek Meadows (#3) ranked as highly vulnerable.

Aquatic Macroinvertebrates

The study area streams supported a sparse, but diverse macroinvertebrate fauna that was indicative of very good water quality. Macroinvertebrate densities averaged approximately 180 organisms per Hess sample (0.1 m^2) in October, 1988, and approximately 250 organisms per Hess sample in August, 1988 and April, 1989. A spate, which occurred immediately prior to collection of the October samples, had a distinct impact on macroinvertebrate density and community structure. The low macroinvertebrate density and community biomass that typified most stations was attributable to the inherent productivity and extreme discharge patterns that prevail within the study area. By comparison, most Montana streams support more abundant and productive benthic faunas.

One hundred forty-four macroinvertebrate taxa were identified during this investigation. Diptera, with 55 taxa, were the most diverse group. Caddisflies, stoneflies, and mayflies were also well represented, with a combined total of 66 taxa. Mayflies, dipterans, and stoneflies were numerically dominant on each sampling date, accounting for approximately 85% of the fauna. Most of the taxa in the study area were considered intolerant of fine sediments, heavy metals, and organic pollution.

The nine indices used to characterize macroinvertebrate assemblages indicated extremely high water quality in each of the study area streams. Differences in parameter values between stations were generally small, and were attributed to differences in stream order, microhabitat diversity, productivity, and variable sampling efficiency due to substrate particle size, rather than water quality.

Periphyton

August and October, 1988, periphyton samples have been identified by Dr. John Priscu, Montana State University, Bozeman. Analyses of April, 1989, are ongoing. A complete periphyton results and discussion section will be submitted as a supplement to this report upon completion in late June or early July, 1989.

Fisheries Species Composition

Bull trout, rainbow trout, and sculpins were collected in Libby Creek and its tributaries. Bull trout, westslope cutthroat trout, and hybridized westslope cutthroat trout were collected in the East Fork of Rock Creek drainage. The MDFWP have designated bull and genetically pure westslope

Periphyton

(This section supercedes the Periphyton section on page viii of the final Aquatic Biology report.

Periphyton sampled in study area streams during August and October, 1988 and April, 1989, was sparse, but characteristic of high-elevation mountain streams. Chlorophyta and Cyanophyta algae occurred throughout the study area where *Zygnema* and *Oscillatoria* were the most abundant and widespread genera.

Diatoms were present in all periphyton samples, but were relatively sparse. Total species richness for all streams was 49, 44, and 39 taxa in August. October, and April samples, respectively. *Achnanthes minutissima* was the most abundant taxon at most stations on each date. Species richness was low, particularly in headwater reaches. In general, diatom taxa were typical of clean, soft-water Montana streams.

cutthroat trout as species of special concern in Montana because of their numbers and distribution statewide. Fish previously sampled from the East Fork of Rock Creek have been electrophoretically identified as genetically pure westslope cutthroat trout; however, this population was considered by Huston (1988) to be subject to genetic invasion.

Fish Populations, Age, and Growth

Study area creeks are primarily first or second order, high mountain streams with characteristically low productivity. Resulting fish populations are composed of moderate densities of small, young fish. Densities and age classes of fish were estimated by species for each sampling reach.

Spawning

The mid-October, 1988, survey of streams for bull trout redds was cancelled because of stream flooding and scouring immediately preceding the survey. Nearly 22 miles of Libby, Ramsey, and Poorman Creeks were surveyed for bull trout redds in October, 1989. Two redds made by bull trout that apparently migrated from the Kootenai River were located in upper Libby Creek along with nine redds made by resident bull trout. No redds were located in lower Libby, Ramsey, or Poorman Creeks. Two large, non-resident bull trout were observed in Libby and Ramsey Creeks. Bull trout recruitment in study area streams is by low numbers of older residents and low numbers of larger fish from the Kootenai River.

No spawning or spent bull trout were observed in the 11.46 mile portion of Lower Libby Creek during the mid-November mountain whitefish survey, nor were any schools of spawning whitefish located. Mountain whitefish are also thought to move up Libby Creek from the Kootenai River for fall spawning. Fall anadromous movements up Rock Creek from Cabinet Gorge Reservoir are annually restricted by the creek drying up in mid- to late summer.

Heavy Metals

Twenty-four rainbow trout collected from the Libby Creek cumulative effects sampling reach (LB-1) were analyzed to establish baseline heavy metals content. Muscle or liver tissue was analyzed at Montana State University or the Montana Department of Health and Environmental Sciences for mercury, zinc, cobalt, copper, and lead levels. Mean metal levels for all 24 fish were 0.19, 30.1, 1.9, 6.5, and <0.5 ppm, respectively. Metal levels were generally similar to those reported from fish in other Montana streams.

SECTION 1.0

INTRODUCTION

1.0 INTRODUCTION

The Montana Project (MP) is the proposed development of a silver-copper deposit in the Cabinet Mountains, southwest of Libby and east of Noxon, Montana (Figure 1.1). The development would consist of mine portals and addits, a processing plant, tailings pond, power transmission line, haul and access roads, and ancillary facilities. At present, three potential plant sites, two tailings sites, and two transmission line corridors are being evaluated.

The ore deposit is located below the Cabinet Mountains Wilderness, managed by the U.S. Forest Service (USFS). Mineral resource development will require the preparation of an Environmental Impact Statement (EIS). In April 1988 Western Resource Development Corporation (WRD) was hired to conduct the environmental baseline studies, including fisheries and aquatic biology, to be used for the EIS analyses. This report presents results of the baseline aquatic biology and fisheries investigations which will be used for subsequent impact assessment, alternatives analysis, and development of mitigation measures that are part of the EIS process.

Draft study plans were prepared based on: (1) the Montana Metal Mine Reclamation Act (MMMRA), the Montana Environmental Policy Act (MEPA), the National Environmental Policy Act (NEPA), guidelines to these Acts, interactions with the Kootenai National Forest, the Department of State Lands (MDSL) and Montana Department of Fish, Wildlife, and Parks (MDFWP), and MDSL guidelines for metal mines; (2) a preliminary review of pertinent, existing resource inventory data for the project area; (3) accepted baseline study plans for a similar, adjacent underground mine proposed for the area; and (4) discussions and site visits with state and federal resource and regulatory agency personnel.

The aquatic biology study plan was then reviewed and revised several times by personnel representing the USFS, MDSL, MDFWP, and Montana Department of Health and Environmental Sciences, Water Quality Bureau based on May 4 and 5, 1988, site visits, experience of agency personnel and their interpretation of baseline study requirements, and modification in proposed development plans. The finalized aquatic biology study plan (Appendix 6.1), endorsed by the Kootenai National Forest, was then implemented in 1988/89.

The fisheries study plan was cooperatively developed during office and field meetings by personnel representing the U.S. Forest Service, MDFWP, and the proponent. The finalized study plan, endorsed by the Kootenai National Forest, is contained in Appendix 6.2.

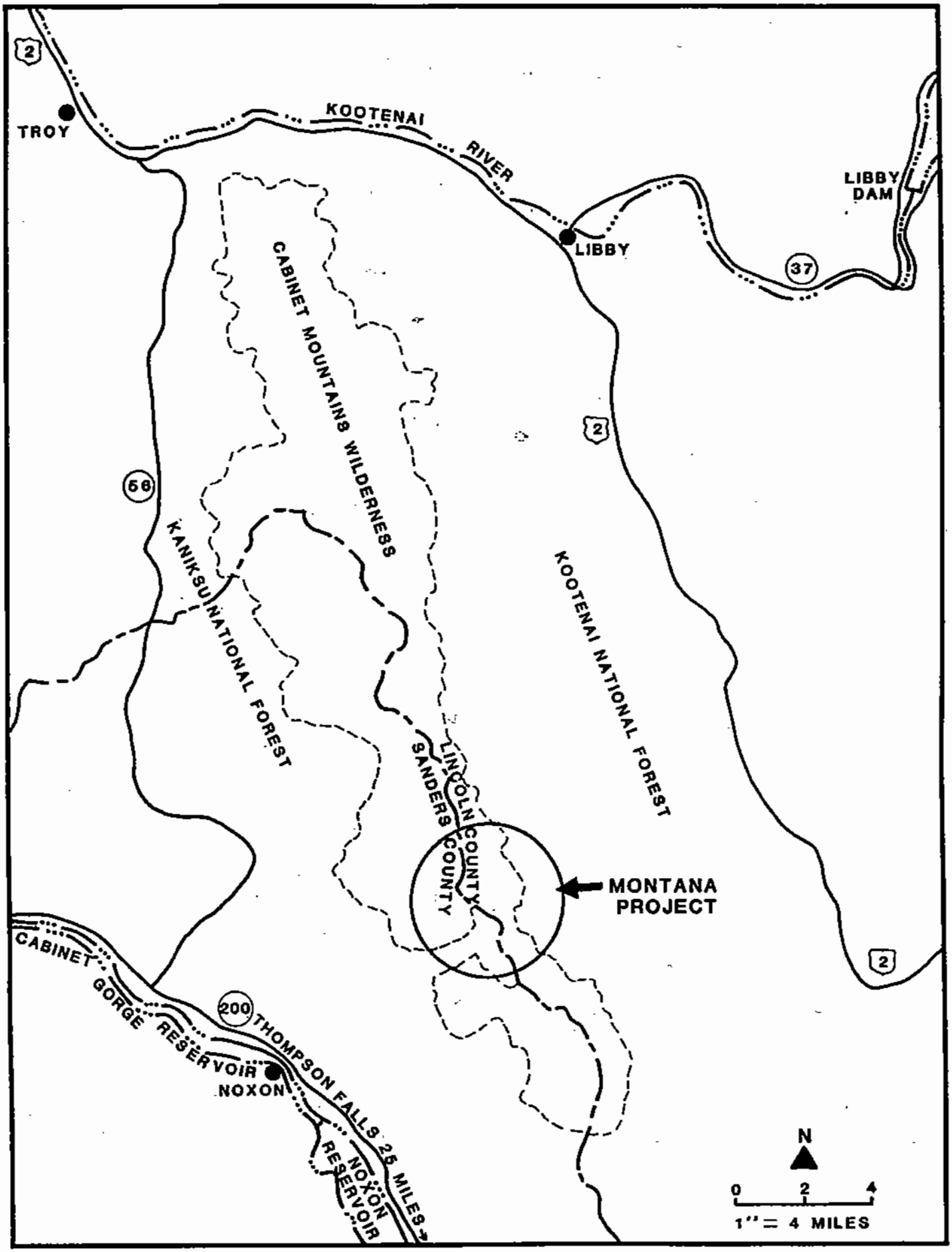

FIGURE 1.1. PROJECT LOCATION

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LINCOLN & SANDERS COUNTIES, MONTANA

Fieldwork for the fisheries study was conducted by MDFWP, Region One Fisheries Division, under contract to Noranda. Data analyses and subsequent office work were conducted by the same personnel under supervision of WRD.

SECTION 2.0

PROJECT DESCRIPTION AND ENVIRONMENTAL SETTING

2.0 PROJECT DESCRIPTION AND ENVIRONMENTAL SETTING

2.1 PROJECT DESCRIPTION

This baseline study was initiated by U.S. Borax as part of the licensing requirements for the development and mining of a silver/copper deposit located underneath the Cabinet Mountain Wilderness Area in the Kootenai National Forest, Sanders and Lincoln counties, Montana. Whereas the State of Montana, Department of State Lands, and the Kootenai National Forest have primary responsibility for permitting these activities, the two agencies and U.S. Borax developed a Plan of Study that defined the nature and extent of the baseline work. This work was initiated in the spring of 1988 and has been conducted in accordance with the terms of the Plan of Study.

A number of alternative sites (Figure 2.1) were identified for portals, processing plant, tailings disposal and ancillary facilities. The area encompassing and adjacent to these sites then became the focus of the baseline work.

In September 1988 Noranda Minerals Corp. and Montana Reserves formed a venture and purchased the silver/copper deposit from U.S. Borax and continued with project development under the "Montana Project" name. Noranda Minerals Corporation (Noranda) was designated the project manager.

Noranda continued to build from the data and information that had been generated by U.S. Borax and after reviewing the many alternative sites developed the proposed mining program detailed in the Application for a Hard Rock Operating Permit from the Montana Department of State Lands. The application also serves as a proposed Plan of Operation to the Kootenai National Forest. Basically, the application describes a 20,000 ton per day operation accessed from two (twin) portals in Ramsey Creek, a mill site located adjacent to the Ramsey portals, a portal in Libby Creek, two portals in the Rock Creek drainage for ventilation and emergency access, and a tailing impoundment in the Little Cherry Creek drainage. Access to the Ramsey Creek mine site would be over the existing Bear Creek Road. A new transmission line from Pleasant Valley to the mine site would provide electrical energy for the operation. The total labor force is expected to number approximately 400 people. These positions would be filled by hiring locally as much as possible.

2.2 LOCATION

The Cabinet Mountains, straddled by the study area, are characterized by high glaciated peaks along a north-northwest/south-southeast divide, a series of parallel sharp spur ridges running northeast off the main divide, and topography

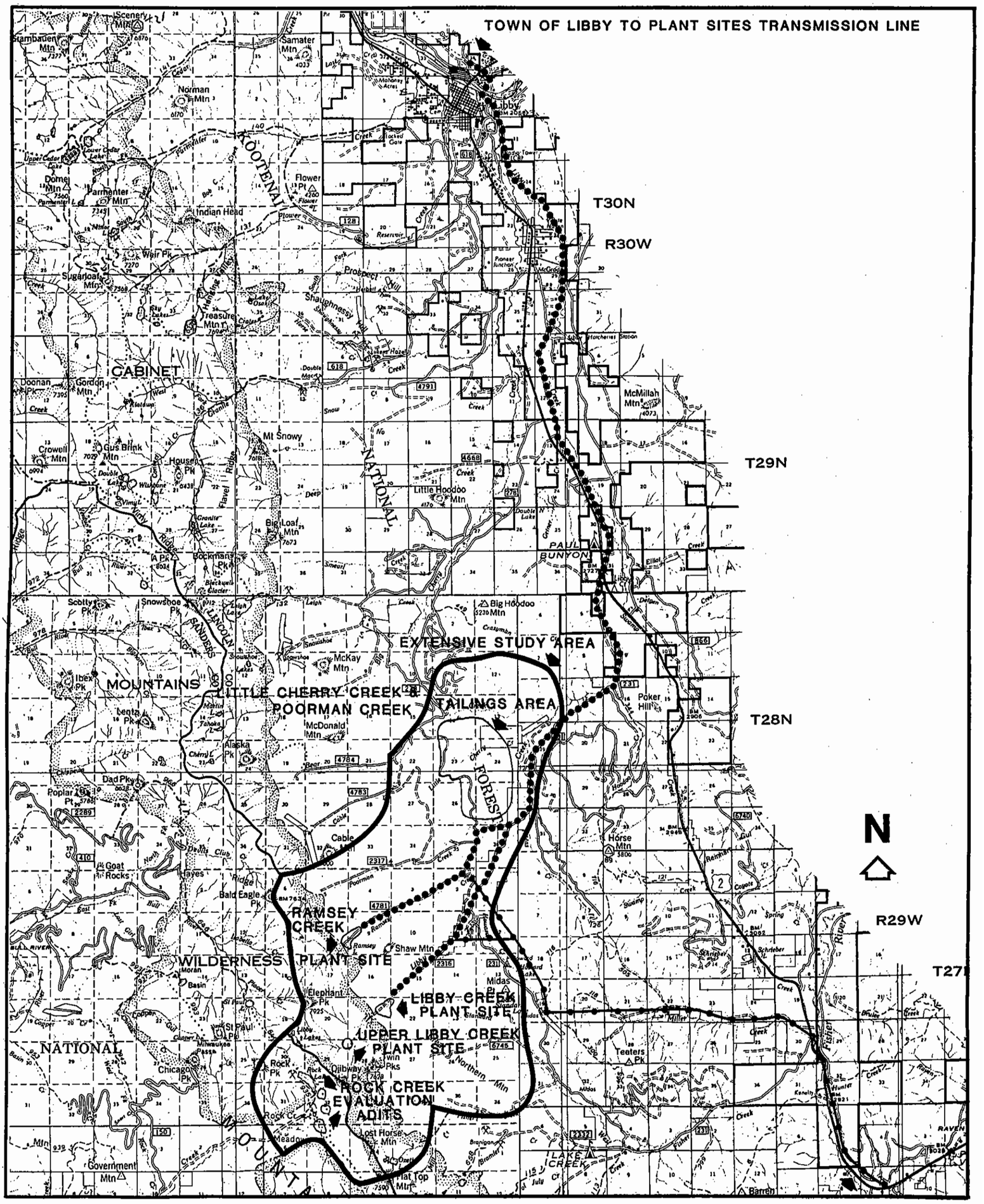

FIGURE 2.1
PROJECT ALTERNATIVES LOCATION MAP

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MONTANA PROJECT
Lincoln & Sanders Counties, Montana
MAY 1989 SCALE 1"= 2 MILES

shaped by glaciation and fluvial processes. Study area elevations range from 3040 ft. along Libby Creek to 7938 ft. at Elephant Peak.

Libby Creek on the east side of the Cabinet Mountains has two alternative plant sites named Libby Creek and Upper Libby Creek. The Libby Creek alternative site is at an elevation of 4,200 feet and the Upper Libby Creek site is at an elevation of 4,400 feet. The Upper Libby Creek Valley, which trends northeast, is generally less than 500 feet wide and has steep slopes which rise to surrounding peaks in excess of 7,000 feet. Avalanche chutes are common in the drainage and many extend across to the valley bottom. The Libby Creek site is approximately 96 acres in size while the Upper Libby Creek site, which has two small ponds, is about 51 acres.

The 54 acre Ramsey Creek alternative plant site is located in Ramsey Creek, the drainage north of Libby Creek. The elevation of the plant site is about 4,400 feet. Like the Upper Libby Creek Valley, the Ramsey Creek Valley is narrow, surrounded by steep slopes, and trends northeast.

The Little Cherry and Poorman Creek tailings areas are located about three and one-half miles northeast of the Libby and Ramsey Creek plant sites. The area in which these sites are located ranges in elevation from 3,400 to 3,800 feet. Little Cherry Creek bisects the northern portion of this area and Poorman Creek is adjacent to the south. The entire site contains numerous small ridges, intermittent drainages, and drains to the northeast. Past continental glacial activity has created a hummocky, poorly drained topography in some areas. A utility corridor will connect the preferred plant site with the preferred tailings alternative.

The town of Libby to plant sites transmission line is about 22 miles in length, considering the terminus at either Libby or Ramsey Creek plant site. The line begins at the Pacific Power and Light substation north of the town of Libby and proceeds south, crossing the Kootenai River, and follows private roads which parallel Libby Creek. Approximately 13 miles south of town the transmission line crosses U.S. Highway 2 and follows the Libby Creek Road to a point just south of the tailings sites. From this point one alternative proceeds up Libby Creek to a plant site and another up Ramsey Creek to a plant site.

The Miller Creek to plant sites transmission line begins at the Bonneville Power Authority transmission line which crosses U.S. Highway 2 southeast of the study area near Pleasant Valley. This transmission line runs north along U.S. Highway 2 for about 4.5 miles to Miller Creek where it turns west and follows the Miller Creek Road. When

the road ends, the transmission line continues west crossing a 4,600 foot mountain and then heads northwest past Howard Lake. Alternative branches then proceed up Libby and Ramsey creeks. This line is about 18 miles in length with either the Libby or Ramsey creek alternative.

2.3 GEOLOGY

The study area is within the northern Rocky Mountain physiographic province, an area characterized by mountain ranges and intermountain valleys. This area is underlain by Precambrian meta sedimentary rocks of the belt series, clastic rocks generally resistant to weathering (Veseth and Montagne 1980). During the Pleistocene epoch of the Quaternary period continental glaciers covered most of the lower elevations of the Cabinet Mountains and alpine glaciers occurred in the stream valleys. During post-glacial time volcanic ash resulting presumably from the Mount Mazama eruption 6600 years ago covered the landscape (Nimlos 1980). The differential deposition of volcanic ash, combined with redistribution by precipitation, results in soil profiles with variable depths of ash.

2.4 SOILS

The soils of the study area vary in age and degree of development. The young soils associated with recent fluvial and slope processes have little or no development and surface horizons with varying accumulations of organic matter. They may or may not be mantled by ash. These soils generally have a sandy texture, abundant coarse fragments, a pH of 5-6, and are infertile.

Intermediate aged soils have horizons which exhibit alteration of the parent material through soil forming processes. The parent material of these soils has been altered through the accumulation, loss, or translocation of soil constituents and has developed a structure. Weathering of volcanic ash in the surface horizons results in development of these soils. These soils range in age from at least 6600 years (Nimlos 1980) to early Wisconsin. These soils are generally silt loams, infertile, have coarse fragments, and a pH of 5-6.

The tailings area has old soils which are probably related to one of the pre-Wisconsin glacial advances. These soils have thick subsurface horizons with accumulations of silicate clays, and have developed strong structure and distinct horizons and contain coarse fragments with substantial weathering rinds. These infertile soils have a clay to silty clay texture and a pH towards the high end of the 5-6 range.

2.5 CLIMATE

The study area is characterized by a Pacific maritime climate modified by the inland continental location (USFS 1984). The prevailing westerlies carry moist Pacific air masses inland, creating cloudy, warm, wet winters. During summer, dry air masses of the prevailing westerlies create dry and warm days with cool nights. The continental location of the study area results in occasional cold periods in winter and hot intervals in the summer (USFS 1984).

Elevation has a major influence on both temperature and precipitation of the study area. Precipitation at 3,600 feet at the tailings area is approximately 30 inches but may range to 80-90 inches on 7,303 foot Ojibway Peak near Rock Lake (USFS 1984). The majority of the precipitation falls during the November-January period. Most summer precipitation is associated with convectional storms.

The mean annual temperature for Libby is 45°F (USFS 1984). About half the days in July and August have maximum temperatures of 90°F or warmer. Summer nighttime lows are commonly in the mid 40°F. Temperature inversions are common in this area, which has a growing season of 30-50 days (Montagne et al. 1982). Extremely cold temperatures occur when arctic air masses from Canada move into the region. December and January are the coldest months of the year.

Both temperature and precipitation affect the vegetation pattern. At lower elevations, moisture is the dominant controlling factor influencing the presence of a forest type and at upper elevations temperature is the major factor (Daubenmire 1956).

2.6 VEGETATION

In the late 1970's and early 1980's the U.S. Forest Service mapped forest habitat types in the Kootenai National Forest. This mapping followed the classification of Pfister et al. (1977) as presented in Forest Habitat Types of Montana.

Six climax series with 15 habitat types occur within the extensive study area. Climax series present include:

- Douglas fir (*Pseudotsuga menziesii*)
- Grand fir (*Abies grandis*)
- Western red cedar (*Thuja plicata*)
- Western hemlock (*Tsuga heterophylla*)
- Subalpine fir (*Abies lasiocarpa*)

Each of the climax series are described from publications of Pfister (1974, 1977) and Cooper et al. (1987). See the MP vegetation baseline report (WRDC 1989) for more information.

Fire and logging activities have dramatically affected the presence, distribution, abundance, and dominance of tree species in the study area .

The northern Rocky Mountains is a region of unusually high fire occurrence in forested areas. Fires of varying size and intensity have historically burned the study area, sometimes destroying the entire forest and sometimes only burning the ground litter. These fires have altered the forest environment by fostering the establishment of new seral communities and by selectively eliminating understory species and those trees least adapted to fire. These seral communities are often long-lived as development of the climax community may require upwards to 500 years due to advanced age of climax trees.

Seral trees are generally adapted to fire and disturbances. Western larch, ponderosa pine, and Douglas-fir have fire resistant bark and, along with white pine, winged/or light seeds for easy travel to disturbed sites. Lodgepole pine has serotinuous cones. Species of *Abies, Tsuga,* and *Picea* are likely to be killed by most fires as they have thin bark and are susceptible to rot entering wounds produced by fires.

Timbering practices also result in the creation of seral communities. The logging of small, scattered patches, followed by burning of residual material has created small seral communities of varying ages throughout the study area.

Massive and successive fires often destroy tree seed sources and result in the development of long-persisting shrubland and forb fields. Most shrublands of the study area are due to avalanches and not the past action of fire.

2.7 LAND USE

Major land uses of the study area include timbering, mining, recreation, and agriculture. Timbering began in this region in the late 1800's due to demands created by the railroad and mining industries (USFS 1984). Timbering on the lower elevation of the study area began in the 1960's and continues to present. Mining is also a historic land use. Placer mining for gold occurred in several locations along Libby Creek in the late 1800's and resulted in the development of a few dwellings and ancillary facilities. Silver was mined at the Heidelberg Mine in the Rock Creek drainage in the 1950's. The principal recreation uses of

the study area include hunting, fishing, hiking, backpacking, camping, and cross country skiing and snowmobiling in the winter. Livestock grazing is the only agricultural land use. Grazing occurs only at lower elevations and is quite limited.

SECTION 3.0

METHODS

3.0 METHODS

The goal of the aquatic biology and fisheries programs was to assemble a database for periphyton, benthic macroinvertebrates, physical habitat, and fisheries in streams within and adjacent to (upstream and downstream of) the potential development areas. Streams included in the study area were the East Fork of Rock Creek, on the west side of the Cabinet Mountains, and Libby, Ramsey, Poorman, Little Cherry, and Bear Creeks on the east side (Map 7.1).

When the MP plan of study was prepared, the proponent was considering potential plant site development alternatives near the headwalls of Libby, Ramsey, and the East Fork of Rock Creek. Consequently, these streams were sampled as part of the aquatic baseline program (Map 7.1). In addition, two potential tailings disposal areas were identified on the east side of the Cabinets which would possibly affect Bear, Little Cherry, and Poorman Creeks, tributaries of Libby Creek, resulting in their inclusion in the aquatic biology sampling.

Existing macroinvertebrate, macrophyte, periphyton, riparian vegetation, fisheries, and hydrological data are available for seven stations along Rock Creek and its tributaries as a result of investigations associated with the proposed ASARCO Rock Creek mine development. Aquatic biology sampling sites (Ro. 1 and Ro. 3, respectively) on the East Fork of Rock Creek correspond to stations ERC-1 and -2 of the ASARCO studies (Farmer et al. 1986).

3.1 PHYSICAL HABITAT ASSESSMENT

Aquatic habitats were evaluated using the recently developed U.S. Forest Service (1985, 1988) General Aquatic Wildlife System (GAWS) Level III assessment. The Level III survey is the basic survey for prescriptive planning of stream habitats and which is also used by the Forest Service to evaluate implementation of the Forest Plan. It uses a series of transects stratified by stream reach and section to measure habitat parameters and is intended for use where non-natural alteration of aquatic habitats is predicted. The objective of the Level III survey is to provide information necessary to make land management recommendations (USFS 1988).

The GAWS assessment was not developed for Forest Service Region One, which contains the Kootenai National Forest, nor has it been implemented in this region. However, this Level III assessment is completely suitable for this application and represents the best model available for evaluating stream habitats and potential impacts to

stream systems. This model is currently being used on forests in other regions to assess baseline aquatic conditions in areas potentially affected by large scale developments.

Each of the study area streams was divided into reaches based on stream channel type according to accepted USFS (Rosgen 1985) methods. A total of 24 reaches were identified in the six streams that could be influenced by facilities and tailings development (Table 3.1.1). Biological and physical habitat data were collected from 18 of these reaches because of their relative location to disturbance sites and their suitability as spatial control or treatment reaches. The lowest reach on Libby Creek was located to evaluate cumulative effects. Where possible, biological and physical sampling sites were located near hydrology and water quality stations, thus providing multiple discipline data for most sites. Reaches that were not surveyed for biological data were characterized after Rosgen (1985).

Physical parameters were measured at 54 stations located in 18 stream reaches (Map 7.1) during August, 1988. Data were collected from five transects at each of three stations per stream reach for a total of 270 stream transects within the study area. Stations were located in representative sections of each reach according to USFS (1985, 1988). Transects at each station were separated by 100 foot intervals. At each transect, the physical parameters measured or evaluated included:

1. Elevation
2. Gradient
3. Stream bank and bottom stability
4. Valley bottom and riparian area width
5. Geological landform
6. Land type
7. Indicators of potential sediment production
8. Beaver activity
9. Current velocity profile
10. Temperature
11. Substrate composition
12. Channel type
13. Organic debris
14. Riparian vegetation and canopy cover
15. Stream size
16. Flow regime
17. Riparian habitat condition
18. Channel and water width
19. Water depth profile
20. Pool and riffle areas
21. Pool quality and quantity relative to adult trout habitat
22. Aquatic plants
23. Stream bottom embeddedness

Table 3.1.1. Summary of aquatic biology sample stream reaches in the Montana Project study area, Lincoln and Sanders Counties, Montana.

			Habitat Analysis	Macro-Inverts.	Characterize Only
Libby Creek					
L.1	1.	1/2 mile reach below Hoodoo and above Crazyman Creeks (cumulative effects)	x	x	
L.2	2.	Reach above to below Bear Creek			x
L.3	3.	Canyon reach to above Little Cherry Creek (experimental station for dam)	x	x	
L.4	4.	Braided reach below Little Cherry Impoundments (experimental station for LCL impoundment)	x	x	
L.5	5.	Old Town reach (above Poorman - Ramsey) (cumulative effects for Ramsey and Libby)	x	x	
L.6	6	Characterize bedrock section within a different reach but no sampling			x
L.7	7.	Ramsey to upstream braided section (experimental station for Libby)			x
L.8	8.	Braided section (experimental for Libby and Howard Creeks)	x	x	
L.9	9.	Howard Creek confluence up to 3720' elevation			x
L.10	10.	Gentle Libby Creek (experimental for mine facilities)	x	x	
L.11	11.	Upper Libby Creek (control for mine facilities)	x	x	
Ramsey Creek					
Ra1	1.	Confluence with Libby upstream 1/2 mile			x
Ra2	2.	Gentle reach (experimental #2 for mine facilities)	x	x	
Ra3	3.	Steeper upper reach (experimental #1 for mine facilities)	x	x	
Ra4	4.	Swampy, meandering upper reach (control for mine facilities)	x	x	
Poorman Creek					
Po1	1.	One reach above Libby Creek with 2 macro stations: one above Bear Creek Road and impoundment (control) one as close to Libby as possible (experimental)	x	2x	

Table 3.1.1. Continued.

			Habitat Analysis	Macro-Inverts.	Characterize Only
Little Cherry Creek					
LC1	1.	One reach: one station above dam (LC100); one station below dam (LC600) macro station(s) ? - one below; one above if flow in August	x	1-2x	
Bear Creek					
Be1	1.	Steep, lower reach (macro sample experimental for dam leaching)	x	x	
Be2	2.	Long, upper section to just above Bear Creek Road bridge (control above bridge)	x	x	
Be3	3.	Reach above bridge to confluence with Cable Creek (control for road and dam)	x	x	
Rock Creek					
Ro1	1.	Section above West Fork	x	x	
Ro2	2.	Steep gradient			x
Ro3	3.	Swamp/meadows	x	x	
Ro4	4.	Upper reach - Rock Lake down to meadows	x	x	
Totals					
Reaches			18		6
Macroinvertebrates (20 stations x 3 samples/ station x 3 sampling periods)			20(180)		
Periphyton Totals (20 stations x 1 sample/ station x 3 sampling periods)			60		

24. Right and left bank soil stability, cover, vegetative stability, angle, shore depth, undercut, and ungulate damage
25. Spawning areas and fry habitat

Field data were analyzed using the USFS (1988) Date General computer system, which is a collection of data base and information system programs. This analysis summarizes habitat condition and a number of physical stream features by stream station and reach. A composite habitat condition index, habitat vulnerability index, and relative potential for vulnerability rating was also computed for each station and reach.

3.2 AQUATIC BIOLOGY SAMPLING

Aquatic macroinvertebrates and periphyton were collected from 20 sites within the study area (Table 3.1.1, Map 7.1) during August and October, 1988, and April, 1989. With one exception, benthic macroinvertebrates in Libby Creek and its tributaries were collected with a modified Hess sampler which enclosed an area of 0.1 square meters with 0.17 mm mesh netting. Three samples were taken at each station during each sample period. The exact site of collection was dictated by water depth, velocity, stream cross-sections, and substrate composition with samples occasionally distributed over 30 or 40 meters of the stream. Samples were collected from riffles or runs with predominantly sand, gravel, or cobble substrates at water depths of 0.1 to 0.3 meters (3.5 to 12 inches). Rocks enclosed by the sampler that were larger than 6 cm (approximately 2 inches) were scrubbed with a brush in the sampler and then discarded. The remaining substrate was stirred to a depth of approximately 6 cm for one minute. All materials washed into the netting were preserved in alcohol and returned to the laboratory for processing. The stream width, distance from shore, water depth, water velocity (at six-tenths of the total depth), and substrate particle size were recorded for each sample. A Swoffer Model 2100 flow meter was used to measure stream velocities. During August, 1988, the low stream flow at the upstream Little Cherry Creek station (LC-2) precluded the use of the Hess sampler, so kick samples were collected. Hess samples were collected at LC-2 during October, 1988, and April, 1989.

The large substrate and steep gradient in the East Fork of Rock Creek precluded the effective use of a Hess sampler. As an alternative, three standardized traveling kick samples (Kinney et al. 1978) were collected at each of the Rock Creek stations. An aquatic kick net (dimensions 20 x 48 cm, 0.9 mm mesh netting) was used to capture organisms dislodged from the substrate. In this method, the net was held downstream of the investigator while he slowly moved downstream

and vigorously kicked the substrate. Sampling effort was standardized for each sample by kicking for 45 seconds over a distance of approximately one meter.

In the laboratory, macroinvertebrate samples were lightly rinsed in a U.S. Series No. 30 sieve (0.6 mm diameter aperture). Materials retained in the screen were transferred to a white enamel pan and the macroinvertebrates were removed. Eight randomly selected samples (five percent of the samples) were resorted to evaluate sorting efficiency.

Macroinvertebrates were identified to lowest taxonomic level practical, usually genus or species. All identifications were made by Daniel L. McGuire, Peter Wilkinson, or Dr. G. Z. Jacobi (Highlands University, Las Vegas, New Mexico). Identifications were based on a consensus among the investigators. Quality assurance-quality control (QA-QC) measures included resorting approximately 5% of the samples to assess sorting efficiency and curating a collection of voucher specimens. In addition, 5% of the samples were sent to Mr. Bob Wissemen, Oregon State University, for review and verification of identifications.

Macroinvertebrate biomass was estimated for each station by pooling organisms from the three samples after sample identification and verification. Organisms were dried at 60°C for 24 hours and weighed to the nearest 0.01 g on an Ainsworth Model MX-200 electronic balance.

Data analysis included calculation of the following parameters:

1. Macroinvertebrate identification and abundance
2. Taxa richness
3. Shannon diversity (Weber 1973)
4. Biotic index (Hilsenhoff 1987)
5. Biotic condition index (Winget and Mangum 1979)
6. EPT richness (Plafkin et al. 1987)
7. EPT to Chironomidae ratio (Plafkin et al. 1987)
8. Macroinvertebrate biomass
9. Equitability (Weber 1973)

Periphyton was collected at the same locations and on the same dates as the macroinvertebrate samples. Approximately 10 minutes were spent by one or two people at each site collecting a composite periphyton sample which consisted of scraping the film of attached algae from natural substrates. The top and bottom side of at least 10 stones were sampled at each site, and where present, wood slivers and bits of vegetation were included in the sample. An effort was made to maximize periphyton diversity by sampling the full range of substrate types, sizes, and locations as well as water velocities and water depths present in a 10-40 m stream reach. Scrapings from each

substrate were combined, transferred to labeled vials, and preserved in Lugol's solution. Periphyton data will be presented as species lists and approximate relative abundances for each sample. QA-QC procedures will include sending a randomly selected 5% of the samples to an independent consultant for verification.

Aquatic macrophytes were identified, and their locations noted as they were encountered. Plants of uncertain identity were pressed in the field and later identified using appropriate taxonomic keys.

3.3 FISHERIES

The purpose of the fisheries study was to inventory baseline fisheries conditions prior to development of the MP. Parameters studied included species composition, population densities, age and growth, spawning, and heavy metals content. Bull trout (*Salvelinus confluentus*) and westslope cutthroat trout (*Oncorhynchus clarki lewisi*), which occur in the area, are designated Species of Special Concern by the Montana Department of Fish, Wildlife and Parks (MDFWP). Streams with populations of bull trout and/or genetically pure westslope cutthroat trout are of special interest to the MDFWP.

Libby Creek, and three of its tributaries, Ramsey, Poorman, and Little Cherry Creek were inventoried in the Kootenai River drainage, on the east side of the Cabinet Mountains, Map 7.2. On the west side, Rock Lake, Rock Creek Meadows, and the East Fork of Rock Creek were surveyed. The Rock Creek drainage is a tributary of Cabinet Gorge Reservoir and the Clark Fork River drainage.

3.3.1 Fish Population Estimates

Fish population estimates were made in 500 or 1000 foot long stream sections. General locations of sections were as follows:

Libby Creek

1. above potential mill site (LB-4)
2. immediately below potential mill site (LB-3)
3. above confluence with Howard Creek (LB-2)
4. main Libby Creek, below confluence with Little Cherry Creek (LB-1)

Ramsey Creek

1. above potential mill site (RM-3
2. immediately downstream of potential mill site (RM-2)
3. near confluence with Libby Creek (RM-1)

3.2 AQUATIC BIOLOGY SAMPLING

(Text to be inserted on page 17 below partial paragraph at top of page and before paragraph beginning with "Aquatic macrophytes...").

Preserved periphyton samples were sent via surface mail to CHEM-PRO Consultants (Bozeman, MT) for analyses. August samples were analyzed by Dr. John Priscu and Thomas Sharp; October and April samples were analyzed by Dr. Priscu. Upon receipt, samples were stored refrigerated until analysis, as described below.

A subsample was placed on a slide and examined at 400x with a NIKON LABOPHOT microscope for the determination of relative abundances of the major algal divisions. Approximately 300-400 cells were counted for each sample when possible (i.e., when adequate cells were present to count 300 within a "reasonable" amount of time. Cells were extremely sparse on several October slides (i.e., Li-11, LC-2) and resulted in low frustule counts even though virtually all cells on the slides were counted. April samples Li-3, Li-5, Li-8, and LC-1 were laden with silt and sand, and contained relatively few intact cells. Owing to time constraints, less than 200 cells were counted from those samples.

Diatom frustules were cleared by the method of Van der Werff (Int. Soc. Theor. Appl. Limnol. 12:276-277). Briefly, 5-10 ml of sample was placed in a 600 ml beaker. The volume of sample used was dependent on the amount of organic matter present in the original sample. One hundred ml of 30% hydrogen peroxide (H_2O_2) was added to the sample and allowed to react for 3 minutes. Approximately 0.5 g of potassium dichromate (K_2CrO_7) was then added to the sample/peroxide solution and mixed. After the color of the mixture changed from brown to yellow (indicating completion of the oxidation reaction), the solution was diluted with about 100 ml deionized water and allowed to settle for 12-24 hours. Samples were then rinsed with deionized water, placed into 15 ml centrifuge tubes, and centrifuged at 1000 x g for 10 minutes. This rinsing procedure was repeated five times to remove dichromate crystals from the sample. After the final rinse, all but 1 ml of deionized water was decanted from the centrifuge tube. The sample pellet was then homogenized completely in the remaining 1 ml and a pasteur pipette was used to place 1 drop of the cleared sample suspension onto a glass cover slip to which 1 drop of deionized water was previously added. The sample was dried by placing the cover slip on a hot plate under low heat.

One drop of cumar resin (dissolved in toluene) was placed on a microscope slide heated on a hot plate under a fume hood at low temperature. Once the cumar/toluene

solution started to bubble, the cover slip containing the sample was placed on the microscope slide (sample side down). The cover slip was pressed firmly onto the slide to remove bubbles from between the cover slip and slide. The mounted sample was allowed to cool at room temperature for 24 hours before microscopic examination. The slides were labeled and approximately 300 cleared frustules were counted and identified at 1000x from random fields. A NIKON LABOPHOT microscope with an oil immersion objective was used for examination of all cleared diatom samples. Results are reported as percent of total diatom frustules.

Four of the 57 periphyton samples (7%) collected during the study were also analyzed by Frank Pickett (Butte, MT), an independent consultant, for QA/QC verification. Mr. Pickett has been a biologist for Montana Power for 15 years. He was recommended to WRD by Loren Bahls, Senior Biologist for the Montana Water Quality Bureau. Mr. Pickett reviewed the same slides analyzed by CHEM-PRO and followed the same procedures.

Poorman Creek

1. immediately above Bear Creek Road and potential tailings pond (PC-2)
2. below potential tailings area (PC-1) and above confluence with Libby Creek

Little Cherry Creek

1. above Bear Creek Road and potential tailings dam (LC-2)
2. below potential tailings dam (LC-1)

Rock Creek

1. East Fork of Rock Creek (EFRC)
2. Rock Creek Meadows (RCM)
3. Rock Lake

Map 7.2 shows the sampling sections established during this study. Sample sections were established such that post-development sampling would reflect effects from any combination of plant and tailing sites based on comparisons with spatial and temporal baseline control sections.

Non-wilderness stream reaches were electrofished with a gasoline powered Coffelt BP1C backpack shocker. Sections in the Cabinet Mountains Wilderness were electrofished with a battery-powered Coffelt BP2C backpack shocker. Prior to sampling, a block net (1/4 inch nylon mesh) was set at the lower end of the section. Fish were collected with dip nets in two passes (two sections required three removal passes) through the sections with the backpack shocker progressing downstream through the reach. Shocked fish were transferred to live cars in five-gallon plastic buckets and held for processing. Fish less than 3 inches were held alive, but excluded from population estimates because of poor sampling efficiency. Upon completion of a pass, all fish were transferred from live cars into plastic buckets, anesthetized, measured, and weighed. Scales were taken from most fish. Processed fish were returned to live cars if a second or third pass was to be conducted. When sampling was completed, fish were redistributed within the sample section. Two-pass estimates were calculated with methods described by Leathe (1983) and for more than two removal passes, methods described by Armour, et al. (1983). Mark-recapture population estimates were calculated with Chapman's modification of the Peterson formula (Vincent 1971).

The mark-recapture method was used to obtain a population estimate for Rock Creek Meadows. An electrofishing boat, along with hook and line, was used to capture fish

on the initial or mark run. Collected fish were marked with an adipose fin clip and redistributed within the sampled section. About one week later, a second, recapture run, using the same methods, was conducted. Collected fish were anesthetized, measured, weighed, and scales taken.

Only age and growth data were collected from fish in Rock Lake. Two 50 foot gill nets, along with hook and line, were used to capture fish. Fish were measured and scales collected.

3.3.2 Age And Growth

Scales for age and growth analysis were collected, from most fish greater than three inches in each reach, placed in individual envelopes, and labeled with the species, fish length and weight, date, stream section, and means of capture. Scale impressions were made on heated acetate strips using a hydraulic press. These impressions were then aged and measured along a standard radius using a microfiche reader for backcalculation of length at annulus. Age and measurement data were analyzed on a microcomputer using programs developed by MDFWP, Region One, Fisheries Division, Kalispell, Montana.

3.3.3 Spawning

A total of 21.6 miles of Libby, Ramsey, and Poorman Creeks were visually searched for bull trout redds on October 11-13, 1989. This survey accomplished the objective of an October, 1988, survey which was cancelled by Joe Huston (MDFWP) because heavy rains flooded study area streams, obliterating the redds, the week preceding the survey. Surveys covered 6.82 miles of upper Libby Creek, from 0.2 miles below the wilderness boundary to the confluence with Midas Creek on October 11 and 8.0 miles of lower Libby Creek from Midas Creek to the U.S. Highway 2 bridge on October 12. Ramsey Creek, from just above the confluence with the creek draining Ramsey Lake to the Ramsey-Libby Creek confluence (4.98 miles), was surveyed on October 13 along with 1.8 miles of Poorman Creek, from the Bear Creek Road to Libby Creek. Surveys were conducted approximately one to three weeks after spawning had occurred and survey conditions were excellent.

Observers (K. Sage, MDFWP, and R. Thompson, WRD) walked downstream searching for gravel deposits and spawning beds within them. Where streams braided, observers separated to survey each braid. Observers also noted size, species, and relative number of fish observed per reach, availability of suitable spawning gravels, size of redds, and barriers to upstream fish movement. Distances were

measured from the 1:24,000, Howard Lake, Cable Mountain, and Horse Mountain 1983 USGS quadrangles using a map wheel.

Libby Creek was visually searched for spawning concentrations of mountain whitefish (*Prosopium williamsoni*) in mid-November 1988. Biologists walked 11.46 miles of the creek from the Howard Lake Road bridge to the U.S. Highway 2 bridge looking for large whitefish schools suspected of moving out of the Kootenai River.

3.3.4 Heavy Metals

Twenty-five rainbow trout were collected from the downstream sampling section of Libby Creek (LB-1) for heavy metals analysis of their tissues. Five fish per inch class were collected (3.0-3.9, 4.0-4.9, 5.0-5.9, 6.0-6.9, and >7.0). Captured fish were individually placed in labeled plastic bags after they were measured and weighed. Collected fish were placed on ice and frozen as soon as possible. Later, muscle tissues were excised from the back, anterior to the dorsal fin, and sent to the Analytical Lab at Montana State University, Bozeman, Montana, for mercury content determination. Livers were extracted and sent to the Department of Health and Environmental Sciences, Helena, Montana, for analysis of copper, zinc, lead, and cadmium concentrations. Analyses for specific metal concentrations followed MDFWP recommendations (Joe Huston, MDFWP, pers. comm.).

3.3.5 Threatened, Endangered, and Sensitive Fish Species

Fish species of special concern to the U.S. Fish and Wildlife Service (FWS), Kootenai National Forest, State of Montana (Flath 1984), and Montana Natural Heritage Program (MNHP), and which occurred in MP area streams, were sampled in conjunction with the fisheries baseline surveys. Sensitive species which do not inhabit project area streams, but which may occur downstream in the project area's drainages, were addressed by literature review, a November 1988 MNHP computer search, and interviews with knowledgeable state and federal agency personnel.

SECTION 4.0

RESULTS AND DISCUSSION

4.0 RESULTS AND DISCUSSION

4.1 PHYSICAL HABITAT

A total of 24 stream reaches were identified among the six perennial streams in the MP study area (see Table 3.1.1). Each stream reach was given an alphanumeric classification (Table 4.1.1) according to Rosgen (1985). In general, 1st order streams were classified as Type A, 2nd and 3rd order streams as Type B, and 4th order streams as Type C. Some stream reaches were difficult to classify succinctly using this multiple feature characterization and, consequently, assignment to specific stream types was rather subjective. Although braiding of the stream channel was minimal at the time of the survey, reaches Li-4 and Li-8 were classified as Type D1 (braided with a cobble substrate) because the channel was obviously unstable and prone to migration.

Throughout the Libby Creek drainage, bedrock outcroppings determined the effective stream gradient, controlled bedload transport, and delineated distinct stream reaches. Instream debris (timber) provided important localized gradient checks which result in gravel accumulation. In addition, timber in the active stream channel provided most of the instream cover and pool habitat within study area streams.

During August, 1988, stream habitats within the MP study area were surveyed using the GAWS level 3 (USFS 1985, 1988) assessment. The principal outputs of this model include the Habitat Condition Index (HCI), Habitat Vulnerability Index (HVI), and Riparian Habitat Condition Rating. Appendix 6.S (an unattached supplement to this report which is available upon request from the MMV) contains the raw data and original GAWS printouts.

4.1.1 Riparian Habitat Condition

The Riparian Habitat Condition Rating is derived from an evaluation of up to nine components of the plant community and physical substrate in the riparian zone. The structure of the riparian community (seral stage) determines the criteria and rating scale used to evaluate habitat condition. Nearly all reaches were classified as "Tree Potential Natural Communities." Accordingly, possible scores ranged from 0 to 36 with scores from 22 to 30 rated as good and scores greater than 30 considered excellent. With a single exception, riparian habitats were in good or excellent condition throughout the MP study area (Table 4.1.1.1). The riparian habitat along the braided section of Libby Creek (Li-4), where the effects of extensive, historic

Table 4.1.1 Classifications of Montana Project stream reaches based on geomorphic features (after Rosgen 1985).

Creek	Reach	Stream Type
Bear	1	B2
	2	B2/3
	3	B2
Little Cherry	1	A3
Poorman	1	B3/4
Ramsey	1	B1
	2	B1
	3	B1
	4	C4/6
Libby	1	C1
	2	C1
	3	C1/B2
	4	C3/D1
	5	B2/3
	6	B1
	7	B2
	8	B1
	9	B1
	10	B1
	11	A2
East Rock	1	B1/2
	2	B1
	3	C3/5
	4	A1

TABLE 4.1.1.1. Riparian habitat condition scores and habitat vulnerability index values for Montana Project study area stream reaches and stations.

Creek	Reach	Station	Riparian Habitat Condition Score[a]	Reach Average	HVI[b]	PV[c]	Reach Average HVI[b]	Reach Average PV[c]
Bear	1	1.1	30		43.18	L[a]		
		1.2	32		52.27	M[b]		
		1.3	27	29	38.18	L	44.55	L
	2	2.1	32		56.36	M		
		2.2	32		55.91	M		
		2.3	32	31	60.91	H	57.73	M
	3	3.1	30		60.45	H		
		3.2	30		65.91	H		
		3.3	31	30	59.55	M	61.97	H
Little Cherry	1	1.1	33		55.91	M		
		1.2	35		50.45	M		
		1.3	31	33	52.27	M	52.88	M
Poorman	1	1.1	33		56.82	M		
		1.2	32		37.27	L		
		1.3	33	32	43.18	L	45.76	M
Ramsey	2	2.1	32		61.36	H		
		2.2	32		59.09	M		
		2.3	29	31	56.36	M	58.94	M
	3	3.1	33		65.91	H		
		3.2	30		42.27	L		
		3.3	34	32	65.91	H	58.03	M
	4	4.1	27		60.45	H		
		4.2	32		60.45	H		
		4.3	36	31	60.45	M	60.45	H
Libby	1	1.1	33		50.91	M		
		1.2	34		55.91	M		
		1.3	33	33	59.55	M	55.45	M
	3	3.1	34		60.45	H		
		3.2	34		55.91	M		
		3.3	33	33	50.45	M	55.61	M
	4	4.1	21		52.27	M		
		4.2	17		51.82	M		
		4.3	18	18	42.27	L	48.79	M
	5	5.1	27		47.73	M		
		5.2	28		41.82	L		
		5.3	30	29	42.27	L	43.94	L

TABLE 4.1.1.1. Continued

Creek	Reach	Station	Riparian Habitat Condition Score[a]	Average Reach	HVI[b]	PV[c]	Reach Average HVI[b]	Reach Average PV[c]
Libby	8	8.1	22		40.45	L		
		8.2	26		43.18	L		
		8.3	29	25	50.45	M	44.70	L
	10	10.1	33		56.36	M		
		10.2	32		50.45	M		
		10.3	35	33	51.36	M	52.73	M
	11	11.1	31		56.82	M		
		11.2	33		55.00	M		
		11.3	33	32	55.91	M	55.91	M
East Rock	1	1.1	32		60.91	H		
		1.2	33		65.00	H		
		1.3	34	33	51.82	M	59.24	M
	3	3.1	34		70.00	H		
		3.2	30		60.45	H		
		3.3	25	29	58.64	M	63.03	H
	4	4.1	31		50.45	M		
		4.2	32		53.64	M		
		4.3	28	30	55.45	M	53.18	M

[a]Riparian Habitat Condition scores range from 0 to 36 and represent the sum of nine vegetation and substrate ratings. Stations with scores of 4 or less are in the poorest condition.
[b]Habitat Vulnerability Indices (HBI) range from 0 to 100 and increase with a stream's susceptibility to damage from management activities.
[c]Potential Vulnerability rankings are: L = Low; M = Moderate; and H = High.

placer mining on riparian habitat remain evident, was rated as fair.

4.1.2 Habitat Vulnerability Index (HVI)

The HVI is a system of rating stream reaches according to their susceptibility to aquatic habitat degradation. This index is derived from measures of valley bottom width, stream gradient, upper bank slope (gradient), lower bank slope, bank stability, and indications of sediment production. Model assumptions include: (1) the wider the valley bottom, the less susceptible to impact the stream; (2) the greater the stream gradient, the less susceptible the stream; (3) the less steep the adjacent valley side slopes, the less vulnerable the stream; (4) the less steep the lower banks, the less vulnerable the stream; (5) the more stable the bank, the less vulnerable the stream; and (6) the more numerous the occurrence of potential sediment production, the more vulnerable the stream. HVI values range from 0 to 100 and increase with a stream's susceptibility to habitat degradation. A stream's potential vulnerability can be classified as high (scores >60), moderate (45 to 60), or low (<45).

Stream reach HVI's in the MP study area varied from low to high, with the upper Bear Creek reach (Be-3), the upper Ramsey Creek reach (Ra-4), and Rock Creek Meadows (Ro-3) ranked as highly vulnerable (Table 4.1.1.1). Upper Bear Creek had a HVI of 62 and was considered highly vulnerable due to its narrow valley bottom, steep side slopes, and steep banks. The preponderance of large downfall in the active stream channel resulted in a relatively low bank stability rating which also contributed to the high vulnerability ranking. The Rock Creek Meadows and upper Ramsey Creek received high HVI values (63 and 60, respectively) due to their low stream gradient, steep banks, and unstable (small particle size) banks.

All other stream reaches were rated as having a moderate or low (Li-5, Li-8, and Be-1) susceptibility to degradation. Headwater streams, with narrow valley bottoms and steep side slopes, tended to receive higher HVI scores than downstream reaches. The HVI is primarily an estimate of a stream's vulnerability to increased sediment loading. The index's predictive abilities, with regard to altered flow regimes, debris recruitment, and thermal insulation, appear limited.

4.1.3 Habitat Condition Index (HCI)

The HCI is a general measure of fish habitat quality which combines six habitat features to provide an overall index. The index represents a mean value of the following parameters: pool measure (pool to riffle ratio),

pool structure (quality), stream bottom composition (particle size), bank cover, streambank soil stability, and streambank vegetation stability. Possible values for this index range from 0 to 100 with higher scores indicating better quality habitat.

Among study area stations, values averaged 68.5 and ranged from 48.2 (Station Ra 4.1) to 86.7 (Station Be 3.3) (Table 4.1.3.1). HCI values for each station and mean values for each stream reach are presented in Table 4.1.2. In general, components of the index that measured bank cover and stability were excellent and scored from 75 to 100% while measurements of pool quality and quantity tended to be lower, which reduced overall scores. Typically, the stream reaches receiving the lowest scores had predominantly sandy substrates in addition to poor pool quality. Stream reaches flowing through stands of mature forest had higher quantities of organic debris and tended to have more and better pool habitat.

4.1.3.1 Bear Creek

Bear Creek had the best aquatic habitat and highest HCI scores among study area streams. The overall HCI for Bear Creek was 76.5 and average values for reaches Be-1, -2, and -3 were 73.2, 78.6, and 77.7, respectively (Table 4.1.3.1). The lack of pools near the stream's mouth (Station 1.1) resulted in the lower score (59.2) at Station 1.1 and for reach Be-1.

4.1.3.2 Little Cherry Creek

HCI values averaged 65.9 in Little Cherry Creek with values ranging from 54.9 at Station LC-1 to 81.5 at LC1-2 (Table 4.1.3.1). The low score at Station 1.1 was primarily attributable to the lack of pools.

4.1.3.3 Poorman Creek

Due to the lack of significant pool habitat, the mean HCI value for Poorman Creek was relatively low at 60.4 (Table 4.1.3.1). Values were similar for all three stations. Stream banks were stable with excellent vegetation cover.

4.1.3.4 Ramsey Creek

HCI values were 72.0, 65.4, and 50.0 for reaches Ra-2, Ra-3, and Ra-4, respectively (Table 4.1.3.1). The upper, meandering reach of Ramsey Creek (Ra-4) received the lowest HCI score among study reaches. The low score was a consequence of the grassy stream banks, small substrate particle size, and lack of riffles; conditions that reflect the low gradient in this reach. This

TABLE 4.1.3.1. Habitat condition index values, potential spawning areas (%), and potential rearing areas (%) for Montana Project study area streams.

Creek	Reach	Station	HCI[a] Station and Reach Averages		Potential Spawning Area (%)		Potential Rearing Area (%)	
Bear	1	1.1	59.2		29.1		17.8	
		1.2	77.2		22.3		34.5	
		1.3	83.1	73.2	38.3	29.1	21.2	25.1
	2	2.1	74.2		36.3		18.7	
		2.2	77.2		36.7		15.7	
		2.3	84.5	78.6	39.9	37.6	60.4	31.6
	3	3.1	72.8		22.7		7.4	
		3.2	73.5		23.3		32.1	
		3.3	86.7	77.7	22.1	22.7	48.7	28.4
Little Cherry	1	1.1	54.9		27.7		0.0	
		1.2	81.5		31.3		38.5	
		1.3	61.3	65.9	16.5	25.2	15.4	17.8
Poorman	1	1.1	62.9		39.0		11.7	
		1.2	59.1		47.3		4.5	
		1.3	59.3	60.4	20.7	35.2	7.2	8.0
Ramsey	2	2.1	60.4		39.9		3.1	
		2.2	81.7		27.6		21.6	
		2.3	74.0	72.0	19.1	29.1	14.9	13.3
	3	3.1	56.5		8.5		14.6	
		3.2	76.6		22.1		19.6	
		3.3	63.2	65.4	23.0	18.6	31.7	21.9
	4	4.1	48.2		0		100	
		4.2	50.2		0		100	
		4.3	54.2	50.9	15.3	4.4	96.4	99.0
Libby	1	1.1	60.9		34.4		0.0	
		1.2	79.3		53.5		3.9	
		1.3	82.2	74.1	42.7	44.6	18.9	7.7
	3	3.1	82.3		5.3		41.4	
		3.2	80.1		20.7		11.1	
		3.3	64.1	75.5	39.4	25.0	7.8	16.8
	4	4.1	49.6		40.0		23.4	
		4.2	56.1		35.5		23.4	
		4.3	60.4	55.4	24.1	34.2	17.0	21.7
	5	5.1	71.1		32.3		21.4	
		5.2	77.6		18.9		33.6	
		5.3	51.6	66.8	27.6	26.2	2.3	18.2

TABLE 4.1.3.1. Continued

Creek	Reach	Station	HCI[a] Station and Reach Averages		Potential Spawning Area (%)		Potential Rearing Area (%)	
Libby	8	8.1	72.3		35.3		45.1	
		8.2	60.2		31.0		6.3	
		8.3	77.7	70.1	42.8	36.6	63.3	39.2
	10	10.1	61.4		36.4		2.0	
		10.2	76.6		23.4		38.3	
		10.3	73.9	70.6	21.8	26.7	19.3	20.6
	11	11.1	79.6		34.2		38.0	
		11.2	83.1		40.5		20.5	
		11.3	77.2	80.0	26.1	33.8	31.1	28.6
East Rock	1	1.1	76.3		6.5		11.8	
		1.2	76.5		7.8		19.5	
		1.3	73.3	75.4	2.4	5.7	75.5	34.2
	3	3.1	59.2		39.4		0.0	
		3.2	64.2		4.2		88.1	
		3.3	58.4	60.6	0.3	3.6	100.0	91.1
	4	4.1	68.4		3.9		72.7	
		4.2	48.3		2.2		0.0	
		4.3	66.6	61.1	0.0	2.3	39.2	34.4

[a]Habitat Condition Indices (HCI) are general measures of fish habitat quality. Values range from 0 to 100 and represent the unweighted mean of six parameters, including pool/riffle ratio, pool structure, streambottom composition, bank cover, streambank soil and vegetation stability. Higher values indicate better quality habitat.

stream reach appeared to be devoid of fish (see Secton 4.3.1.3 of this report).

4.1.3.5 Libby Creek

Among the seven reaches surveyed in Libby Creek, mean HCI values averaged 70.4 and ranged from 55.4 (Li-4) to 80.0 (Li-11) (Table 4.1.3.1). Unlike most study area stream reaches, Li-4 had unstable banks with little or no protective bank cover and, consequently, recieved the second lowest rating among study area reaches. For the reach immediately upstream (Li-5), the lack of pools and poor bank stability also lowered the HCI. All other reaches in Libby Creek received scores of 70 or more with pool structure the primary limiting factor. At the uppermost stream reach (Li-11) the mean HCI score was 80 with the preponderance of bedrock the principal limiting agent.

4.1.3.6 East Fork of Rock Creek

Of the three stream reaches evaluated in Rock Creek's East Fork, the downstream reach (Ro-1) had the highest mean HCI (75.4) (Table 4.1.3.1). The HCI value for Rock Creek Meadows (Ro-3) was a relatively low 60.6. The HCI was influenced by the fine sediments and absence of riffles which characterize this low gradient reach.

4.1.4 Potential Spawning and Rearing Areas

Potential spawning and rearing areas were estimated for each station and stream reach (Table 4.1.3.1). Potential Spawning Areas (PSA) at the time of survey were defined as that portion of the stream bottom covered by 3 to 75 mm diameter (1/8 to 3 inch) gravel. Potential Rearing Areas (PRA) were defined as the area of the stream at the time of the survey with water velocities less than or equal to one foot per second. These data are primarily intended as tools for identifying areas where habitat improvement would be effective and, at best, provide very crude estimates of actual spawning and rearing habitat.

The estimated percentage of stream bottom as potential spawning gravels ranged from 2% in the East Fork of Rock Creek above the meadows (Ro-4) to 45 percent in lowest study reach of Libby Creek (Li-1). Predominantly gravel substrates were scarce throughout the East Fork of Rock Creek (Table 4.1.3.1). In contrast, predominantly gravel substrates accounted for 20 to 40% of the stream bottom at the time of survey in most of the Libby Creek drainage.

The utilization of a particular stream reach by spawning fish depends on several factors in addition to substrate particle size. More useful evluations of spawning

potential can be obtained when, in addition to substrate size, other important habitat parameters are considered. Graham et al. (1984) reported that stream order, channel gradient, and channel substrate sizes were significantly correlated to bull trout redd frequencies in the Flathead River drainage. They found the highest frequency of bull trout redds in predominantly small gravel (6 to 50 mm) substrates located in low gradient (mean 1.5%) reaches of 3rd and 4th order streams. Considering these parameters, the most likely bull trout spawning areas in the MP study area included Bear Creek downstream of the Bear Creek Road (Be-1 and -2), Libby Creek below the confluence of Bear Creek (Li-1 and -2), and Libby Creek near the confluence of Poorman Creek (Li-4 and -5). The lower 200 meters of Poorman Creek and Libby Creek downstream from Ramsey Creek (Li-7) and Howard Creek (Li-8) also contained potential spawning areas.

Spawning habitat was limited in the East Fork of Rock Creek due to the preponderance of large substrate materials. Small deposits of spawning gravels were present immediately above and, to a greater extent, immediately below Rock Creek Meadows. Other potential spawning sites appeared limited to small gravel deposits in relatively low gradient sections near the lower end of the East Fork of Rock Creek. The availability of spawning habitat in the Rock Creek drainage is further restricted because the lower portions of the creek regularly dry up in late summer, blocking upstream movements of fall spawners out of Cabinet Gorge Reservoir. See Section 4.3.5.4 of this report for additional discussion of this subject.

4.2 AQUATIC BIOLOGY

4.2.1 Aquatic Macroinvertebrates

The raw data, descriptive statistics, and values of indices used to characterize macroinvertebrate collections from August and October, 1988, and April, 1989, are presented in Appendices 6.3 through 6.5, respectively. The number of organisms in a sample has important implications regarding the appropriateness and reliability of data analyses. Samples containing less than 100 organisms are generally considered inappropriate for statistical analyses and some analysis techniques may require 300 to 400 organisms to provide reliable data (DAT Index, USFS 1985). The samples obtained during this study contained an average of 230 organisms. With few exceptions, individual samples contained more than 100 macroinvertebrates and were sufficient for statistical analyses. In addition to individual sample means and standard deviations, the three samples from each station were combined, and each index was calculated from the pooled data (Appendices 6.3-5). It is important to

note that Shannon diversity and measures of taxa richness are not independent of sample size, but increase with the number of organisms in a sample. Comparisons using these indices would be more meaningful if they were based on a standard number of organisms.

Two sampling techniques were used to collect macroinvertebrates during this study. In the Libby Creek drainage, fine mesh Hess samples were collected. In the East Fork of Rock Creek, where large substrates precluded the effective use of the Hess sampler, samples were collected with a coarse mesh kicknet. Mesh size undoubtedly influenced the composition of the fauna collected by each technique; however, differences in habitat (the reason for the different sampling methods) probably had a far greater influence on the macroinvertebrate abundance and community composition in the two drainages. Since the habitats sampled were decidedly different, rigorous statistical comparisons between the two drainages are not warranted. The two data sets are, however, sufficiently compatible to allow careful subjective comparison.

Study area streams supported a sparse, but diverse, macroinvertebrate fauna that was indicative of very good water quality. Nearly 40,000 organisms, distributed among 144 taxa (Table 4.2.1), were collected during this investigation. The ten most abundant taxa included four mayfly genera (*Cinygmula* spp., *Epeorus* spp., *Rhithrogena* spp., and *Baetis* spp.), two stonefly taxa (*Chloroperlinae* and *Zapada* spp.), three chironomids (*Micropsectra* spp., *Rheocricotopus* sp., and *Paraphaenocladius* spp.), and a fingernail clam (*Sphaeriidae*). With the exception of the fingernail clam, which was abundant only in Rock Creek Meadows (Ro-3), these taxa were abundant throughout the study area. Other taxa that were locally or seasonally abundant included *Drunella coloradensis, D. doddsi, Paraleptophlebia* sp., *Perlomyia* sp., *Doddsia* sp., *Yoroperla brevis, Rhyacophila betteni gp., Apatania* sp., *Oligophleboides* sp., *Tvetenia* spp., *Polypedilum* sp., *Stempellina* sp., *Thienemannimyia gp.*, and *Prosimulium* sp. Most of these taxa are considered intolerant of fine sediments, heavy metals, and organic pollution and could be used to monitor water quality and environmental conditions in study area streams. To be effective, a monitoring program based on densities of indicator species will require additional documentation of the life history, distribution, and natural variability in the density of each species or taxon.

Nine parameters were used to characterize macroinvertebrate assemblages in study area streams (Tables 4.2.2-4). Without exception, the macroinvertebrate fauna in study area streams were indicative of extremely high water quality. The low macroinvertebrate density and biomass that typified most staitons was attributed to the inherent low

Table 4.2.1 A list of aquatic macroinvertebrates collected from Montana Project area streams during August and October, 1988, and April, 1989.

ORDER	FAMILY	GENUS/SPECIES
COLLEMBOLA		
	Poduridae	
COLEOPTERA		
	Dytiscidae	
	Elmidae	*Cleptelmis ornata*
		Heterlimnius corpulentus
		Lara avara
		Narpus concolor
		Optioservus sp.
		Zaitzevia parvula
	Hydrophilidae	*Helophorus sp.*
		Hydrobius sp.
		Hydrochus sp. ?
		unidentified larvae
	Staphylinidae	
DIPTERA		
	Chironomidae	unassociated pupa
	(Podonominae)	*Boreochlus sp.*
	(Tanypodinae)	*Krenopelopia (?) sp.*
		*Macropelopia sp. [Brundininella (?) sp.]**
		Paramerina sp.
		Thienemannimyia group
		Zavrelimyia sp.
	(Diamesinae)	*Diamesa spp.*
		Monodiamesa sp.
		Pagastia sp
		Psuedodiamesa sp.
	(Orthocladiinae)	*Brillia sp.*
		Bryophaenocladius sp.
		Cardiocladius spp.
		Chaetocladius sp.
		Corynoneura sp
		Cricotopus spp.
		Diplocladius sp.
		Eukiefferiella spp.
		Krenosmittia sp.
		Heterotrissocladius sp
		Hydrobaenus sp.
		Lopescladius sp.
		Orthocladius spp.
		*Paraphaenocladius spp. [Psilometriocnemus & Parametriocnemus sp.]**
		Psectrocladius sp.
		Psuedoorthocladius sp.
		Rheocricotopus sp. *[Zalutshia (?) sp.]**
		Symposiocladius sp.
		Synorthocladius sp.
		Thienemanniella sp.
		Tvetenia sp.

Table 4.2.1 Continued.

ORDER	FAMILY	GENUS/SPECIES
DIPTERA (cont.)		
	(Chironominae)	*Micropsectra spp.*
		Microtendipes sp.
		Phaenopsectra sp
		Polypedilum spp.
		Rheotanytarsus sp.
		Stempellina sp.
	Tipulidae	*Antocha sp.*
		Dicranota sp.
		Hesperoconopa sp.
		Hexatoma sp.
		Pedicia sp.
		Rhabdomastix sp.
		Tipula spp.
	Empididae	*Chelifera sp.*
		Hemerodromia sp.
		Oreogeton sp.
	Tabanidae	*Tabanus sp.*
	Athericidae	*Atherix pachypus*
	Simuliidae	*Simulium spp.*
		Prosimulium sp.
	Psychodidae	*Pericoma sp.*
	Certatopogonidae	(Stilobezzini)
	Syrphidae	
	Pelecorhynchidae	*Glutops sp.*
EPHEMEROPTERA		
	Siphlonuridae	*Ameletus spp.*
	Baetidae	*Baetis bicaudatus*
		Baetis tricaudatus
	Heptageniidae	*Cinygma sp.*
		Cinygmula spp.
		Epeorus deceptivus (?)
		Rhithrogena spp. (robusta,hageni,sp)
	Ephemerellidae	*Caudatella edmundsi*
		Caudatella hystrix
		Drunella coloradensis
		Drunella doddsi
		Drunella spinifera
		Ephemerella infrequens/inermis
		Serratella tibialis (spp?)
	Leptophlebiidae	*Paraleptophlebia spp.*
MEGALOPTERA		
	Sialidae	*Sialis sp.*

Table 4.2.1 Continued.

ORDER	FAMILY	GENUS/SPECIES
PLECOPTERA		
	Peltoperlidae	*Yoraperla brevis*
	Taeniopterygidae	*Doddsia sp.*
		Taeniopteryx sp.
	Nemouridae	*Visoka sp.*
		Zapada spp. (columbiana, oregonensis, frigida,
		Zapada cinctipes
	Luectridae	*Despaxia sp.*
		Perlomyia sp.
	Capniidae	*Capnia gp. (including Eucapnopsis sp.)*
	Perlidae	*Doroneuria theodora*
	Perlodidae	*Isoperla sobria*
		Kogotus sp.
		Megarcys sp.
		Rickera sp.?
		Setvenia bradleyi
		Skwala sp.
	Chloroperlidae	*Kathroperla perdita*
		Chloroperlinae (including *Alloperla, Sweltsa and Suwallia sp.)*
TRICHOPTERA		
	Philopotamidae	*Dolophilodes sp.*
		Wormaldia sp.
	Polycentropodidae	*Polycentropus sp.*
	Hydropsychidae	*Arctopsyche grandis*
		Cheumatopsyche sp.
		Hydropsyche (Ceratopsyche) oslari or tana
		Parapsyche elsis
	Rhyacophilidae	*Rhyacophila sp.*
		Rhyacophila Alberta gp.
		Rhyacophila Betteni gp.
		Rhyacophila Brunnea gp.
		Rhyacophila Coloradensis gp.
		Rhyacophila Hylinata gp
		Rhyacophila Sibrica gp
		Rhyacophila Iranda gp. (sp.1, verrula)*
		Rhyacophila narvae (velpulsa)*
	Glossosomatidae	*Agapetus sp.*
		Anagapetus sp.
		Glossosoma sp.
	Hydroptilidae	*Agraylea sp.*
		Hydroptila sp.
		Ochrotrichia sp.
	Brachycentridae	*Micrasema sp.*
	Lepidostomatidae	*Lepidostoma spp.*

Table 4.2.1 Continued.

ORDER	FAMILY	GENUS/SPECIES
TRICHOPTERA (cont)	Limnephilidae	*Apatania sp.*
		Chryandra sp.
		Cryptochia sp.
		Dicosmoecus sp.
		Ecclisomyia sp.
		Homophylax sp.
		Limnephilus (?) sp.
		Neothremma sp.
		Neophylax sp.
		Oligophlebodes sp.
		Psychoglypha sp.
MOLLUSCA		
	Sphaeriidae	
	Lymnaidae	
	Physidae	
ANNELIDA		
	Enchytraeidae	
	Lumbricidae	
	Lumbriculidae	
	Tubificidae	
	Glossiphoniidae	
OSTRACODA		
TURBELLARIA		

* indicates ealier identifications that have been changed.

Table 4.2.2 Mean values of selected indices used to characterize communities in Montana Project area streams during August, 1988.

Station	density	taxa richness	Shannon diversity	biotic index	EPT richness	EPT/C	BCI	biomass gm dry wt
Li 1	358	32	3.9	3.6	18	1.5	83	0.03
Li 3	570	35	3.7	3.5	20	2.5	87	0.05
Li 4	468	32	3.8	3.0	19	2.5	87	0.05
Li 5	493	32	3.7	4.6	16	0.8	78	0.04
Li 8	216	29	3.9	2.0	17	5.1	86	0.03
Li10	177	26	3.8	1.6	15	6.5	95	0.02
Li11	197	28	4.0	2.8	16	1.5	90	0.01
Ra2	162	28	3.9	2.7	15	2.1	82	0.02
Ra3	164	28	3.8	2.3	16	2.4	83	0.02
Ra4	165	26	4.0	2.8	13	3.6	92	0.03
Po 1	186	31	3.9	1.6	16	6.6	79	0.03
Po 2	207	35	4.2	1.7	18	4.6	91	0.04
LC 1	308	34	3.8	3.9	17	0.8	85	0.06
LC 2*	133	26	4.0	1.0	17	17	97	na
Be 1	307	33	4.2	2.6	22	6.6	105	0.04
Be 2	193	24	3.8	2.1	15	4.6	84	0.03
Be 3	109	22	3.8	1.6	12	13	83	0.01
Ro 1*	224	29	4.0	3.3	17	3.9	89	0.07
Ro 3*	260	33	4.1	3.8	14	1.3	86	0.06
Ro 4*	135	19	3.6	1.6	13	16	92	0.10
Mean	252	29	3.9	2.6	16	5	88	0.04
Stand. dev.	129	4	0.2	1.0	2	5	6	0.02

* three kick samples (45 seconds) collected at these stations, three Hess samples (0.1 m2) collected at all other stations.

Table 4.2.3 Mean values of selected indices used to characterize aquatic macroinvertebrate communities in the Montana Project area streams during October, 1988.

Station	density	taxa richness	Shannon diversity	biotic index	EPT richness	EPT/C	BCI	biomass gm dry wt
Li 1	233	30	3.7	1.8	20	21	96	0.04
Li 3	293	26	3.4	1.7	19	63	106	0.07
Li 4	104	19	3.4	1.6	16	78	117	0.03
Li 5	75	20	3.4	1.9	15	23	115	0.02
Li 8	65	14	2.8	2.0	11	44	126	0.02
Li10	160	23	3.4	1.3	18	23	116	0.03
Li11	120	18	3.0	2.4	11	8	84	0.01
Ra2	122	20	3.5	1.2	16	64	111	0.04
Ra3	205	26	3.5	1.3	18	4.7	106	0.04
Ra4	88	20	3.5	2.4	11	6.7	102	0.02
Po 1	291	34	3.8	1.4	22	16	96	0.06
Po 2	146	25	3.6	1.4	16	14	95	0.05
LC 1	236	34	4.1	2.7	20	3	83	0.05
LC 2	126	24	3.7	2.2	16	7.9	104	0.02
Be 1	375	31	3.8	1.6	24	56	114	0.09
Be 2	192	23	3.7	0.8	18	47	107	0.05
Be 3	225	25	3.5	1.5	19	47	99	0.05
Ro 1*	58	20	3.9	1.6	15	18	104	0.09
Ro 3**	395	31	3.3	2.3	13	10	76	0.11
Ro 4*	107	24	3.7	1.7	16	28	99	0.07
Mean	181	24	3.5	1.7	17	29	103	0.05
Stand. dev.	100	5	0.3	0.5	4	23	12	0.03

* three kick samples (45 seconds) collected at Rock Creek stations, three Hess samples (0.1m2) collected at all other stations.

** modified by deleting 2,863 Sphaeriidae, original data as follows:

Ro 3	1349	32	2.5	5.2	13	10	75	na

Table 4.2.4 Mean values of selected indices used to characterize aquatic macroinvertebrate communities in the Montana Project area streams during April, 1989.

Station	density	taxa richness	Shannon diversity	biotic index	EPT richness	EPT/C	BCI	biomass gm dry wt
Li 1	215	33	3.9	2.2	19	7.1	83	0.11
Li 3	190	30	3.9	1.5	21	10.7	99	0.12
Li 4	114	22	3.6	2.5	11	2.3	86	0.06
Li 5	111	23	3.7	2.5	13	6.5	87	0.03
Li 8	102	20	3.4	2.0	11	4.1	82	0.08
Li10	192	24	3.7	2.5	14	2.1	90	0.05
Li11	113	23	3.7	2.4	12	2	79	0.03
Ra2	376	32	4	2.9	20	1.6	93	0.09
Ra3	744	38	3.9	2.7	21	1.4	80	0.08
Ra4	324	29	3.6	2.3	14	6.3	100	0.08
Po 1	196	32	4.1	2.1	18	2.9	85	0.06
Po 2	287	32	4.1	3.3	17	0.8	81	0.02
LC 1	274	35	3.9	4.5	18	0.7	77	0.04
LC 2	209	25	3.7	3.5	13	0.9	83	0.05
Be 1	252	31	3.7	1.2	20	23	88	0.14
Be 2	153	24	3.6	2.1	13	3.1	83	0.04
Be 3	103	23	3.9	2.4	12	3.1	86	0.02
Ro 1*	147	21	2.8	1.5	13	13	89	0.1
Ro 3*	482	31	3.4	4.9	12	1.1	66	0.14
Ro 4*	ND	ND	ND	ND	ND	ND	ND	ND
Mean	241	28	3.7	2.6	15	5	85	0.07
Stand. dev.	159	5	0.3	0.9	4	6	8	0.04

* three kick samples (45 seconds) collected at Rock Creek Stations 1 and 3, no samples from Ro 4. Three Hess samples (0.1m2) collected at all other stations.

productivity and extreme discharge patterns that prevail within the study area. Differences in parameter values between stations were generally small, and were attributed to differences in stream order, microhabitat diversity, substrate particle size, and productivity rather than water quality.

Several of the indices used in this investigation offer an attractive alternative, or supplement, to the indicator organism approach to environmental monitoring. The appropriateness of each index as a monitoring tool is discussed in the following sections. To facilitate rigorous comparisons over a period of years, sampling methodology, laboratory techniques, and taxonomy should be consistent. Although less variable than species density estimates, some variation, particularly on a seasonal base, should be expected. It would be prudent, therefore, to develop a multiple year database that could be used as a standard for future comparisons.

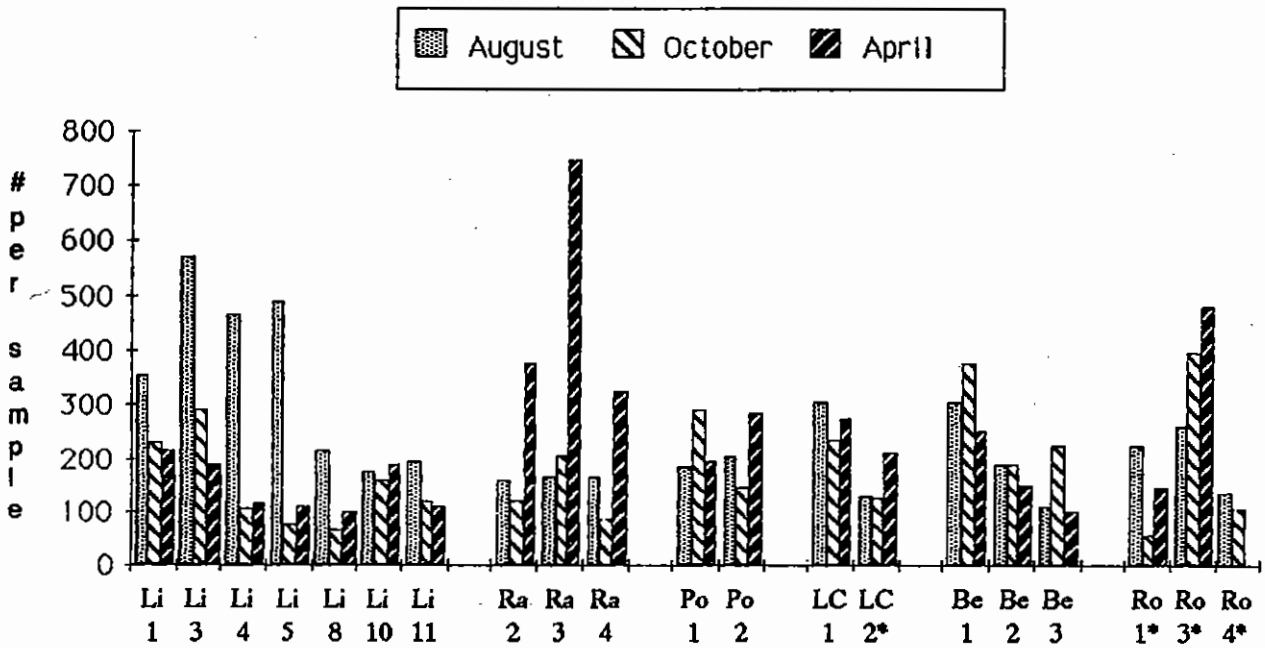
4.2.1.1 Total Macroinvertebrate Abundance

Total macroinvertebrate abundance, although variable, can be a useful indicator of overall environmental condition. Macroinvertebrate density increases in response to a stream's productivity; consequently, nutrient and/or organic enrichment will result in increased macroinvertebrate abundance. Conversely, total macroinvertebrate density will decline in response to moderate toxic pollution or severe habitat degradation. Macroinvertebrate density estimates are also influenced by factors other than water quality and habitat condition; for instance, the conditions during sampling and recent extremes in stream flow may have a profound effect on the number of macroinvertebrates collected.

Macroinvertebrate densities were quite low at most study area stations, a consequence of the low productivity and frequent extreme flow events which typify the streams. For all stations combined, densities averaged 250 in August (Table 4.2.2), 180 in October (Table 4.2.3), and 240 in April (Table 4.2.4). Relative to other study area stations, densities were consistently high (Figure 4.2.1) downstream of Rock Creek Meadows (Ro-3), at the lower station on Little Cherry Creek (LC-1), near the mouth of Bear Creek (Be-1), and in lower Libby Creek (Li-1 and Li-3).

During April, a large number of macroinvertebrates were captured at Station Ra-3, located downstream from the proposed Ramsey Creek mine site (Figure 4.2.1). Due to ice in the channel and high stream flows, samples were collected along the left bank near a spring seep. The high density estimate (744 organisms per Hess sample) was attributable to the favorable conditions within

Figure 4.2.1 Aquatic macroinvertebrate densities (organisms per sample) at twenty locations in Montana Project area streams, August and October, 1988, and April, 1989.



* Kick samples were collected at Rock Creek stations on each date and at LC-2 during August. Hess samples (0.1 m2) were collected at LC-2 during October and April and at all other stations.

the plume of spring water and is not representative of the reach as a whole.

Macroinvertebrate densities in Cabinet Mountain streams appeared impoverished when compared to most Montana streams. For example, macroinvertebrate densities have been estimated at more than a thousand organisms per Hess sample in Lake Creek (Envirosphere Co. 1987) and in much of the Clark Fork River drainage (McGuire 1987, 1989). Macroinvertebrate densities in study area streams were similar to those in nearby Stanley and Fairway Creeks (Envirosphere Co. 1986 and 1987).

4.2.1.2 Taxa Richness

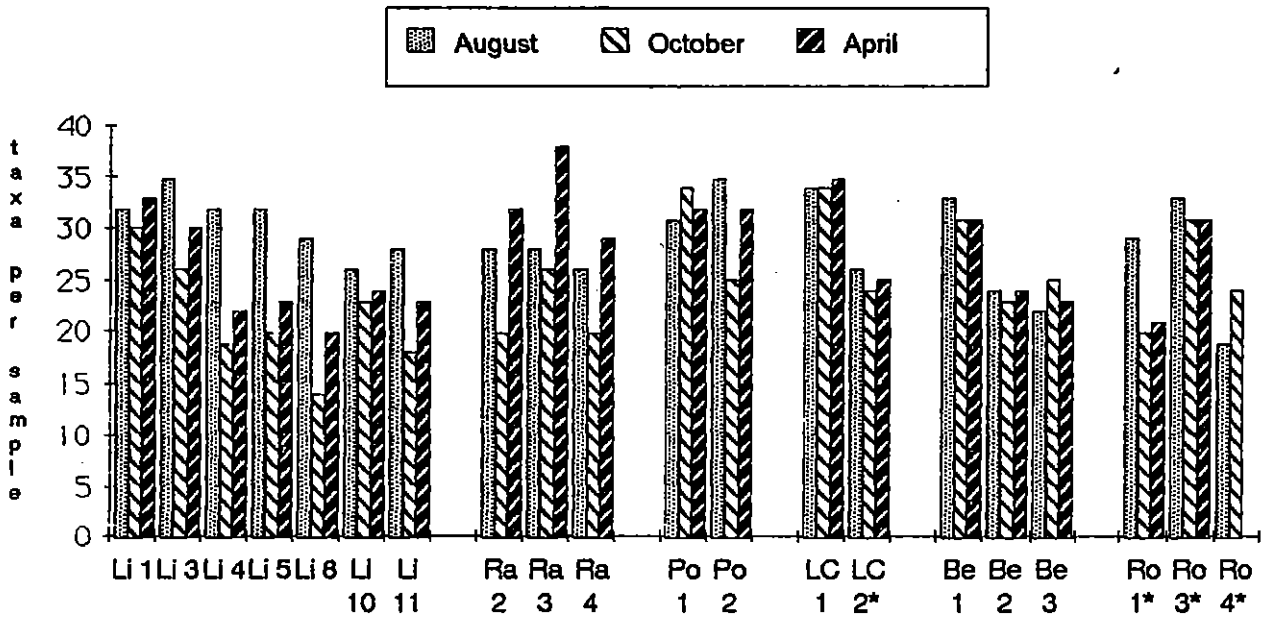
Macroinvertebrate taxa richness is potentially the single best tool for measuring the environmental condition and biological integrity of streams in the Montana Project area. It is a very robust measure of biological integrity since the loss of the "most sensitive taxa to any pollutant" will affect the index. Taxa richness is positively correlated with the number of organisms in a sample and is, therefore, most useful when based on a constant number of organisms rather than a constant sample area. Consistent taxonomy is a requisite for the effective use of this index.

For all samples combined, taxa richness averaged 29, 24, and 28 taxa per sample in August, October, and April, respectively. The relatively low number of taxa collected in October was probably a consequence of scouring and high stream flows immediately prior to sampling. Among individual stations, LC-1, Ro-3, Be-1, Po-1, Po-2, Ra-2, Li-1, and Li-3 consistently had the highest taxa richness (Figure 4.2.2) and averaged more than 30 taxa per sample. Similar values (29 to 35) were reported for the nearby Lake Creek drainage (McGuire 1987). Taxa richness was also relatively high in August, following several months of stable flows, at stations Li-4, Li-5, and Li-8. Taxa richness declined noticeably at these stations in October and April. The decline was attributable to scouring and bedload transport during episodes of high stream flow. The biotic potential of this portion of Libby Creek was substantially reduced by the unstable stream channel. Li-8 had the lowest taxa richness among study area stations and averaged only 21 taxa per sample. The relatively low taxa richness at Li-10, Li-11, and Be-3 was primarily due to the reduced effectiveness of the Hess sampler at sites with predominantly large substrate materials.

4.2.1.3 Shannon Diversity

Shannon diversity is a widely used index of environmental condition. It was originally

Figure 4.2.2 Aquatic macroinvertebrate taxa richness (taxa per sample) at twenty locations in Montana Project area streams, August and October, 1988, and April, 1989.



* Kick samples were collected at Rock Creek stations on each date and at LC-2 during August. Hess samples (0.1 m2) were collected at LC-2 during October and April and at all other stations.

developed as a measure of organic pollution but does respond to other forms of severe degradation. Values above three are usually considered indicative of good water quality while values less than two indicate polluted conditions (Weber 1973). Used with this broad empirical scale, Shannon diversity is not a reliable indicator of slight or moderate perturbations. Statistical comparisons of Shannon diversity values between sites and/or dates can provide more sensitive analyses. For the most reliable data, comparisons should be based on replicated samples containing equal numbers of organisms and taxonomy must be consistent.

Shannon diversity values averaged 3.7 during this study and, with few exceptions, were greater than 3.4 (Figure 4.2.3). Good water quality was indicated at all stations. The lowest values recorded in the study, 2.8 at Li-8 in October and Ro-1 in April, were obtained during poor sampling conditions due to high stream flows.

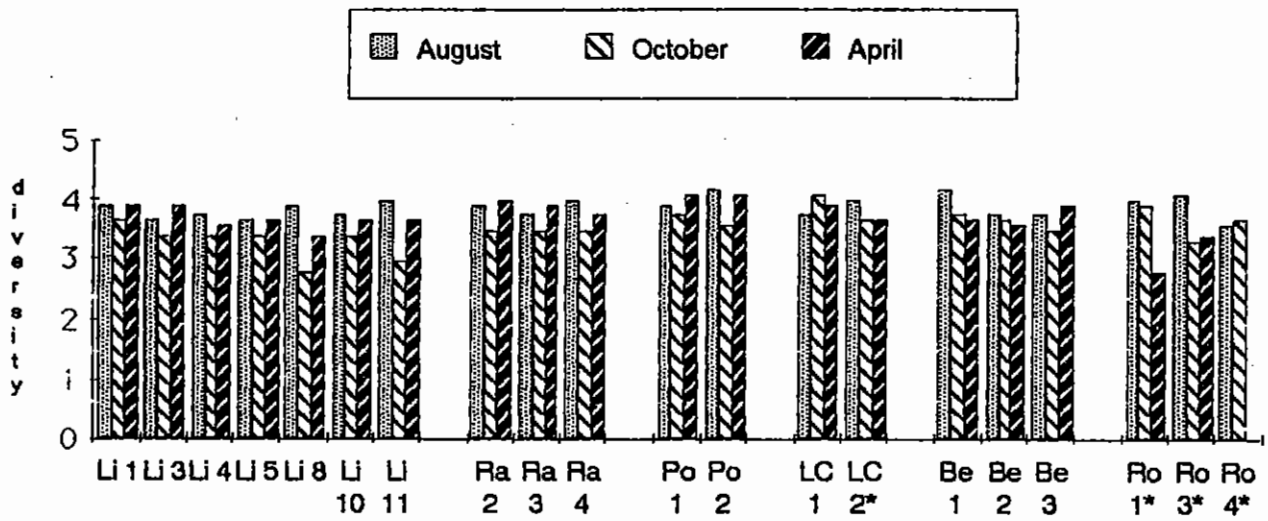
4.2.1.4 Biotic Index

The biotic index is based on the indicator organism approach to water quality assessment. Although originally developed to detect organic pollution, this index is also reasonably responsive to sediment and metal pollution. The index is based on a scale of 0 to 10 with higher values indicating more polluted conditions. Hilsenhoff (1987) recognized seven categories of water quality ranging from excellent (<3.5) through very good (3.6 to 4.5), good (4.6 to 5.5), fair (5.6 to 6.5), fairly poor (6.6 to 7.5), poor (7.6 to 8.5), to very poor (>8.5).

The mean biotic index value for study area steams was 2.3. When averaged for the three sampling dates, 18 of the 20 stations had biotic index scores in the excellent water quality category (0 to 3.5). Stations LC-1 and Ro-3, among the most productive stations in the study area, had mean biotic index values of 3.7, which is indicative of very good water quality.

This index has seen limited use in Montana but appears to be extremely sensitive to nutrient loading and organic pollution. Kerr (1988) reported that biotic index values in an unpolluted reach of the Bitterroot River, a slightly polluted reach of Big Spring Creek, and a moderately polluted section of Hot Springs Creek averaged three, four, and seven, respectively. Biotic index values were near five in moderately polluted sections of the Clark Fork River (McGuire 1989). Montana Project area streams had the lowest biotic index values recorded in Montana. The biotic index appears to provide a reliable assessment of nutrient loading and organic pollution and will probably also respond to significant heavy metal pollution. This

Figure 4.2.3 Mean macroinvertebrate Shannon diversity (per sample) at twenty locations in Montana Project area streams, August and October, 1988, and April, 1989.



* Kick samples were collected at Rock Creek stations on each date and at LC-2 during August. Hess samples (0.1 m2) were collected at LC-2 during October and April and at all other stations.

index should be included in any future biomonitoring program.

4.2.1.5 EPT Richness

EPT richness is the number of distinct taxa in the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) and is a component of the U.S. EPA rapid bioassessment methodology. Taxa in these orders are generally considered intolerant to most forms of pollution (Plafkin et al. 1988). An additional advantage of this index is that the taxonomy within these orders is relatively standardized. During this investigation, 15 mayfly, 18 stonefly, and 33 caddisfly taxa were identified from Montana Project area streams (Table 4.2.1). Given the high number of taxa within these groups found in the study area, this index should be an excellent tool for detecting deleterious impacts of metal contamination in Cabinet Mountain streams.

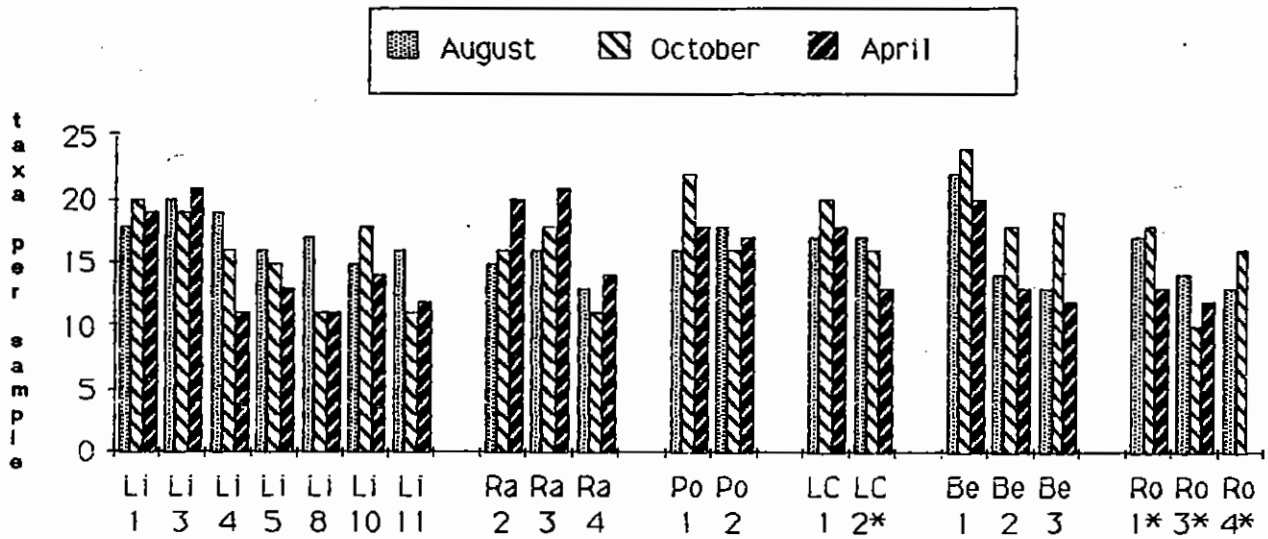
EPT richness averaged 16, 17, and 15 during August, October, and April, respectively. Values for individual stations ranged from a low of 13 at Li-5 and Ra-4 to a maximum of 22 at Be-1 (Figure 4.2.4). Similar values (18 to 21) were reported for nearby Lake, Stanley, and Fairway Creeks (McGuire 1988). By comparison, in Silverbow Creek, where metal contamination is severe, EPT richness values ranged from zero to four and, in the moderately polluted upper Clark Fork River, values were near 10 (McGuire 1987, 1989).

4.2.1.6 EPT to Chironomidae Ratio

The relative abundance of aquatic insect orders can be an effective method of detecting changing environmental conditions. The U.S. EPA rapid bioassessment methodology uses the ratio of Ephemeroptera, Plecoptera, and Trichoptera to Chironomidae to summarize these data in a simple index (Plafkin et al. 1988). During this investigation, however, EPT richness values were highly variable, ranging over two orders of magnitude (0.7 to 78). In an apparent response to scouring stream flows, values of this index increased dramatically in October. Without an extensive baseline, this index is probably too variable to be a reliable monitoring tool.

Much of the variability inherent to this index can be eliminated by considering the individual components on a seasonal basis (Table 4.2.5). Composition of the benthic community indicated a very good water quality throughout the study area. Mayflies and stoneflies accounted for the majority of organisms on each sampling date. During August and April, dipterans were numerically codominant. Dipterans were reduced in relative (and abso-

Figure 4.2.4 Mean EPT richness (number of Ephemeroptera, Plecoptera, and Trichoptera taxa per sample) at twenty locations in Montana Project area streams, August and October, 1988, and April, 1989.



* Kick samples were collected at Rock Creek stations on each date and at LC-2 during August. Hess samples (0.1 m2) were collected at LC-2 during October and April and at all other stations.

Table 4.2.5 Relative abundance of insect orders at 20 locations in Montana Project streams during August and October, 1988, and April, 1989.

Station	% mayflies			%stoneflies			%caddisflies			% dipterans			% others		
	Aug	Oct	Apr	Aug	Oct	Apr	Aug	Oct	Apr	Aug	Oct	Apr	Aug	Oct	Apr
Li 1	32	42	61	12	38	11	13	12	9	41	7	17	1	1	2
Li 3	32	55	56	10	30	14	24	9	16	32	3	14	2	3	1
Li 4	40	63	51	21	26	17	7	7	2	31	3	30	1	1	1
Li 5	19	46	39	15	32	19	6	13	4	58	6	37	3	3	1
Li 8	38	53	55	31	35	20	7	7	2	22	5	22	2	1	1
Li10	31	45	36	31	40	25	16	10	2	21	6	36	1	0	1
Li11	16	56	30	34	16	30	6	7	5	43	20	33	1	1	2
Ra 2	22	41	33	36	34	15	7	20	4	35	4	47	0	1	1
Ra 3	8	19	10	51	52	39	8	8	4	33	21	46	0	0	1
Ra 4	24	34	38	38	27	25	3	11	1	22	21	28	13	7	7
Po 1	22	31	38	41	43	27	17	14	6	20	10	28	1	2	1
Po 2	14	34	22	44	41	16	18	12	3	23	8	58	1	5	1
LC 1	11	33	15	11	22	13	10	16	5	61	22	63	7	7	4
LC 2	18	31	9	51	28	21	18	7	5	10	9	62	3	25	2
Be 1	40	53	64	13	19	19	23	19	7	15	3	8	8	6	2
Be 2	27	28	36	29	49	25	17	17	3	21	4	35	6	2	1
Be 3	33	59	29	35	21	30	10	11	5	17	4	33	5	5	3
Ro 1*	29	29	73	11	30	10	16	27	8	40	9	8	4	5	1
Ro 3*	8	14	31	11	3	2	27	5	6	41	3	48	13	75	13
Ro 4*	34	21	ND	25	24	ND	28	19	ND	8	21	ND	5	15	ND
Mean	25	39	38	28	31	20	14	13	5	30	9	34	4	8	2
Stand. dev.	10	14	18	14	12	9	8	6	3	15	7	17	4	17	3

* kick samples at Rock Creek stations, all others Hess samples, ND= no data.

lute) abundance in October samples, probably due to high flows prior to sampling. Caddisflies typically comprised 10 to 20% of the macroinvertebrate fauna.

A few stations within the study area had distinct benthic faunas (Table 4.2.5). Station Ro-3, located downstream from Rock Creek Meadows, with its preponderance of fingernail clams and dipterans, had the most unique fauna. Dipterans were also relatively more abundant at LC-1 where the deposition of fine sediments was evident. Stoneflies were relatively more abundant at headwater stations than in downstream reaches. A multiple year database would enhance the usefulness of ordinal relative abundance data.

4.2.1.7 Biotic Condition Index

The biotic condition index (BCI) measures a stream against its own potential and is based upon mean community tolerance which varies in response to intensity of perturbation to a stream's ecosystem (USFS 1985). Biotic index values above 90 are considered excellent, while values between 75 and 90 are considered good.

BCI values averaged 88, 103, and 85 during August, October, and April, respectively. The increase in values following the October spate was the opposite of the expected response. Station Ro-3, with scores of 86, 76, and 66 in August, October, and April, respectively, had the lowest BCI score for two of the three sampling periods. With the exception of the April score at station Ro-3, all BCI scores were in the good or excellent category. BCI scores were highly variable for most stations and substantially more data would be required for a reliable interpretation.

4.2.1.8 Biomass

The dry weight (biomass) of macroinvertebrates in the three samples (pooled) was determined for each set of samples (Table 4.2.6). Biomass can indicate whether a stream is reaching its potential and shows its potential for supporting a fishery (USFS 1985). USFS Fisheries Habitat Handbook (1985) categorized dry weight biomas per square meter as follows: 0 to 0.5 as poor, 0.6 to 1.4 as fair, 1.6 to 4.0 as good, and 4.1 to 12.0 as excellent.

For all Hess samples combined, biomass estimates averaged 0.3, 0.4, and 0.6 during August, October, and April, respectively. The low biomass was not surprising given the nutrient poor streams in the study area. Rock Creek appeared to be slightly more productive than streams in the Libby Creek drainage and biomass measurements for

Table 4.2.6 Equitability (Lloyd and Ghelardi 1964) and biomass values at 20 stations in Montana Project area streams during August and October, 1988, and April, 1989 (values are for three pooled Hess samples, each 0.1 m square).

	Equitability			Biomass (dry wt.-gms/.3m)		
Station	August	October	April	August	October	April
Li 1	0.51	0.51	0.49	0.08	0.13	0.33
Li 3	0.43	0.45	0.53	0.16	0.20	0.35
Li 4	0.53	0.55	0.62	0.15	0.08	0.17
Li 5	0.48	0.54	0.63	0.12	0.06	0.08
Li 8	0.59	0.52	0.56	0.10	0.07	0.24
Li 10	0.65	0.49	0.62	0.06	0.10	0.16
Li 11	0.68	0.45	0.68	0.03	0.04	0.10
Ra 2	0.64	0.65	0.61	0.05	0.11	0.27
Ra 3	0.60	0.50	0.44	0.05	0.12	0.25
Ra 4	0.69	0.63	0.51	0.10	0.06	0.23
Po 1	0.57	0.47	0.60	0.10	0.19	0.18
Po 2	0.65	0.58	0.70	0.11	0.16	0.07
LC 1	0.48	0.64	0.48	0.17	0.16	0.13
LC 2	0.72*	0.63	0.64	ND	0.07	..14
Be 1	0.69	0.48	0.48	0.13	0.26	0.42
Be 2	0.69	0.68	0.63	0.10	0.16	0.11
Be 3	0.64	0.48	0.80	0.04	0.14	0.06
Ro 1*	0.75	0.89	0.32	0.20	0.28	0.30
Ro 3*	0.70	0.11	0.37	0.19	0.32	0.41
Ro 4*	0.77	0.76	ND	0.31	0.21	ND
Mean	0.62	0.55	0.56	0.12	0.15	0.21
St. Dev.	0.10	0.15	0.12	0.07	0.08	0.12

* Kick samples.

Rock Creek tended to be higher; however, the data for Rock Creek were not directly comparable to the data from Hess samples. Biomass estimates, for the most part, reflected the occurrence of large insects in the samples. Large craneflies (*Tipula* and *Hexatoma*), stoneflies (*Doroneuria theodora*), and caddisflies (several Limnephilidae) comprised most of the biomass in each set of samples. Since the presence or absence of a few large individuals greatly influenced this index, it was quite variable and it is not recommended as a future monitoring tool.

4.2.1.9 Equitability

Equitability was originally proposed as a measure of the distribution of individuals among species. It compares the number of taxa present in a sample with a number based on the calculated Shannon diversity and a theoretical distribution of individuals among taxa (Lloyd and Gelardi 1964). Equitability values can range from 0 to 1 with values between 0.6 and 0.8 typical of unpolluted streams, while values less than 0.5 indicate degradation (Weber 1973).

Equitability values for among study area streams averaged 0.57 and ranged from 0.11 to 0.89 (Table 4.2.6). This index has a long history of use, but has fallen into disfavor because it has little ecological basis (Pielou 1977). Since it is derived, in part, from taxa richness and Shannon diversity, it provides no new information and is not recommended for monitoring.

4.2.1.10 Quality Assurance/Quality Control

As a quality assurance measure, sorting efficiency was examined. Based on the resorting of nine samples (5% of all samples), sorting efficiency was estimated at 98, 95, and 98% for the August, October, and April samples, respectively. In addition, nine samples were reviewed and the identification of additional samples were verified by Mr. Bob Wisseman (Oregon State University) (Appendix 6.6). Voucher specimens were curated and are available for examination upon request from Daniel McGuire, P. O. Box 764, Espanola, NM.

4.2.2 Periphyton

August and October, 1988, periphyton samples have been identified by Dr. John Priscu, Montana State University, Bozeman. Analyses of April, 1989, are ongoing. A complete periphyton results and discussion section will be submitted as a supplement to this report upon completion in late June or early July, 1989.

4.2.2 Periphyton

(This section supercedes the previous section 4.2.2 on page 50).

Periphyton was sparse in study area streams and algal growths sufficiently dense for sampling were difficult to find (Tables 4.2.2.1-4.2.2.6). This problem was accentuated by scouring stream flows prior to sample collection in October and April. Due to their high visibility, filamentous green and bluegreen algae were probably collected out of proportion to their relative abundance.

Green (Chlorophyta) and blue green (Cyanophyta) algae occurred throughout the study area. *Zygnema* and *Oscillatoria* were the most widespread and abundant genera (Tables 4.2.2.1 and 4.2.2.5). *Nostoc*, a bluegreen algae, was abundant in the April Little Cherry Creek (LC-1) sample (Table 4.2.2.5). This taxon was found only at this site and indicated a localized increase in sediment and nutrient loading.

Diatoms were present in all periphyton samples; however, most collections were relatively sparse. Species richness appeared rather impoverished, particularly in headwater reaches. A total of 49, 44, and 39 diatom taxa were identified in the August, October, and April samples, respectively (Tables 4.2.2.1, 4.2.2.3, and 4.2.2.5). *Achnanthes minutissima* was the most abundant taxon at most stations on each date; however, seasonal succession among abundant taxa was evident. *Fragilaria* spp., *Gomphonema constrictum*, *Melosira* spp., and *Tabellaria* spp. were also relatively abundant on one or more sampling dates. In general, the diatom flora was typical of clean, soft-water streams in Montana.

Four of the 57 periphyton slides (7%) were re-examined to verify identifications. Results are presented in Appendix 6.7

In addition to algae, moss (Bryophyta) was an important component of the periphyton in study area streams. Bryophytes were the most common characteristic vegetation of most stream reaches. They were particularly abundant in the upstream portions of each stream, but were present wherever stable substrates and dense forest canopies occurred. Bryophytes were essentially absent from Li-4 and occurred only sporadically in Li-5, Li-6, and Li-8.

Aquatic macrophytes occurred only incidentally within the study area. A few sprigs of water buttercup (*Ranunculus*) were found in spring seeps in the Libby Creek floodplain (Li-4) and in Rock Creek Meadows (RO-3). Sedges (*Carex*) were also present in Rock Creek Meadows.

Table 4.2.2.1. Relative abundance of diatoms and other algae collected in Montana Project streams, during August, 1988.

GENERA	Li-1	Li-3	Li-4	Li-5	Li-8	Li-10	Li-11	Ra-2	Ra-3	Ra-4
CHLOROPHYTA (green algae)										
Cosmarium			P						P	
Spirogyra			P							
Ulothrix	C									
Zygnema			C	C	C	A	P	A	A	P
CYANOPHYTA (blue-green algae)										
Oscillatoria	P	P	A	A	C		A	P		
BACILLARIOPHYCEAE (diatoms)	A	A	P	P	P	C	C	P	P	A

Symbols: A=Abundant (>60%), C=Common (60%-20%), P=Present (<20%)

GENERA	Po-1	Po-2	LC-1	Be-1	Be-2	Be-3	Ro-1	Ro-3	Ro-4
CHLOROPHYTA (green algae)									
Cosmarium								P	
Spirogyra									
Ulothrix			A	A				C	
Zygnema	P		P				P		C
CYANOPHYTA (blue-green algae)									
Oscillatoria	A	C	P		C	C	A		P
BACILLARIOPHYCEAE (diatoms)	P	A	P	P	C	A	P	A	C

Symbols: A=Abundant (>60%), C=Common (60%-20%), P=Present (<20%)

Table 4.2.2.1. Continued.

(PERCENT TOTAL OF DIATOM SPECIES=100%) TR=Trace (<1%)

GENERA	Li-1	Li-3	Li-4	Li-5	Li-8	Li-10	Li-11	Ra-2	Ra-3	Ra-4
Achnanthes lanceolata	2		3	TR			8	TR	5	
A. linearis					TR					
A. minutissima	60	14	48	68	62	18	5	39	20	5
A. sp.		TR				TR	TR			TR
Amphora sp.			TR			3	TR			
Callonesis bacillum				TR						
Cocconeis placentula				TR		TR		2		
Cymbella affinis	TR		2	TR	TR	TR		2		
C. sp.	TR	2		TR	TR	TR	TR	5	TR	
Diatoma anceps			TR		TR	TR	TR	TR	TR	TR
D. hiemale			13	TR	TR	27	18	7	5	23
Diatomella balfouriana				TR						
Eunotia incisa					TR					
E. pectinalis			TR			3	4	5	2	11
E. perpusilla									TR	
E. vanheurkii				TR					TR	
E. sp.									TR	
Fragilaria bicapitata			TR	TR						2
F. capucina	32	73	18	5	7	6	6	5	35	34
F. construens		3	5	3	3		41		TR	5
F. pinnata							TR			
F. vaucheriae						TR		5		
Frustulia rhomboides								TR		TR
Gomphonema constrictum				2						
G. intricatum		TR		TR	TR		TR	2		
G. lanceolatum	TR									
G. parvulum			TR							
G. sp.									TR	
Gyrosigma sp.				TR						
Hannaea arcus	3	5	3	10	3			TR		
Melosira distans								11		
M. islandica						TR	TR			
M. italica		TR	TR			12	2		22	13
M. varians							2			
Meridion circulare			TR	2	2	8	2	2	2	2

Table 4.2.2.1. Continued.

(PERCENT TOTAL OF DIATOM SPECIES=100%) TR=Trace (<1%)

GENERA	Li-1	Li-3	Li-4	Li-5	Li-8	Li-10	Li-11	Ra-2	Ra-3	Ra-4
Navicula cryptocephala									TR	
N. minima								TR		TR
N. radiosa			TR		2			TR		
N. sp.	TR	TR	TR		TR	3	2	2		
Nitzschia sp.							TR	TR	TR	
Rhoicosphenia curvata	TR									TR
Stauronesis smithii										TR
Synedra incisa					TR					TR
Tabellaria fenestrata	2			2	14	14	2	2	TR	TR
T. flocculosa		TR		TR	2		7		2	2
Species Counted	10	10	17	19	17	17	20	20	19	16
Frustules Counted	313	300	297	294	335	266	291	256	397	260

Table 4.2.2.1. Continued.

GENERA	Po-1	Po-2	LC-1	Be-1	Be-2	Be-3	Ro-1	Ro-3	Ro-4
Achnanthes lanceolata	3	2		TR	6	10	2	TR	5
A. affinis					TR				
A. minutissima	39	11		71	35	74	13	8	46
A. sp.	TR				TR				
Amphora sp.					TR		TR		
Cocconeis placentula	TR	TR.		TR	7	TR			
Cymbella affinis	5	2		3	TR	TR	TR		TR
C. naviculiformis		TR							
C. sp.	6	4	TR	6	6	3	TR	2	TR
Diatoma anceps							TR	TR	
D. hiemale	11	31			1	TR	8	TR	29
Diatomella balfouriana				TR					
Eunotia pectinalis		2					TR	TR	
E. perpusilla								TR	
Fragilaria bicapitata			5	2					
F. capucina	23	3	19	10	8	3	43	10	6
F. construens	2	TR			19		TR		2
F. leptostauron			TR						
F. vaucheriae			66	2			TR		TR
Frustulia rhomboides		TR	TR		TR				
Gomphonema constrictum						3			
G. intricatum		2		TR	TR		2		
G. sp.	TR		4						
Hannaea arcus	3	TR		TR	TR	TR	2	TR	6
Melosira distans								5	
M. italica		3					9	44	
Meridion circulare	TR	4			4		TR		3
Navicula cryptocephala						3		TR	
N. minima								TR	
N. radiosa							TR	TR	
N. sp.		2	TR	TR	3	TR			
Nedium sp.					TR				
Nitzschia sp.					TR	TR	TR	2	TR
Rhoicosphenia curvata				TR	TR				
Synedra rumpens	3								
S. sp.	TR			TR					

Table 4.2.2.1. Continued.

(PERCENT TOTAL OF DIATOM SPECIES=100%) TR=Trace (<1%)

GENERA	Po-1	Po-2	LC-1	Be-1	Be-2	Be-3	Ro-1	Ro-3	Ro-4
Tabellaria fenestrata	TR	33	2				2	TR	
T. flocculosa					1		13	22	
Species Counted	16	18	9	14	20	12	19	17	12
Frustules Counted	311	309	300	310	403	293	302	399	312

Table 4.2.2.2. Diatoms identified from Montana Project stream reaches in August, 1988.

Achnanthes affinis Grun.
A. lanceolata Breb. ex Kutz.
A. linearis (W. Sm.) Grun.
A. minutissima
A. sp.

Amphora sp.

Callonesis bacillum (Grun.) Cl.

Cocconeis placentula Ehr.

Cymbella affinis Kutz.
C. naviculiformis Auersw. ex Heib.
C. sp.

Diatoma anceps (Ehr.) Kirchn.
D. hiemale (Roth) Heib.

Diatomella balfouriana Grev.

Eunotia incisa W. Sm. ex Greg.
E. pectinalis (O. F. Mull.) Rabh.
E. perpusilla Grun.
E. vanheurkii Patr.

Fragilaria bicapitata A. Mayer
F. capucina Desm.
F. construens (Ehr.) Grun.
F. leptostauron (Ehr.) Hust.
F. pinnata Ehr.
F. vaucheriae (Kutz.) Peters.

Gomphonema constrictum Ehr.
G. intricatum Kutz.
G. lanceolatum Ehr.
G. parvulum (Kutz.)
G. sp.

Gyrosigma sp.

Hannaea arcus (Ehr.) Patr.

Melosira distans (Ehr.) Kutz.
M. islandica O. Mull.
M. italica (Ehr.) Kutz.
M. varians Ag.

Meridion circulare (Grev.) Ag.

Navicula cryptocephala Kutz.
N. minima Grun.
N. radiosa Kutz.
N. sp.

Nitzschia sp.

Table 4.2.2.2. Continued.

Nitzschia sp.

Rhoicosphenia curvata (Kutz.) Grun.

Stauronesis smithii Grun.

Synedra incisa Boyer
S. rumpens Kutz.
S. sp.

Tabellaria fenestrata (Lyngb.) Kutz.
T. flocculosa (Roth) Kutz.

Table 4.2.2.3. Relative abundance of diatoms and other algae collected in Montana Project streams, during October, 1988.

(PERCENT TOTAL OF DIATOM SPECIES=100%) TR=Trace (<1%)

GENERA	Li-3	Li-5	Li-8	Li-10	Li-11	Ra-2	Ra-3	Ra-4	Po-1	Po-2
Achnanthes minutissima	48	23	61	15	63	18	53	11	68	70
A. lanceolata	TR	2		TR		TR		TR		
A. lapponica									TR	TR
A. peragalli	TR	TR								
A. sp.	TR				4			TR		TR
Cocconeis placentula	TR	TR	TR		4					TR
Cymbella affinis		TR					TR		TR	TR
C. gracilis	TR						TR			
C. tumida	TR									
C. turgida	TR	2	TR	3	2	2		TR	3	
C. sp.	TR	TR	2							
Diatoma anceps		TR		TR			TR	TR		
D. hiemale	2	12	4	22		40	8	15	15	2
Epithemia sp.	TR									
Eunotia curvata								TR		
E. diodon						TR				
E. hexaglyphis		TR	TR			TR	TR	6		
E. pectinalis		5	TR	4	2	TR	5	12		3
E. perpusilla		TR	TR		2					
E. praerupta		TR								
E. septentrionalis					2					
Fragilaria capucina	TR	TR	5	4		16	2	11		
F. construens	7	6	TR							
F. virescens	4	19	6	16	8	TR	5	TR	9	
Frustulia rhomboides		TR	TR			TR	TR	TR		
Gomphonema constrictum	23			TR				TR		
G. intricatum		TR	TR			TR			2	TR
G. lanceolatum								TR		
G. sp.							TR			
Hannaea arcus		TR	5	2					TR	
Melosira italica		2	8	8		5	12	31		
Meridion circulare	TR	8		13		8	TR		TR	4

Table 4.2.2.3. Continued.

(PERCENT TOTAL OF DIATOM SPECIES=100%) TR=Trace (<1%)

GENERA	Li-3	Li-5	Li-8	Li-10	Li-11	Ra-2	Ra-3	Ra-4	Po-1	Po-2
Navicula bicephala	TR							TR		
N. cryptocephala	2	TR	2	2	2	4	TR	TR		
N. pupula				2			TR	2		
N. radiosa	TR	TR	TR				TR		TR	
N. sp.	TR							TR		TR
Nitzschia sp.	3		2		6		TR	TR		
Pinnularia sp.								TR		
Rhoicosphenia curvata	TR				2					
Surirella sp.	TR									
Syndra paristica	TR		TR							
Tabellaria fenestrata		11		TR		TR	8	TR		16
Species Counted	24	24	19	16	12	15	18	22	10	11
Frustules Counted	314	301	307	232	49	312	320	282	302	294

Table 4.2.2.3. Continued.

(PERCENT TOTAL OF DIATOM SPECIES=100%) TR=Trace (<1%)

GENERA	LC-1	LC-2	Be-1	Be-2	Be-3	Ro-1	Ro-3	Ro-3 Macro	Ro-4
Achnanthes minutissima	5	5	99	86	90	94	7	64	38
A. lanceolata	2	15				TR	TR	TR	4
A. peragalli								TR	TR
A. sp.				TR					
Cocconeis placentula	4			TR	TR				
Cymbella affinis						TR	TR	TR	TR
C. gracilis			TR			TR	TR	TR	2
C. turgida	TR	TR		2			TR		TR
Diatoma anceps							TR	TR	
D. hiemale	16	8					40	11	7
Epithemia sp.	7								
Eunotia pectinalis	TR	4					TR	TR	
E. perpusilla							TR	TR	
Fragilaria capucina	35				TR				2
F. construens		5				TR	3	3	
F. vaucheriae							TR		
F. virescens	5	9	TR	3	4	TR	5	TR	14
Frustulia rhomboides	TR	5					TR	TR	
Gomphonema constrictum			TR	5	4	TR		TR	
G. intricatum	7			TR		2			TR
G. lanceolatum	TR	6							
Hannaea arcus				TR			TR		4
Melosira italica	6					TR	36	7	
Meridion circulare	TR			TR	TR				4
Navicula cryptocephala	2	4	TR	TR	TR		TR		TR
N. pupula	TR	TR					2		
N. radiosa	3	10		TR			TR	TR	TR
N. sp.	2	TR		TR					
Nitzschia sp.		2							TR
Pinnularia sp.		2							

Table 4.2.2.3. Continued.

(PERCENT TOTAL OF DIATOM SPECIES=100%) TR=Trace (<1%)

GENERA	LC-1	LC-2	Be-1	Be-2	Be-3	Ro-1	Ro-3	Ro-3 Macro	Ro-4
Tabellaria fenestrata	TR	21						TR	
T. flocculosa									23
Species Counted	19	16	5	12	7	9	18	16	
Frustules Counted	305	170	311	319	346	375	323	309	

Table 4.2.2.4. Diatoms identified from Montana Project stream reaches in October, 1988.

Achnanthes minutissima
A. lanceolata Breb. ex Kutz.
A. lapponica (Guerm. & Mang.) Reim. comb. nov.
A. peragalli Brun and Herib.
A. sp.

Cocconeis placentula Ehr.

Cymbella affinis Kutz.
C. gracilis (Rabh.) Cleve
C. tumida (Breb.) van Huerck
C. turgida (Greg.) Cleve
C. sp.

Diatoma anceps (Ehr.) Kirchn.
D. hiemale (Roth) Heib.

Epithema sp.

Eunotia curvata (Kutz.) Largerst.
E. diodon Ehr.
E. hexaglyphis Ehr.
E. pectinalis (O. F. Mull.) Rabh.
E. perpusilla Grun.
E. praerupta Ehr.
E. septentrionalis Ostr.

Fragilaria capucina Desm.
F. construens (Ehr.) Grun.
F. vaucheriae (Kutz.) Peters.
F. virescens Ralfs

Gomphonema constrictum Ehr.
G. intricatum Kutz.
G. lanceolatum Rhr.
G. sp.

Hannaea arcus (Ehr.) Patr.

Melosira italica (Ehr.) Kutz.

Meridion circulare (Grev.) Ag.

Navicula bicephala Hust.
N. cryptocephala Kutz.
N. pupula Kutz.
N. radiosa Kutz.
N. sp.

Table 4.2.2.4. Continued.

Nitzschia sp.

Pinnularia sp.

Rhoicosphenia curvata (Kutz.) Grun.

Surirella sp.

Synedra parasitica (W. Sm.) Hust.

Tabellaria fenestrata (Lyngb.) Kutz.
T. flocculosa (Roth) Kutz.

Table 4.2.2.5 Relative abundance of diatoms and other algae collected in Montana Project streams, during April, 1989.

GENERA	Li-1	Li-3	Li-4	Li-5	Li-8	Li-10	Li-11	Ra-2	Ra-3	Ra-4
CHLOROPHYTA (green algae)										
Ulothrix					P				C	
Zygnema			C		P			C	P	
CYANOPHYTA (blue-green algae)										
Oscillatoria	C	P	C	C	C	C	A	P		C
BACILLARIOPHYCEAE (diatoms)	C	C	C	A	P	C	C	C	C	C

Symbols: A=Abundant (>60%), C=Common (60%-20%), P=Present (<20%)

GENERA	Po-1	Po-2	LC-1	LC-2	Be-1	Be-2	Be-3	Ro-1	Ro-3
CHLOROPHYTA (green algae)									
Ulothrix									C
Zygnema	C	A				P			
CYANOPHYTA (blue-green algae)									
Nostoc			A						
Oscillatoria	C	C		P		A	P	P	P
BACILLARIOPHYCEAE (diatoms)	P	P	P	A	A	C	A	A	C

Symbols: A=Abundant (>60%), C=Common (60%-20%), P=Present (<20%)

Table 4.2.2.5. Continued.

(PERCENT TOTAL OF DIATOM SPECIES=100%) TR=Trace (<1%)

GENERA	Li-1	Li-3	Li-4	Li-5	Li-8	Li-10	Li-11	Ra-2	Ra-3	Ra-4
Achnanthes lanceolata	TR	5	TR		2		4	3	TR	2
A. minutissima	87	45	53	16	53	18	66	8	29	3
A. sp.			TR			TR	TR			2
Cocconeis placentula	TR	2			TR	TR				
Cymbella affinis	TR	2	2	2			TR			
C. turgida		2		TR						
C. sp.							TR			TR
Diatoma anceps	TR	TR	TR	TR			TR	TR	6	TR
D. hiemale	4	2	29	46		23	4	45	49	5
Eunotia hexaglyphis						TR	TR			
E. pectinalis	TR			TR	TR	8		3	TR	25
E. perpusilla				2					5	3
E. sp.										
Fragilaria capucina										
F. construens	TR	6		6	6	2		3		
F. vaucheriae			TR							
F. virescens	4	5	5	3		6	2	TR		
Frustulia rhomboides					TR					TR
Gomphonema constrictum	TR	23		6	17	TR	TR	2		
G. intricatum					TR		TR			
G. lanceolatum			TR							
G. sp.										
Hannaea arcus		TR	4	2		TR	TR	2	TR	TR
Melosira italica				6	10	6	3	28	5	47
Meridion circulare		TR	TR	3	TR	29	9	3	3	TR

Table 4.2.2.5. Continued.

(PERCENT TOTAL OF DIATOM SPECIES=100%) TR=Trace (<1%)

GENERA	Li-1	Li-3	Li-4	Li-5	Li-8	Li-10	Li-11	Ra-2	Ra-3	Ra-4
Navicula bicephala			TR							2
N. cryptocephala		TR	TR	2	5	TR	4	TR	TR	3
N. pupula			TR	TR		TR		TR		3
N. radiosa				TR		TR		TR		TR
N. sp.		TR			TR	2		TR	TR	TR
Nitzschia sp.	TR			TR		TR	TR			TR
Pinnularia sp.							TR	TR		
Stauronesis sp.			TR							
Synedra rumpens		2								
S sp.										TR
Tabellaria fenestrata	TR	TR	2		TR	TR	1	TR		TR
Species Counted	13	16	16	17	13	18	19	17	12	21
Frustules Counted	327	150	304	108	153	303	308	306	333	317

Table 4.2.2.5. Continued.

(PERCENT TOTAL OF DIATOM SPECIES=100%) TR=Trace (<1%)

GENERA	Po-1	Po-2	LC-1	LC-2	Be-1	Be-2	Be-3	Ro-1	Ro-3
Achnanthes lanceolata	TR	3	9	9	5	3		3	2
A. minutissima	31	84	6	6	24	48	22	64	3
A. sp.	2			6	TR		2		
Cocconeis placentula			2	TR	TR	TR	2		
Cymbella affinis					TR				
C. naviculiformis		2			TR			TR	TR
C. turgida				TR	TR	2	2		
C. sp.			2		TR		TR		2
Diatoma anceps				2	TR	TR		TR	TR
D. hiemale	22	4	5	7	25	13	20	23	14
Eunotia diodon				TR					
E. hexaglyphis							TR		
E. pectinalis				TR			TR	TR	4
E. perpusilla				2					
E. sp.				TR					
Fragilaria capucina				TR			6		2
F. construens	15	TR	9	8	8	20	6	TR	2
F. vaucheriae			3	TR			TR		
F. virescens	7		33	31	3		14	2	4
Frustulia rhomboides				TR					
Gomphonema acuminatum							TR		
G. constrictum	12	3	3	TR	5		2	2	
G. intricatum	2	TR			TR	2			
G. lanceolatum				9			TR		
Hannaea arcus	5				16		3	TR	2
Melosira italica			2	4	TR	4	3	TR	30
Meridion circulare	TR	TR	8	2	2	4	6	TR	TR
Navicula cryptocephala			TR	TR	2		3	2	3
N. pupula				TR			TR		4
N. radiosa			TR	4	TR		TR		TR
N. sp.	TR	TR	TR	TR	TR				TR
Nitzschia sp.	TR	TR	TR	2		TR	TR	TR	TR
Pinnularia sp.			TR	TR		2			TR
Synedra rumpens	TR								
S. sp.									

Table 4.2.2.5. Continued.

(PERCENT TOTAL OF DIATOM SPECIES=100%) TR=Trace (<1%)

GENERA	Po-1	Po-2	LC-1	LC-2	Be-1	Be-2	Be-3	Ro-1	Ro-3
Tabellaria fenestrata		TR	4	3	TR	TR	TR		
T. flocculosa		1	12			TR	2		22
Species Counted	14	12	17	27	22	14	23	15	20
Frustules Counted	317	306	139	308	289	310	301	308	299

Table 4.2.2.6 Diatoms identified from Montana Project stream reaches in April, 1989.

Achnanthes lanceolata Breb. ex Kutz.
A. minutissima
A. sp.

Cocconeis placentula Ehr.

Cyabella affinis Kutz.
C. naviculiformis Auersw. ex Heib.
C. turgida (Greg.) Cleve
C. sp.

Diatoma anceps (Ehr.) Kirchn.
D. hiemale (Roth) Heib.

Eunotia diodon Ehr.
E. hexaglyphis Ehr.
E. pectinalis (O. F. Mull.) Rabh.
E. perpusilla Grun.
E. sp.

Fragilaria capucina Desm.
F. construens (Ehr.) Grun.
F. vaucheriae (Kutz.) Peters.
F. virescens Ralfs

Gomphonema acuminatum Ehr.
G. constrictum Ehr.
G. intricatum Kutz.
G. lanceolatum Rhr.
G. sp.

Hannaea arcus (Ehr.) Patr.

Melosira italica (Ehr.) Kutz.

Meridion circulare (Grev.) Ag.

Navicula bicephala Hust.
N. cryptocephala Kutz.
N. pupula Kutz.
N. radiosa Kutz.
N. sp.

Table 4.2.2.6. Continued.

Nitzschia sp.

Pinnularia sp.

Stauronesis sp.

Synedra rumpens Kutz.
S. sp.

Tabellaria fenestrata (Lyngb.) Kutz.
T. flocculosa (Roth) Kutz.

4.3 FISHERIES

4.3.1 FISH POPULATIONS

Bull trout, rainbow trout (*Oncorhynchus mykiss*), and sculpins (*Cottus* spp.) were collected in the Libby Creek drainage. Bull trout, westslope cutthroat trout, and hybridized westslope cutthroat trout were found in the Rock Creek drainage.

Table 4.3.1.1 presents the streams, sections, locations, sampling dates, and population estimate method of the sites in the Libby Creek and Rock Creek drainages. Population estimates of the study sites follow by stream.

4.3.1.1 Little Cherry Creek

Little Cherry Creek was the smallest stream in the study area. Section LC-1 was approximately 1/4 mile upstream of the confluence of Little Cherry and Libby Creeks and downstream of the proposed tailings site. This section had an average gradient of 5.7 percent. This reach began approximately 100 feet upstream of where the water disappeared beneath the streambed. Fine sediments, from a recent, upstream clearcut were present throughout the reach, but became progressively thicker towards the top of the reach. Alders were thick along and overhanging the shorelines. There was one 2-foot deep pool where the channel cut through bedrock; however, most of the reach was shallow (2-4 inches) riffles between shallow pools. No undercut banks were present.

Section LC-2 was about 1.5 miles upstream of the Libby Creek confluence with an average gradient of 4.9 percent. Section LC-2 was located in the proposed Little Cherry Creek tailings impoundment beginning approximately 150 feet upstream of the Little Cherry Loop Road. A narrow strip of mature, mixed conifer forest, and recent clearcuts beyond flanked each side of this reach. Sediments from the adjacent clearcuts covered pool bottoms where water velocities were slow. Debris jams, overhanging devil's club, and undercuts below banks and roots were common. Both sample sections were 500 feet in length.

Rainbow trout were the only fish species found in Little Cherry Creek (Table 4.3.1.1.1). Densities were similar in both sections, 1.7 (PC-1) and 1.5 (PC-2) rainbow per 100 feet^2, and the fish averaged less than 4 inches total length.

4.3.1.2 Poorman Creek

Sections 1 (PC-1) and 2 (PC-2) were approximately 0.25 mile and 1.1 mile upstream of the conflu-

Table 4.3.1.1. Stream, electrofishing sample section, legal description, sampling dates, and population estimate method for the Libby Creek and Rock Creek watersheds, Montana Project, Lincoln and Sanders Counties, Montana.

Stream	Section	Location T[a]	R[a]	S[a]	Sample Dates	Method
Little Cherry	LC-1	28N	31W	13	08/24/88	two-pass
	LC-2	28W	31W	24	09/22/88	two-pass
Poorman Creek	PC-1	28W	31W	25	08/25/88	two-pass
	PC-2	28N	31W	35	08/26/88	two-pass
Ramsey Creek	RM-1	27N	31W	02	08/30/88	two-pass
	RM-2	27N	31W	09	08/31/88 09/01/88	three-pass
	RM-3	27W	31W	09	09/07/88	two-pass
Libby Creek	LB-1	28N	30W	18	09/21/88	two-pass
	LB-2	27N	31W	11	09/22/88	three-pass
	LB-3	27N	31W	15	09/06/88	two-pass
	LB-4	27N	31W	21	09/23/88	two-pass
Rock Creek	EFRC	26N	32W	02	09/11/88	two-pass
Rock Creek Meadows	RCM	26N 27N	31W 31W	06 31	09/89/88 09/12/88 09/1516/88	mark-recapture
Rock Lake	RKL	27N	31W	29& 31	09/10/88 09/14/88	age-growth data only

[a]T = Township
R = Range
S = Section

Table 4.3.1.1.1 Population estimates, densities, and average total lengths, weight, and condition factor for rainbow trout (Rb) in Little Cherry Creek, Montana Project, Lincoln and Sanders Counties, Montana. Ninety-five percent confidence intervals and ranges are given in parentheses.

Species	Population Estimate	Density Number/ 100 ft^2	Average Length (in.)	Average Weight (lbs.)	Average Condition Factor
Section LC-1					
Rb	52 (±7)	1.7	3.6 (3.0-5.4)	0.02 (0.01-.08)	1.32
Total	52 (±7)	1.7			
Section LC-2					
Rb	36 (±4)	1.5	3.8 (3.0-5.5)	0.03 (0.01-.06)	0.97
Total	36 (±4)	1.5			

Table 4.3.1.2.1 Population estimates, densities, and average total lengths, weight, and condition factors for rainbow trout (Rb) and bull trout (DV) in Poorman Creek, Montana Project, Lincoln and Sanders Counties, Montana. Ninety-five percent confidence intervals and ranges are given in parentheses.

Species	Population Estimate	Density Number/ 100 ft^2	Average Length (in.)	Average Weight (lbs.)	Average Condition Factor
Section PC-1					
Rb	105 (±21)	0.7	4.7 (3.0-8.6)	0.05 (0.01-.24)	1.27
DV	4 (±0)	<0.1	6.6 (4.8-8.1)	0.11 (0.05-.20)	1.08
Total	109 (±21)	0.8			
Section PC-2					
Rb	45 (±7)	0.7	4.6 (3.0-7.8)	0.05 (0.01-.20)	1.19
Total	45 (±7)	0.7			

ence of Poorman Creek and Libby Creek (Map 7.2), respectively. PC-1 was 1000 feet long with a 4.0 percent gradient. The lower end of this reach began approximately 100 feet above where the stream went underground. The reach was flanked with alders, cottonwoods, and other riparian vegetation which, in places, completely overhung the stream. Substrates were primarily cobble. PC-2 was a 500 foot section with a 6.0 percent average gradient. This reach ran through a mature hemlock forest with a closed canopy. Substratse were primarily boulders and cobble. Undercut banks/roots were present, but uncommon. The lower end of PC-2 was several hundred feet above the Bear Creek Road, above the influence of the road and the proposed Little Cherry Loop tailings impoundment.

Rainbow trout were the predominant trout species in both sections of Poorman Creek, comprising 96 percent of the estimated population in PC-1 and 100 percent of the population in PC-2 (Table 4.3.1.2.1). Bull trout, a species of special concern in Montana, comprised the remaining 4 percent of the population in PC-1. They averaged 6.6 inches in length, but were uncommon (.03 DV/100 ft^2). The average size, weight, and densities of rainbow trout were virtually identical in the two sections. However, sculpins, which were not intentionally captured, enumerated, or processed, were numerically the most common fish in PC-1. The identity of these sculpins is unknown because sculpin taxonomy is being completely revised and no specimens were collected for subsequent identification.

4.3.1.3 Ramsey Creek

Sections RM-1, RM-2, and RM-3 were approximately 0.9, 3.8, and 4.4 miles, respectively, upstream of the confluence of Ramsey and Libby Creeks (Map 7.2). Their respective gradients were 4.0, 7.1, and 1.1 percent. Sections RM-3 and RM-2 were located just upstream and downstream of the proposed Ramsey Creek plant site respectively. The lower two sections were 1000 feet in length and RM-3 was a 500 foot section.

Section RM-1, the lowest reach on Ramsey Creek, ran through an old-growth hemlock/cedar forest. Fallen trees across the stream, undercut banks, and "holes" under old stumps were common. Some vegetation (e.g., devil's club) overhung portions of the creek. Substrates contained some gravel among cobbles and boulders.

The two halves of section RM-2 were somewhat different. The lower half contained local gradients exceeding 15 percent over bedrock cascades. Below the cascades were large, deep, pools containing some gravels, but still a primarily bedrock substrate. This portion of the reach ran through a mature, nearly closed, spruce-fir

forest with only a few alders flanking the banks. The upper half of the reach contained gentle gradients over a bedrock substrate, but with large, local gravel deposits. The spruce-fir forest was open here allowing alders to crowd the banks and overhang the stream. Pools were long but shallow in this section with some undercut banks.

Section RM-3, located above the proposed plant site, ran through an open fen, choked with submerged and overhanging logs from a former spruce-fir forest. Substrate, throughout the reach, was a deep, apparently anaerobic silt which supported relatively large numbers of caddisfly larvae. Shorelines along the length of this reach were primarily undercut banks.

Rainbow trout and bull trout were found in sections RM-1 and RM-2. No fish were captured or observed in RM-3. Rainbow trout predominated in both sections, composing 77 percent of the estimated population in RM-1 and 63 percent in RM-2 (Table 4.3.1.3.1). The density of RM-1 was more than double the density of RM-2; however, rainbow and bull trout had a larger average length in RM-1.

4.3.1.4 Libby Creek

Three sections, LB-2,LB-3,and LB-4 were upstream of the Ramsey-Libby Creek confluence and data from these sections are presented in Table 4.3.1.4.1. Section LB-1 was downstream of the three previously mentioned tributaries and will be presented separately. Sections LB-2, LB-3, and LB-4 were 2.5, 4.4, and 5.3 miles upstream of the confluence of Libby and Ramsey Creeks, respectively. Section LB-4 was located above the proposed plant site and LB-3 was located just below it. The three sections were each 1000 feet in length.

Section LB-2 flowed through a riparian/mixed conifer ecotone whose canopy coverage ranged from open to closed. Substrates were primarily large cobbles and boulders. Undercut banks and stumps were common and some "holes" were relatively deep.

Section LB-3, located just below the proposed plant site, ran through an open spruce-fir forest with alders flanking its banks. Substrates were primarily cobbles and boulders with a small bedrock cascade near the upper end. Two log jams were present in the reach; undercuts were otherwise uncommon.

The upper half of section LB-4 runs through relatively open spruce-fir forest. Large pools and holes, below and adjacent to undercut stumps, were common. Substrates were primarily cobble. The lower half of the reach runs through an open, avalanche chute. Substrates

Table 4.3.1.3.1 Population estimates, densities, and average total lengths, weights, and condition factors for rainbow trout (Rb) and bull trout (DV) in Ramsey Creek, Montana Project, Lincoln and Sanders Counties, Montana. Ninety-five percent confidence intervals and ranges are given in parentheses.

Species	Population Estimate	Density Number/ 100 ft^2	Average Length (in.)	Average Weight (lbs.)	Average Condition Factor
Section RM-1					
Rb	46 (±5)	0.3	4.9 (3.1-8.6)	0.06 (0.2-.20)	0.97
DV	33 (±24)	0.2	5.4 (3.5-12.6)	0.09 (0.02-.66)	0.87
Total	78 (±29)	0.5			
Section RM-2					
Rb	33 (±6)	0.2	6.2 (3.5-8.8)	0.10 (0.02-.22)	1.12
DV	10 (±4)	0.1	7.9 (6.7-10.0)	0.17 (0.09-.30)	1.01
Total	43 (±10)	0.3			

Table 4.3.1.4.1 Population estimates, densities, and average total length, weight, and condition factor for bull trout (DV) in Upper Libby Creek, Montana Project, Lincoln and Sanders Counties, Montana. Ninety-five percent confidence intervals are given in parenthesis. No fish were observed or captured in LB-4.

Species	Population Estimate	Density Number/ 100 ft^2	Average Length (in.)	Average Weight (lbs.)	Average Condition Factor
Section LB-2					
DV	38 (±18)	0.2	7.1 (5.3-9.1)	0.13 (0.06-.26)	0.92
Total	38 (±18)	0.2			
Section LB-3					
DV	38 (±12)	0.2	7.6 (6.1-9.8)	0.15 (0.07-.30)	0.95
Total	38 (±12)	0.2			

range from large cobbles to bedrock. The profile of this section is that of a narrow, deep, V-shaped channel whose slopes are dominated by huckleberries with bunchgrasses and other herbaceous vegetation.

Bull trout were the only fish captured in LB-2 and LB-3. No fish were observed or captured in section LB-4. The population estimates, densities, and average lengths and weights were essentially identical in both sections (Table 4.3.1.4.1). Average lengths and weights were slightly greater in the upstream sections (LB-3).

4.3.1.5 Lower Libby Creek (LB-1)

Section LB-1 was downstream of the Ramsey, Poorman, and Little Cherry Creek confluences with Libby Creek and about 0.25 mile upstream of the confluence of Bear and Libby Creeks. LB-1 was the lowest sample section in the Libby Creek drainage, downstream of all potential plant and tailing sites. The section had an average gradient of 1.3 percent and was also 1000 feet in length. Section LB-1 was the broadest channel in the study area (which in places approached 100 feet). The reach cut through a mixed conifer forest, but was flanked by large cottonwoods, alders, and a bedrock wall. The two latter areas contained undercuts, including a large, deep "hole" adjacent to the wall. Substrates ranged from gravels to large cobbles.

Rainbow trout and bull trout were found in section LB-1 and sculpins were noted as common. Rainbow trout comprised 93 percent of the estimated population and bull trout comprised the remaining 7 percent (Table 4.3.1.5.1). Both species averaged slightly less than 5 inches in length and had similar average weights (0.05 lb. for Rb vs. 0.03 lb. for DV).

4.3.1.6 East Fork of Rock Creek

Section EFRC was approximately 7.7 miles upstream of the confluence of Rock Creek and Cabinet Gorge Reservoir. The average gradient through this 500 foot long section was 5.5 percent. The reach ran through a mature hemlock/cedar forest which was open above the stream. Alders were common along the bank and overhung the creek in several places. Log jams, fallen trees, and large boulders created numerous undercuts and deep pools.

This same reach was sampled in 1985 (Barnard and Vashro 1986) and in 1986 (Hightower and Vashro 1987). Electrophoretic analyses of 21 fish collected August 24, 1984, "near the mouth" of Rock Creek indicated a pure westslope cutthroat population, a threatened species of

Table 4.3.1.5.1 Population estimates, densities, and average total length, weight, and condition factor for bull trout (DV) in main Libby Creek, Montana Project, Lincoln and Sanders Counties, Montana. Ninety-five percent confidence intervals are given in parenthesis.

Species	Population Estimate	Density Number/ 100 ft^2	Average Length (in.)	Average Weight (lbs.)	Average Condition Factor
Section LB-1					
Rb	110 (±14)	0.3	4.9 (3.0-8.7)	0.05 (0.01-.24)	1.14
DV	8 (±0)	<0.1	4.8 (3.1-5.7)	0.03 (0.01-.06)	0.97
Total	118 (±14)	0.4			

special concern in Montana. However,this population was considered subject to genetic invasion (Huston 1988).

In the present study, westslope cutthroat and bull trout comprised 73 percent and 27 percent of the estimated populations of EFRC (Table 4.3.1.6.1), respectively. In the 1985 and 1986 samples cutthroats composed 75 percent and 70 percent of their respective populations. In 1988, cutthroats averaged 5.6 inches, slightly shorter than the 5.9 inch average in 1987 and the 6.3 inch average of 1986. Bull trout averaged 6.3 inches in 1988, the same as in 1987, but below the 7.0 inch 1986 average. For discussion purposes only, density will be expressed as "fish per 100 m^2" and thus can be compared to densities of the prior studies. The 1988 density for cutthroat and bull trout was 9.3 and 3.8, respectively, which yields a total density of 13.1 fish per 100 m^2. This result was similar to the 1986 density estimates of 9.6 Wct, 3.2 DV, and a total density of 12.8 fish per 100 m^2. The 1988 and 1986 estimates were about one-third of the 1987 figures.

4.3.1.7 Rock Creek Meadows

Rock Creek Meadows is about 10 miles upstream of the confluence of Rock Creek and Cabinet Gorge Reservoir. This area, encompassing 59 acres, is a flooded mountain meadow with a network of channels, ponds, and numerous beaver dams. Electrophoretic studies indicated westslope cutthroat trout, westslope cutthroat x Yellowstone cutthroat, and westslope cutthroat x Yellowstone cutthroat x rainbow hybridization in Rock Creek Meadows (Huston 1988). The mark-recapture method resulted in a population estimate of 510 (+229) and a density of 0.9 *Oncorhynchus* spp. per 100 foot2 (Table 4.3.1.7.1). The average length was 8.8 inches with an average weight of 0.27 pounds.

4.3.1.8 Rock Lake

Fisheries study objectives, developed in cooperation with the Kootenai National Forest and MDFWP, did not include a population assessment for Rock Lake. Age and growth data were collected from fish in Rock Lake and are presented in the following section.

4.3.2 AGE AND GROWTH

Scales for age and growth analysis were analyzed by section and stream. Results of these analyses follow.

Table 4.3.1.6.1 Population estimates, densities, and average total ngths, weights, and condition factors for westslope cutthroat trout /ct) and bull trout (DV) in the East Fork of Rock Creek, Montana Project, Lincoln and Sanders Counties, Montana. Ninety-five percent confidence intervals are given in parentheses.

Species	Population Estimate	Density Number/ 100 ft²	Average Length (in.)	Average Weight (lbs.)	Average Condition Factor
Section EFRC					
Wct	95 (±9)	0.9	5.6 (3.2-9.2)	0.08 (0.01-.25)	0.95
DV	39 (±11)	0.4	6.3 (3.0-12.0)	0.09 (0.01-.48)	0.84
Total	134 (±20)	1.3			

able 4.3.1.7.1 Population estimates, densities, and average total length, weight, and condition factor for Oncorhynchus spp. in Rock Creek Meadows, Montana Project, Lincoln and Sanders Counties, Montana. Ninety-five percent confidence intervals and ranges are given in parentheses.

Species	Population Estimate	Density Number/ 100 ft²	Average Length (in.)	Average Weight (lbs.)	Average Condition Factor
Section RCM					
Oncorhynchus spp.	510 (±229)		8.8 (4.6-12.2)	0.27 (0.3-0.62)	0.95
Total	510 (±229)				

4.3.2.1 Little Cherry Creek

In both sections, Age I rainbow trout were dominant, followed by Age II fish (Table 4.3.2.1.1). Age I fish made up 72 percent of the LC-1 sample and 61 percent of sample LC-2. Only one fish over Age II was captured.

4.3.2.2 Poorman Creek

Age II rainbow predominated in both sections of Poorman Creek (Table 4.3.2.2.1). Age I and Age III fish were the second largest age classes in sections PC-1 and PC-2, respectively. In general, average length and growth of rainbow trout was greater in Poorman Creek than in Little Cherry Creek.

Only 4 bull trout were captured in Poorman Creek (PC-1). Two were Age II and the remaining two were Age I and Age III fish. The Age I bull trout was 4.8 inches, the two Age II fish averaged 6.7 inches, and the Age III fish was 8.1 inches.

4.3.2.3 Ramsey Creek

In section RM-1, Age III rainbow predominated, followed by Age II, Age I, and Age IV fish (Table 4.3.2.3.1). In section RM-2, Age II fish were predominant, followed by Age I and Age III fish. Age structure was relatively even between age classes I to III in RM-1 and -2. Average length and growth were also similar in both sections.

Age II and Age I bull trout made up 52 and 56 percent of the bull trout samples for RM-1 and RM-2, respectively (Table 4.3.2.3.2). Overall, Age I and Age II bull trout comprised 71 percent of the Ramsey Creek sample.

4.3.2.4 Libby Creek

Rainbow trout were found only in the lowest sections (LB-1) of Libby Creek (Table 4.3.2.4.1). Age II fish made up 59 percent of the sample, followed by Age III (25 percent), and Age I (16 percent) rainbow trout. The average length and growth were similar to rainbow trout found in Ramsey Creek.

Age composition of bull trout in LB-2 and LB-3 were similar; Age III fish were predominant followed by Age II fish (Table 4.3.2.4.2). Age II fish comprised the majority of the LB-1 sample. Average length and growth of Age II and Age III fish were very similar for LB-2 and LB-3. Age II fish in LB1 were smaller than bull trout in the upper two sections (LB-2 and LB-3).

Table 4.3.2.1.1 The section, age, number, average length at time of capture and the back-calculated average length at annulus for rainbow trout in Little Cherry Creek, Montana Project, Lincoln and Sanders Counties, Montana.

Section	Age (Yrs.)	No.	Average Length (in.)	Average Length at Annulus (in.) I	II	III	IV	V
LC-1	1	26	3.4	2.2				
	2	9	4.3	2.0	3.3			
	3	1	5.4	1.3	3.0	4.4		
LC-2	1	11	3.5	2.3				
	2	7	4.6	2.0	3.6			
LC-1 & 2	1	37	3.4	2.2				
	2	16	4.4	2.0	3.4			
	3	1	5.4	1.3	3.0	4.4		

Table 4.3.2.2.1 Age, number, average length at time of capture, and the back-calculated average length at annulus for rainbow trout in Poorman Creek, Montana Project, Lincoln and Sanders Counties, Montana.

Section	Age (Yrs.)	No.	Average Length (in.)	Average Length at Annulus (in.) I	II	III	IV	V
PC-1	1	9	3.6	2.0				
	2	35	5.6	2.2	4.3			
	3	3	7.9	1.9	3.9	6.3		
PC-2	1	1	4.2	2.8				
	2	9	5.3	2.7	4.3			
	3	6	6.5	2.1	3.7	5.4		
PC-1 & 2	1	10	3.7	2.1				
	2	44	5.5	2.4	4.3			
	3	9	6.9	2.0	3.7	5.7		

Table 4.3.2.3.1 Age, number, average length, and the back-calculated average length at annulus for rainbow trout in Ramsey Creek, Montana Project, Lincoln and Sanders Counties, Montana.

Section	Age (Yrs.)	No.	Average Length (in.)	Average Length at Annulus (in.) I	II	III	IV	V
RM-1	1	6	3.6	2.0				
	2	8	5.4	2.1	3.6			
	3	12	7.6	2.0	4.2	6.0		
	4	3	8.9	1.5	4.0	6.1	7.7	
RM-2	1	16	3.5	2.0				
	2	19	5.0	1.8	3.6			
	3	9	7.5	2.2	4.2	6.1		
RM-1 & 2	1	22	3.6	2.1				
	2	27	5.2	1.9	3.6			
	3	21	7.6	2.1	4.2	6.1		
	4	3	8.9	1.5	4.0	6.1	7.7	

Table 4.3.2.3.2 Age, number, average length at time of capture and the back-calculated average length at annulus for bull trout in Ramsey Creek, Montana Project, Lincoln and Sanders Counties, Montana.

Section	Age (Yrs.)	No.	Average Length (in.)	Average Length at Annulus (in.) I	II	III	IV	V
RM-1	1	-	---	---	---			
	2	5	7.1	2.9	5.6			
	3	2	8.4	2.7	4.7	6.7		
	4	2	9.6	2.0	3.9	5.7	7.8	
RM-2	1	13	3.8	2.4				
	2	6	5.6	2.3	4.1			
	3	3	6.5	1.7	3.0	4.8		
	4	2	9.6	1.7	3.5	5.5	7.0	
	5	1	12.6	1.3	3.6	6.4	9.1	11.0
RM-1 & 2	1	13	3.8	2.4				
	2	11	6.3	2.6	4.8			
	3	5	7.3	2.1	3.7	5.6		
	4	4	9.6	1.8	3.7	5.6	7.4	
	5	1	12.6	1.3	3.7	6.4	9.1	11.0

Table 4.3.2.4.1 Age, number, average length at time of capture and the back-calculated average length at annulus for rainbow trout in Libby Creek, Montana Project, Lincoln and Sanders Counties, Montana.

Section	Age (Yrs.)	No.	Average Length (in.)	Average Length at Annulus (in.) I	II	III	IV	V
LB-1	1	10	3.9	2.2				
	2	37	5.2	2.1	3.8			
	3	16	7.5	1.9	3.8	5.8		

Table 4.3.2.4.2 Age, number, average length at time of capture and the back-calculated average length at annulus for bull trout in Libby Creek, Montana Project, Lincoln and Sanders Counties, Montana.

Section	Age (Yrs.)	No.	Average Length (in.)	Average Length at Annulus (in.) I	II	III	IV	V
LB-1	1	1	3.6	2.6				
	2	6	5.2	2.4	3.8			
	3	1	8.7	1.7	3.8	7.3		
LB-2	1	--	---					
	2	13	6.6	2.6	4.6			
	3	14	7.8	2.1	3.9	5.9		
LB-3	1	--	---					
	2	10	6.5	2.3	4.6			
	3	18	7.8	2.2	4.0	6.0		
	4	4	9.4	1.8	3.4	5.4	7.5	
LB-1, 2, and 3	1	1	3.6	2.6				
	2	29	6.3	2.4	4.4			
	3	33	7.8	2.1	3.9	6.0		
	4	4	9.4	1.8	3.4	5.4	7.5	

4.3.2.5 East Fork of Rock Creek

Age II westslope cutthroat trout composed 66 percent of the EFRC sample, followed by Age III and Age I fish (Table 4.3.2.5.1). These data were similar to the 1986 and 1987 studies (Barnard and Vashro 1986, Hightower and Vashro 1987); however, Age II cutthroat made up a larger proportion of the 1988 sample than in the previous studies. In all three studies, Age I fish composed less than 10 percent of the sample. Cutthroat trout were smaller per age class than *Oncorhynchus* spp. in Rock Creek Meadows and Rock Lake.

Age II bull trout comprised 50 percent of the EFRC sample, followed by Age I fish with 25 percent (Table 4.3.2.5.2). Age II fish comprised 70 percent of the 1987 sample (Hightower and Vashro 1987) and 40 percent of the 1988 sample. Age I fish were absent, or contributed little, in the earlier studies. Compared to previous studies, Age II fish averaged 0.5 inch larger and Age III fish were over an inch larger. Compared to bull trout in Ramsey and Libby Creeks, Age I and Age III fish were somewhat larger in the East Fork of Rock Creek, but Age II fish were slightly larger in Libby and Ramsey Creeks.

4.3.2.6 Rock Creek Meadows

Age III and Age II *Oncorhynchus* spp. (which includes the westslope cutthroat trout and two westslope cutthroat hybrids, Huston 1988) composed 52 and 28 percent of the sample, respectively (Table 4.3.2.6.1). Only one age I fish was collected in this reach. Average length and growth was similar to that of Rock Lake; however, Age III fish in the RCM were over an inch larger than Age III fish in Rock Lake.

4.3.2.7 Rock Lake

Only 19 fish were captured in Rock Lake and Age III *Oncorhynchus* spp., followed closely by Age IV fish, made up 89 percent of the sample (Table 4.3.2.7.1). This apparently older age structure is probably due to the different sampling methodology employed. Fish in Rock Lake were captured by hook and line and gill nets, whereas other study area streams were electrofished. Methods used at Rock Lake were selective for larger fish and resulted in poor sampling of younger age classes. Age II and Age IV Rock Lake fish had identical average lengths as those age classes in Rock Creek Meadows. *Oncorhynchus* spp. in Rock Lake include westslope cutthroat trout and westslope cutthroat x Yellowstone cutthroat hybrids (Huston 1988).

Table 4.3.2.5.1 Age, number, average length at time of capture and the back-calculated average length at annulus for westslope cutthroat trout in the East Fork of Rock Creek, Montana Project, Lincoln and Sanders Counties, Montana.

Section	Age (Yrs.)	No.	Average Length (in.)	Average Length at Annulus (in.) I	II	III	IV	V
EFRC	1	2	4.1	2.9				
	2	26	6.2	2.7	4.7			
	3	11	7.4	2.4	4.4	6.1		

Table 4.3.2.5.2 Age, number, average length at time of capture and the back-calculated average length at annulus for bull trout in the East Fork of Rock Creek, Montana Project, Lincoln and Sanders Counties, Montana.

Section	Age (Yrs.)	No.	Average Length (in.)	Average Length at Annulus (in.) I	II	III	IV	V
EFRC	1	5	4.4	2.9				
	2	10	6.0	2.6	4.4			
	3	4	8.8	2.8	4.9	7.4		
	4	0	---					
	5	1	11.1	2.0	3.7	5.9	8.6	9.9

ble 4.3.2.6.1 Age, number, average length at time of capture and e back-calculated average length at annulus for Oncorhynchus spp. in Rock Creek Meadows, Montana Project, Lincoln and Sanders Counties, Montana.

Section	Age (Yrs.)	No.	Average Length (in.)	Average Length at Annulus (in.) I	II	III	IV	V
RCM	1	1	4.6	3.5				
	2	23	6.7	2.4	4.5			
	3	45	9.4	2.4	4.8	7.4		
	4	9	11.2	2.4	5.0	7.3	9.5	
	5	2	10.9	1.5	3.3	5.7	8.0	9.5

Table 4.3.2.7.1 Age, number, average length at time of capture and the back-calculated average length at annulus for Oncorhynchus spp. in Rock Lake, Montana Project, Lincoln and Sanders Counties, Montana.

ection	Age (Yrs.)	No.	Average Length (in.)	Average Length at Annulus (in.) I	II	III	IV	V
RKL	1	--	---					
	2	2	6.7	2.4	4.2			
	3	9	8.3	1.7	3.6	6.1		
	4	8	11.2	2.4	4.5	6.9	9.4	

APPENDIX 6.7 QA/QC review of four periphyton samples by Mr. Frank Pickett, Butte, MT.

4.3.3 SPAWNING

A total of 21.6 miles of Libby, Ramsey, and Poorman Creeks were surveyed on October 11-13, 1989, to evaluate bull trout spawning. This survey was postponed from 1988 when flooding from heavy rains obliterated redds. 1989 survey conditions were excellent for detecting redds. Spawning had occurred one to three weeks prior to the survey, no major precipitation events had occurred within the preceding month to increase stream flows, and stream volume was characteristically low for October.

Evidence of spawning was greatest in Libby Creek, and suggested a low level of recruitment from resident fish and from large bull trout that migrated out of the Kootenai river. In upper Libby Creek five small (13-14 inch depression diameter) redds were located in the 2.5 mile reach (2.0 redds/mile) from below the wilderness boundary to a 40 foot, 75° cascade at approximately 3,760 feet. This cascade was considered a barrier to fish attempting to move upstream. How those fish upstream got above this cascade is unknown, but it is most likely that they were transplanted. Based on the small size of the redds, the presence of the cascade, and that only small fish were observed, it appears that the spawning above this cascade is by resident fish.

Four redds were detected in 0.86 miles in Libby Creek (4.7 redds/mile), from the cascade at 3,760 feet to the Howard Lake Road bridge. All redds were small, apparently made by residents, and all were within 300 yards of the cascade. Only bull trout were observed in this reach and all were less than approximately 9 inches long.

Two large (depression diameter 38 x 31 inches) and one small bull trout redds were observed in the 2.82 mile reach (1.1 redds/mile) between the Howard Lake Road bridge and the Libby Creek bridge below Old Town. The large redds were assumed to have been made by the large fish that move upstream out of the Kootenai. One bull trout approximately 16 inches long was observed in this reach; few other fish were observed. Excluding the portion of this reach which lies adjacent to the fen above the Howard-Libby Creek confluence, suitable areas of spawning gravel were extremely limited in this reach. This reach also supports the highest level of beaver activity of any study area stream.

From the Libby Creek bridge at Old Town downstream to U.S. Highway 2 (8.64 miles), no redds were observed and suitable spawning gravels were extremely limited, representing a small fraction of one percent of total substrate cover. One 17 inch long unidentified trout and one 14 inch rainbow were observed in a large pool below

the confluence with Bear Creek; however, other fish observed in this reach were small (≤7 inches) and sparsely distributed. Nevertheless, while suitable spawning gravels were virtually absent from some mile-long reaches in this section, suitable gravels were available, though small and spotty.

Spawning densities of resident bull trout in Libby Creek were 3.3 redds/mile for the 2.75 mile reach from near the wilderness boundary to approximately 0.25 miles below the cascade, and 0.7 redds/mile for the entire surveyed length of Libby Creek (14.82 miles). Spawning density of bull trout that migrated out of the Kootenai River was 0.54 redds/mile for the 3.68 mile reach from the cascade at 3,760 feet in Libby Creek to the U.S. Highway 2 bridge. Spawning density of anadromous bull trout for the 12.32 miles of Libby Creek below the cascade and above the U.S. Highway 2 bridge was 0.16 redds/mile. "Good" bull trout spawning densities in tributaries of the North Fork of the Flathead River that are closed yearround to fishing have redd counts averaging approximately 16 redds/mile (K. Sage, MDFWP, pers. comm.).

The only evidence of spawning detected in Ramsey Creek was a 15-16 inch long bull trout observed resting in slack water 50 yards above a tall cascade at approximately 4,280 feet. This fish most likely migrated up from the Kootenai to spawn. No redds were observed in the survey reach; however, resident and non-resident spawning probably occurs. Bedrock creek bottom and bryophyte development limit spawning gravel availability in the upper third of Ramsey Creek. Suitable spawning gravels are also extremely limited, but available, in lower sections of the creek. A 14 foot, 65° waterfall/cascade at 4,360 feet on Ramsey Creek is an apparent barrier to upstream fish movements. This cascade may account for why no fish were observed above this site during the present survey or during fall 1988 electroshocking in reach RM-3.

No redds or any fish larger than 5 inches were observed in 1.8 miles of Poorman Creek below the Bear Creek Road. Suitable spawning gravels were much more abundant in this reach than in other creeks surveyed, but still represented less than one percent of total substrate area.

No spawning or spent bull trout were observed in the 11.6 mile section of lower Libby Creek, from the confluence with Howard Lake Road bridge downstream to U.S. Highway 2 during the mid-November, 1988, mountain whitefish survey. This survey was also unsuccessful in locating schools of whitefish that were thought to have moved upstream from the Kootenai River to spawn. No mountain whitefish were observed in study area streams during the October, 1989, bull trout redd surveys.

Additional data on spawning in study area streams is discussed in Sections 4.1.4 and 4.3.5.4.

4.3.4 HEAVY METALS

Heavy metal concentrations of rainbow trout tissues were analyzed to establish ambient baseline levels. Sample fish were collected in fishery reach LB-1 (Map 7.2), the reach on Libby Creek located below all potential MP tailings and facility sites. As such, content of fish tissues can be monitored from this sample reach during mining for whatever combination of facility and tailings sites are selected.

Metal concentrations in the rainbow trout are listed by inch class in Table 4.3.4.1. The fish collected were relatively small and young (see Tables 4.3.1.5.1 and 4.3.2.4.2), but representative of the reach.

Mercury (Hg) concentrations were derived from muscle tissue excised from the back, anterior to the dorsal fin, of each fish. Because the fish were so small, resulting samples were small. During analyses, it was difficult to weigh the frozen samples due to loss of moisture. Consequently, mercury results are reported to one significant figure. Mercury, which has a tendency to bioaccumulate with age (Phillips 1982), did not increase in older age classes. Mercury levels ranged from 0.1-0.4 ppm and averaged approximately 0.19 ppm. These levels were similar, though slightly higher, than levels reported by Barnard and Vashro (1986) and MDSL and KNF (1978) for ASARCO's Rock Creek and Troy Projects, respectively. These slightly elevated levels may reflect mercury used during historic mining operations in Libby Creek and/or the low level, single-person placer mining that was ongoing in the sample reach during the baseline study.

Zinc (Zn) levels were derived from livers that were sent frozen to the Department of Health and Environmental Sciences Laboratory in plastic bags. Laboratory personnel informed us that plastic bags have been known to

Table 4.3.4.1 Heavy metal concentrations from rainbow trout collected in Libby Creek reach LB-1, downstream of all potential Montana Project facilities and tailings sites.

Fish No.	Fish Length (in.)/ Weight (lb.)	Metal Content[a] (micrograms/gram = ppm) Hg[b]	Zn[c]	Co	Cu	Pb
Inch Class 3-4						
1	3.7/0.04	0.2	62.8	2.1	13.6	<0.8
2	3.6/0.02	0.3	25.0	4.3	7.5	<1.4
3	3.8/0.04	0.2	22.3	2.1	5.7	<0.9
4	3.8/0.03	0.2	24.6	12.4	3.0	<0.9
5	3.8/0.03	0.1	59.6	3.6	2.7	<0.9
Mean (n=5)	3.7/0.032	0.2	38.9	4.9	6.5	<1.0
SD	0.08/0.007	0.06	18.3	3.8	4.0	<0.2
Inch Class 4-5						
6	4.3/0.04	0.2	25.0	1.7	2.6	<0.5
7	4.6/0.03	0.4	28.0	3.2	14.4	<1.0
8	4.5/0.06	0.2	26.4	2.1	29.4	<0.6
9	4.5/0.03	0.2	33.8	3.7	3.3	<0.8
10	4.8/0.09	0.2	25.9	1.3	6.6	<0.4
Mean (n=5)	4.5/0.05	0.2	27.8	2.4	11.3	<0.7
SD	0.16/0.02	0.08	3.1	0.9	10.0	<0.2
Inch Class 5-6						
11	5.6/0.07	0.3	27.0	1.8	3.9	<0.3
12	5.9/0.07	0.3	32.0	0.6	4.6	<0.4
13	5.6/0.08	0.2	30.8	1.2	5.0	<0.3
14	5.3/0.05	0.2	36.8	1.1	4.0	<0.4
15	5.7/0.06	0.2	25.6	0.8	2.5	<0.3
Mean (n=5)	5.6/0.07	0.2	30.4	1.1	4.0	<0.3
SD	0.19/0.01	0.05	4.0	0.4	0.9	<0.05
Inch Class 6-7						
16[d]	6.2/0.08[d]	0.2	24.4	0.2	9.1	<0.3
17[d]	6.6/0.11[d]	0.2	29.4	0.5	5.0	<0.2
18	6.3/0.08	0.2	27.8	0.4	3.7	<0.5
19[d]	6.4/0.10[d]	0.1	25.1	0.5	2.4	<0.2
20[d]	6.4/0.09[d]	0.2	28.8	0.3	9.7	<0.1
Mean (n=5)	6.4/0.09	0.2	27.1	0.4	6.0	<0.3
SD	0.13/0.01	0.04	2.0	0.1	2.9	<0.14
Inch Class > 7						
21	7.9/0.17	0.1	26.6	0.2	7.6	<0.1
22	7.0/0.13	0.1	24.8	0.4	4.0	<0.1
23	8.1/0.22	0.1	24.0	0.1	2.5	<0.1
24	8.2/0.20	0.1	26.9	1.4	3.4	<0.1
Mean (n=4)	7.8/0.18	0.1	25.6	0.5	4.4	<0.1
SD	0.47/0.03	0.0	1.2	0.5	1.9	<0.0

Table 4.3.4.1 Continued.

Fish No.	Fish Length (in.)/ Weight (lb.)	Metal Content[a] (micrograms/gram = ppm) Hg[b]	Zn[c]	Co	Cu	Pb
All Inches Classes (n = 5)						
Mean (n=24)	5.5/0.08	0.19	30.1	1.9	6.5	<0.5
SD	1.39/0.05	0.07	9.9	2.5	5.8	<0.3

[a]Hg content derived from muscle tissue; other metal concentrations derived from liver tissue.
[b]Results reported to one significant digit because of small sample mass and potential moisture loss.
[c]Levels may be high due to storage in plastic bags potentially containing zinc.
[d]Female with eggs.

contain zinc and that the levels reported for these fish might be high due to contamination from the bags. However, zinc levels (Table 4.3.4.1) were comparable with those from fish analyzed from adjacent ASARCO projects, suggesting that no contamination occurred (or that ASARCO studies also used plastic bags). Zinc levels from Libby Creek ranged from 22.3-62.8 ppm and averaged 30.1 ppm. Mean levels from Rock Creek, the East Fork of Rock Creek, and Cabinet Gorge Reservoir were 82 (range 61-166 ppm), 75 (range 75-112 ppm), and 73 (range 58-91 ppm), respectively (Barnard and Vashro 1986). Zinc levels in fish from Stanley and Lake Creeks, on ASARCO's Troy study area, ranged from 23.2-44.9 ppm (MDSL and KNF 1978). Accumulations and toxicity of zinc concentrations vary between trout species (Slater 1961).

Cobalt (Co) concentrations in rainbow trout livers ranged from 0.1-12.4 ppm and averaged 1.9 ppm. Accumulations declined with increasing size of fish (Table 4.3.4.1). Three four-inch class fish (n = 5) had concentrations which averaged 4.9 ppm while seven-inch plus fish (n = 4) averaged 0.5 ppm. No comparative cobalt concentrations were available for ASARCO's Rock Creek or Troy projects.

Copper (Cu) levels from trout livers averaged 6.5 ppm and ranged from 2.4-29.4 ppm (Table 4.3.4.1). The mean value was over twice the levels (average 3.0, range 1-6.0, n = 75) reported from westslope cutthroat trout and mountain whitefish gill tissues from Rock Creek, the East Fork of Rock Creek, and Cabinet Gorge Reservoir (Barnard and Vashro 1986). No comparative copper concentrations were available for ASARCO's Rock Creek or Troy projects. Phillips (1982) reported copper concentrations in brown trout (*O. trutta*) muscle from two sites on the upper Clark Fork River and one location on the Little Blackfoot River which ranged from the lower limits of detection up to 0.97 ppm. Means (n = 6-18) from age class I-IV fish from these three sites ranged from 0.02 to 0.28 ppm.

Lead (Pb) concentrations in fish livers averaged <0.5 ppm for all 24 fish and ranged from <0.1-<1.4 ppm (Table 4.3.4.1). Lead levels were slightly higher in the smaller size classes. No comparative lead levels were available for ASARCO's Rock Creek or Troy projects. Lead concentrations from brown trout muscle tissue in Phillips' (1982) study on the Clark Fork and the Little Blackfoot Rivers ranged from the lower detection limits to 0.45 ppm. Means (n = 3-18) from age class I-IV fish ranged from 0.08 to 0.3 ppm.

4.3.5 THREATENED, ENDANGERED, AND SENSITIVE SPECIES

Wildlife species listed as threatened, endangered, sensitive, or of special concern by federal and state agencies were identified by the FWS, Flath (1984), Kootenai

National Forest, and a November 1988 MNHP computer search for sensitive species, which covered the MP study area and potential transmission line corridors. The species identified are listed in Table 4.3.5.1. Individual species accounts, presented below, address the species' status and its known or suspected occurrence on or proximal to the MP area.

4.3.5.1 White Sturgeon (*Acipenser transmontanus*)

The white sturgeon has no federal status, but is considered a sensitive species on the Kootenai National Forest (Table 3.5.1). It is considered a Montana game species but is fully protected from harvest. The MNHP lists the species as historically present in Montana (Table 4.3.5.1) and currently rare with a declining population.

The white sturgeon inhabits the Columbia River and other large, cold rivers from northern California to Alaska (Brown 1971). It is native to Montana, but is confined to the Kootenai River below Kootenai Falls. There have been several recent attempts to confirm the species presence below the falls in Montana; however, results have been inconclusive (D. Perkinson, USFS, Libby, pers. comm.). The decline of the Montana population appears to be associated with altered flow patterns resulting from completion of Libby Dam (Holton 1980).

Sturgeons are bottom feeders and will eat fish, crustaceans, mollusks, worms, and plant material (Weisel 1957, Brown 1971). Spawning probably occurs every three or four years in May thorugh July at temperatures of 50-60°F (Brown 1971). Egg sink and stick to bottom materials. Eggs hatch in one to two weeks and the fry seek shallow bays.

4.3.5.2 Westslope Cutthroat Trout (*Oncorhynchus clarki lewisi*)

The westslope cutthroat has no federal status, but is a Kootenai National Forest sensitive species, a game fish, and is considered threatened or rare in Montana by the MNHP (Table 4.3.5.1.).

Cutthroat trout, a native to Montana, were originally abundant in all of the cold mountain streams and lakes in, or adjacent to, both sides of the Continental Divide (Brown 1971). Their present distribution is restricted to small, relict populations in extreme headwaters because of their hybridization with rainbow trout and other cutthroat subspecies.

Table 4.3.5.1 Status of fishes of special concern to the Montana Project , Lincoln and Sanders Counties, Montana

Species	Status			
	Federal[a]	Forest[b]	State[c]	MNHP[d]
White sturgeon		S	GFRH	SH
Westslope cutthroat trout		S	GF	S3
Inland rainbow trout		S	GF	S1
Bull trout	C2	S	GFRH	S4
Torrent sculpin		S	NG	S2

[a]Federal status of species as defined by the U.S. Fish and Wildlife Service:

C2 - Notice of review, Category 2 (current information indicates that proposing to list as endangered or threatened is possibly appropriate, but substantial biological information is not on file to support an immediate ruling).

[b]Kootenai National Forest species status identified as endangered (E), threatened (T), or sensitive (S) on the forest by B. Summerfield (USFS, Libby, pers. comm.).

[c]State status of species identified as being of "special interest or concern" for Lincoln and/or Sanders Counties by Flath (1984) and the MNHP 1988 computer survey. Status codes are:

GF - Game Fish
RH - Restricted Harvest
NG - Nongame

[d]Status of species identified during a November 1988 Montana Natural Heritage Program computer survey of the Noranda study area, including transmission line corridors. Codes are:

S1 - Critically imperiled in Montana because of extreme rarity (5 or fewer occurrences, or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extirpation from the state. (Critically endangered in state.)
S2 - Imperiled in Montana because of rarity (6 to 20 occurrences), or because of other factors demonstrably making it very vulnerable to extirpation from the state. (Endangered in state.)
S3 - Rare in Montana (on the order of 20+ occurrence). (Threatened in state.)
S4 - Apparently secure in Montana.
S5 - Demonstrably secure in Montana.
SH - Historically known in Montana; may be rediscovered.

Twenty-four fish collected by J. Huston (MDFWP) "near the mouth" of Rock Creek on August 24, 1984, were determined by electrophoresis to be genetically pure westslope cutthroats, although this population was considered subject to genetic invasion (Huston 1988). In the present MP study, westslope cutthroats composed 73 percent of fish numbers in the East Fork of Rock Creek sample reach, although some of these fish may have been hybrids from other species (rainbows) and subspecies (Yellowstone cutthroats) which occur up and downstream. Electrophoretic studies indicated that westslope cutthroat trout, westslope cutthroat *x* Yellowstone cutthroat, and westslope cutthroat *x* Yellowstone cutthroat *x* rainbow hybrids occur in Rock Creek Meadows (Huston 1988).

4.3.5.3 Inland Rainbow Trout (*Oncorhynchus gardneri*)

This species has no special federal status, but it is a Kootenai Forest sensitive species, a Montana game fish, and a species considered by the MNHP to be critically endangered in Montana (Table 4.3.5.1). This species is native to Pacific coast streams from Alaska to northwest Mexico, and to a few interior basins (Lee et al. 1980). It is native to the lower Kootenai River drainage (MNHP, pers. comm.), and is probably restricted to small, inaccessible headwater streams below Kootenai Falls where there have been no introductions of cutthroats or other rainbow trout subspecies and consequential hybridization (D. Perkinson, USFS Libby, pers. comm.). No electrophoretic studies have been conducted on rainbow trout inhabiting streams on the east side of the MP study area to determine if those fish are genetically pure inland rainbow trout; however, based on the proximity of these tributaries to the Kootenai River, the hatchery raised rainbow releases that have occurred in the river, and the lack of barriers to upstream fish movements in these tributaries, it is unlikely that any inland rainbow are present. Rainbow trout in the East Fork Rock Creek drainage have been electrophoretically determined to be hybrids with westslope and Yellowstone cutthroat trout (Huston 1988).

4.3.5.4 Bull Trout (*Salvelinus confluentus*)

The bull trout is a federal candidate species that may be listed as endangered or threatened as more information becomes available. It is considered a Kootenai Forest sensitive species, a game fish with restricted harvest, and apparently secure in Montana (Table 4.3.5.1). It is of special concern because of its localized distribution and its hybridization with brook trout, which produces sterile offspring (Whitney, ND).

Bull trout are found throughout the Kootenai and Clark Fork River drainages, the two systems which drain the MP study area. They prefer larger cold-water streams and lakes, but may move long distances upstream to spawn in headwater creeks with clean gravel or rubble substrates (Brown 1971). Spawning occurs in September to November, depending on water temperature. Eggs are laid in redds and hatch in mid-late winter. Young usually remain in the headwater streams for the first 2 or 3 years (Brown 1971). Young feed heavily on aquatic insects, adults feed primarily on fish.

A remnant bull trout run up Libby Creek from the Kootenai River is suspected (J. Huston, MDFWP, D. Perkinson, FS, pers. comm.). Redd counts conducted during mid-October 1989, noted several large bull trout in Libby and Ramsey Creeks that probably moved out of the Kootenai River to spawn and two large redds in Libby Creek that were probably from non-resident fish. Spawning by resident bull trout occurs in upper Libby Creek, probably occurs in Ramsey Creek, and may occur in Poorman Creek. Bull trout in age classes ranging from I to V were observed in 1988 sample reaches of Poorman, Ramsey, and Libby Creeks.

A low number of bull trout may move upstream out of Cabinet Gorge Reservoir to spawn in Rock Creek and its East and West Forks; however, barriers to upstream movements, including the ephemeral nature of the creek (it dries up in late summer-fall) probably limits access to most spawning bull trout (Barnard and Vashro 1986). Bull trout, aged I-V, were captured in the EFRC electrofishing reach during fall 1988, as part of the MP baseline program. Barnard and Vashro (1986) thought that bull trout populations in the main stem of Rock Creek were probably permanent residents. This population is probably subject to hybridization with brook trout, which were common in Rock Creek (section RC-2) during the 1985 sampling (Barnard and Vashro 1986).

4.3.5.5 Torrent Sculpin (*Cottus rhotheus*)

Torrent sculpins do not have a special federal status, but are considered sensitive species on the Kootenai National Forest, a state nongame species, and an endangered state species (Table 4.3.5.1). This native Montana species is only found on the Kootenai River and its tributaries (Brown 1971) and its populations have declined after Libby Dam was built (Huston et al. 1984).

Torrent sculpins inhabit the riffles of swift, clear, cold streams with stable gravel or rubble bottoms. Young eat planktonic crustaceans and aquatic

insect larvae. Adults feed mainly on aquatic insects and invertebrates and larger individuals eat fish. They are also considered an important forage fish for trout (Brown 1971).

SECTION 5.0

LITERATURE CITED

5.0 LITERATURE CITED

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SECTION 6.0

APPENDICES

APPENDIX 6.1 FINALIZED AQUATIC BIOLOGY STUDY PLAN

WESTERN RESOURCE DEVELOPMENT CORP.

P.O. Box 467
711 Walnut Street
Boulder, Colorado 80306
(303) 449-9009

August 15, 1988

Mr. Kenneth M. Reim
Manager, Mining Development
U.S. Borax
3075 Wilshire Boulevard
Los Angeles, CA 90010-1294

Re: Plans of Study

Dear Ken:

We have reviewed the Plans of Study Section 5 (Wildlife and Aquatic Biology), Section 6 (Vegetation), and Section 8 (Soils) as provided in your letter of July 11, 1988. Since development of the Plans of Study numerous changes have occurred. The U.S. Forest Service and the Montana Department of Fish, Wildlife, and Parks have modified details of the wildlife and aquatic biology. Field conditions of the area have resulted in minor changes to all Plans of Study.

These changes have been incorporated into the Plans of Study and they have been retyped. The enclosed document now represents what the agencies would like implemented.

Please call if you have questions.

Sincerely,

David

David L. Johnson
Ecologist

DLJ:ei
Enclosures

cc:
Gary Fletcher

Section 5

WILDLIFE AND AQUATIC BIOLOGY

A detailed plan of study for baseline wildlife and aquatic inventories is presented in the following sections. The plan represents present understanding of state and federal requirements for mine development. Specifically, the plans are based upon the Montana Environmental Policy Act (MEPA), National Environmental Policy Act (NEPA), Montana Metal Mine Reclamation Act (MMMRA), guidelines to these acts, interactions with Kootenai National Forest and Montana Department of State Lands (MDSL), and MDSL guidelines for metal mines.

Section 5.1 provides information on the fisheries and aquatic biology plans, while Section 5.2 discusses the wildlife inventory.

5.1 FISHERIES AND AQUATIC BIOLOGY

Outlined below are the fisheries and aquatic biology programs.

5.1.1 Fisheries

A detailed fisheries study plan is presently being developed between the Montana Department of Fish, Wildlife, and Parks (MDFWP) and U.S. Borax. Fisheries sampling is scheduled to begin in mid-August 1988.

5.1.2 Aquatic Biology

The objective of aquatic sampling is to assemble a database for periphyton, benthic macroinvertebrates, and physical habitat in streams within and adjacent to (and upstream and downstream of) the potential development areas. Streams included in the study area are Upper Rock Creek, on the west side of the Cabinet Mountains, and Ramsey, Libby, Poorman, Little Cherry, and Bear creeks on the east side.

Each stream will be divided into classification reaches according to Forest Service accepted methods. Classification will be based on stream channel type (i.e., morphology, flow regime, etc.). Three sampling stations will correspond to each of the designated stream type classification reaches on each stream. A survey of the project area was conducted on May 4 and 5, 1988, with biologists for the U.S. Forest Service, Montana Water Quality Bureau, and U.S. Borax to more accurately identify stream types prior to establishing exact locations of study sites. The number of sites to be investigated are as indicated in the table on the following page.

AQUATIC SAMPLING SUMMARY

		Hab. Anal.	Macro inverts	Characterize only
Libby Creek				
L.1	1. 1/2 mi reach below Hoodoo & above Crazyman Cks (Cum. effects)	X	X	
L.2	2. Reach above to below Bear Ck			X
L.3.	3. Canyon reach to above Little Cherry Ck (exp stn for dam)	X	X	
L.4	4. Braided reach below Little Cherry Inpoundmt. (exp stn for LCL impound)	X	X	
L.5	5. Old Town reach (above Poorman -> Ramsey) (cumm effects for Ramsey & Libby)	X	X	
L.6	6. characterize bedrock section within a dif reach but no sampling			X
L.7	7. Ramsey to upstream braided section (exp stn for Libby)			X
L.8	8. Braided section (exp for Libby & Howard Cks)	X	X	
L.9	9. Howard Ck confl. up to 3720' elev.			X
L.10	10. Gentle Libby Ck (exp for mine facilities)	X	X	
L.11	11. Upper Libby Ck (control for mine facilities)	X	X	
Ramsey Creek				
Ra1	1. Confl. w Libby upstream 1/2 mi			X
Ra2	2. Gentle reach (exp 2 for mine facilities)	X	X	
Ra3	3. Steeper upper reach (exp 1 for mine facilities)	X	X	
Ra4	4. Swampy, meandering upper reach (control for mine facilities)	X	X	
Poorman Creek				
Po1	1. One reach above Libby Ck w 2 macro stns: one above Boar Ck Rd & impound (control) one as close to Libby as possible (exp)	X	2X	
Little Cherry Creek				
LC1	1. One reach: one stn above dam (LC100); one stn below dam (LC600) macro stn(s) ? - one below; one above if flow in August	X	1-2X	
Bear Creek				
Be1	1. Steep, lower reach (macro sample exp for dam leaching)	X	X	
Be2	2. Long, upper section to just above Boar Ck Rd bridge (control above bridge)	X	X	
Be3	3. Reach above bridge to confl w Cable Ck (Control for road & dam)	X	X	
Rock Creek				
Ro1	1. Upper reach - Rock Lk down to meadows	X	X	
Ro2	2. Swamp/meadows	X	X	
Ro3	3. Steep gradient			X
Ro4	4. Section above West Fork	X	X	
Totals		18	20(180)	6
Proposed (samples)		18	18(162)	0
Periphyton Totals (1 sample/stn/3 times/yr)			60	
Periphyton Proposed			18	

Existing macroinvertebrate, macrophyte, periphyton, riparian vegetation, fisheries, and hydrologic data are available for seven stations along Rock Creek and its tributaries as a result of investigations associated with the ASARCO proposed Rock Creek mine development. Sampling sites within Rock Creek reaches for the U.S. Borax baseline study will correspond as closely as possible to some of these stations so that these existing data will be directly comparable.

In other streams, coordination will occur between aquatic biologic, hydrologic, and water quality specialists to maximize multidisciplinary sampling from the same stations.

Major tasks of the aquatic data collection program are discussed below.

Task 1. Physical Habitat Evaluation. Physical habitat for all streams will be evaluated once during August 1988. Some specified habitat parameters will be measured during both high- and low-flow conditions as required by the analysis. Habitat evaluation will follow the Forest Service General Aquatic Wildlife System (GAWS) Prescriptive Planning Level (Level 3) methodology for evaluating aquatic ecosystems. Physical parameters to be measured will include, but are not limited to:

1. Riparian vegetation
2. Streambank stability
3. Gradient
4. Channel stability
5. Substrate composition
6. Pool and riffle area
7. Pool quality and quantity relative to adult trout habitat
8. Average width
9. Stream depth
10. Stream flow
11. Current velocity
12. Temperature
13. Spawning areas and fry habitat
14. Stream structure and diversity

All physical parameters will be measured at each of the designated study sites. Level 3 GAWS methodology specifies measurement of parameters across five transects at each study site; three study sites are located in representative portions of each classification reach; all environmental consultants will conduct creel surveys as opportunities are available.

Task 2. Benthic Macroinvertebrates and Periphyton. Macroinvertebrate community parameters will be measured on the following creeks: Upper Rock Creek (East Fork), Ramsey

Creek, Libby Creek, Poorman Creek, Little Cherry Creek, and Bear Creek.

Portions of Rock Creek other than reaches within the upper part will not be sampled for macroinvertebrates because adequate, recent data are available and will be utilized. Methods will follow those outlined by the Forest Service (Mangum 1987). Sampling will occur two times during 1988 (summer low flow and fall) and once in 1989 (pre-runoff) with specific periods to be decided. Aquatic and water quality sampling will be coordinated. Three square foot Hess samples will be collected from each of the channel classification reaches (excluding those in previously sampled reaches of Rock Creek). The Standardized Traveling kick method (Kinney et al. 1978) will be used to sample macroinvertebrates in Rock Creek. The specific sampling methods will be determined at the first site visit with the discipline coordinator. Methods will be documented so they can be duplicated in the future. Macroinvertebrates will be identified at the species level, wherever possible. Collections will be analyzed for the following measures:

1. Taxa identifications and counts
2. Taxa richness
3. Community density
4. Community biomass
5. Shannon diversity
6. Equitability

Other biotic or community indices may be calculated, as appropriate, to assess the macroinvertebrate community health.

A reference collection of all macroinvertebrate taxa identified will be maintained for future use. Sampling and sample sorting methods and taxonomic references will be recorded. A quality assurance/quality control program will be developed and implemented to assure accurate taxonomic identifications and thorough sample sorting (i.e., some samples will be sent out for verification by an independent biologist). A biotic condition index (BCI - Mangum 1987) will be calculated.

Qualitative periphyton sampling will be conducted to provide species lists and an approximate relative abundance of algae in the study area streams. Periphyton will be sampled at the same locations and on the same dates as the macroinvertebrates. A composite periphyton sample will consist of scraping the film of attached algae from natural substrates at each site.

At each site, substrates will be sampled in proportion to their occurrence, and microscopic algae will be sampled in proportion to the percentage of substrate it covers.

Scraping from each site will be combined, transferred to labeled vials, and preserved in Lugol's solution. Aquatic macrophyton will be identified, and the locations noted as they are encountered.

Taxa of uncertain identity will be pressed in the field and later identified using appropriate taxonomic keys.

QA/QC procedures will include sending 5% of the samples out to an independent consultant for review and verification.

Task 3. Literature Review and Evaluation. Existing literature and available agency data related to physical habitat and macroinvertebrates in the area will be reviewed and evaluated prior to field work for background data, applicability to the sampling program, and for fine-tuning proposed methodology.

Task 4. Report. A stream analysis report will be prepared integrating results from the physical habitat, macroinvertebrate studies, literature review, and pertinent study results from other associated disciplines (e.g., water quality). Report contents will include background, purpose, methods, detailed analyses, results, conclusions, recommendations, and appendices. It is assumed, at present, that fisheries data collected by the MDFWP will be supplied to a fisheries specialist for report preparation.

The final report shall be suitable for inclusion in U.S. Borax's permit application as a technical appendix.

The company will review the findings with the agencies and depending on the findings, the company's schedule for development and the need to characterize the potentially affected benthic macroinvertebrate community, the company will negotiate a sampling/monitoring program with the agencies.

5.2 WILDLIFE

This wildlife study plan has been designed to assemble a database on local wildlife resources which is adequate for subsequent impact analysis and the development of mitigation measures for U.S. Borax's proposed mine development in the Cabinet Mountains. This study plan was developed based on:

(1) Montana Metal Mine Reclamation Act (MMMRA), Montana Environmental Policy Act (MEPA), National Environmental Policy Act (NEPA), and guidelines to these Acts;

(2) Wildlife guidelines recommended by the Montana Department of State Lands (MDSL) for similar mining projects;

(3) Preliminary review of pertinent, existing resource inventory data for the project area;

(4) Accepted baseline study plans for a similar, adjacent underground mine proposed for the area;

(5) An October 1987 site visit; and

(6) Discussions with state and federal resource and regulatory agency personnel.

This plan is intended for review, revision, and endorsement by regulatory and resource agencies.

Major objectives of the study plan are to:

(1) Develop a list of wildlife species observed and which potentially occur in the proposed project area;

(2) Evaluate the types, distribution, and relative importance of local habitats to various wildlife taxa;

(3) Assess the seasonal distribution of important wildlife species on and adjacent to the project area;

(4) Estimate relative numbers of important (i.e., elk and mountain lions) wildlife species on and adjacent to the project area; and

(5) Document the occurrence of federal and state threatened, endangered, and candidate species and habitat suitability for such species in the project area. The review will include Animal Species of Special Concern for the State of Montana and Kootenai National Forest Sensitive Species.

Field data collection for this plan of study will be conducted over one calendar year such that surveys will be made during spring, summer, and fall, and one complete winter. U.S. Borax will review the baseline data with the agencies. The findings, planned development scheduling, and the need for monitoring will be discussed and negotiated. Field data will be supplemented with results of the ASARCO baseline study (whose study area is overlapped by a portion of this study area) and other local studies to incorporate interannual differences in wildlife utilization. A thorough

literature review, data analysis, and report preparation will be conducted prior to and following field surveys.

The study area circumscribing the area in which field investigations are implemented will be stratified into intensive and extensive study areas. The intensive study area (potential impact area) encompasses all project-related facilities and activities associated with the development alternatives including mine facilities, mill, tailings disposal areas; road, pipeline and power transmission line corridors, and other ancillary facilities. Field surveys will be concentrated in these areas because of the relative magnitude of potential impacts.

The extensive study area (buffer) will surround the impact area. Wildlife surveys conducted in this zone will be less intensive and oriented towards identifying the ecologic setting in which the proposed project area is located. Potential wildlife impacts resulting from a proposed development can not be adequately assessed unless the relative importance of project area habitats can be placed in perspective with seasonal wildlife use, and importance of, surrounding habitats. The size of the extensive study area will vary between wildlife groups, depending on the type and magnitude of anticipated impact and the extent of seasonal wildlife movements.

The exact delineation of both study zones will be finalized for individual wildlife groups following final refinement of conceptual development alternatives and interactions with resource and regulatory agency personnel. Presently proposed areas are shown on Figure 5-1.

The methodology for each of the major tasks of the wildlife study are discussed below.

5.2.1 Literature Review

A thorough literature review will be conducted prior to the advent of field work to identify the extent and quality of existing, useful wildlife information that can:

(1) Be used by itself to meet study objectives,

(2) Function as additional information on use of the study area in prior years, and/or

(3) Be used to supplement field inventories,

Much of this information is available from the MDFWP, the Forest Service, and their local wildlife specialists, and includes harvest data, population estimates, locations of seasonal ranges (e.g., winter range, parturition areas, migration corridors), and raptor nest sites. Further,

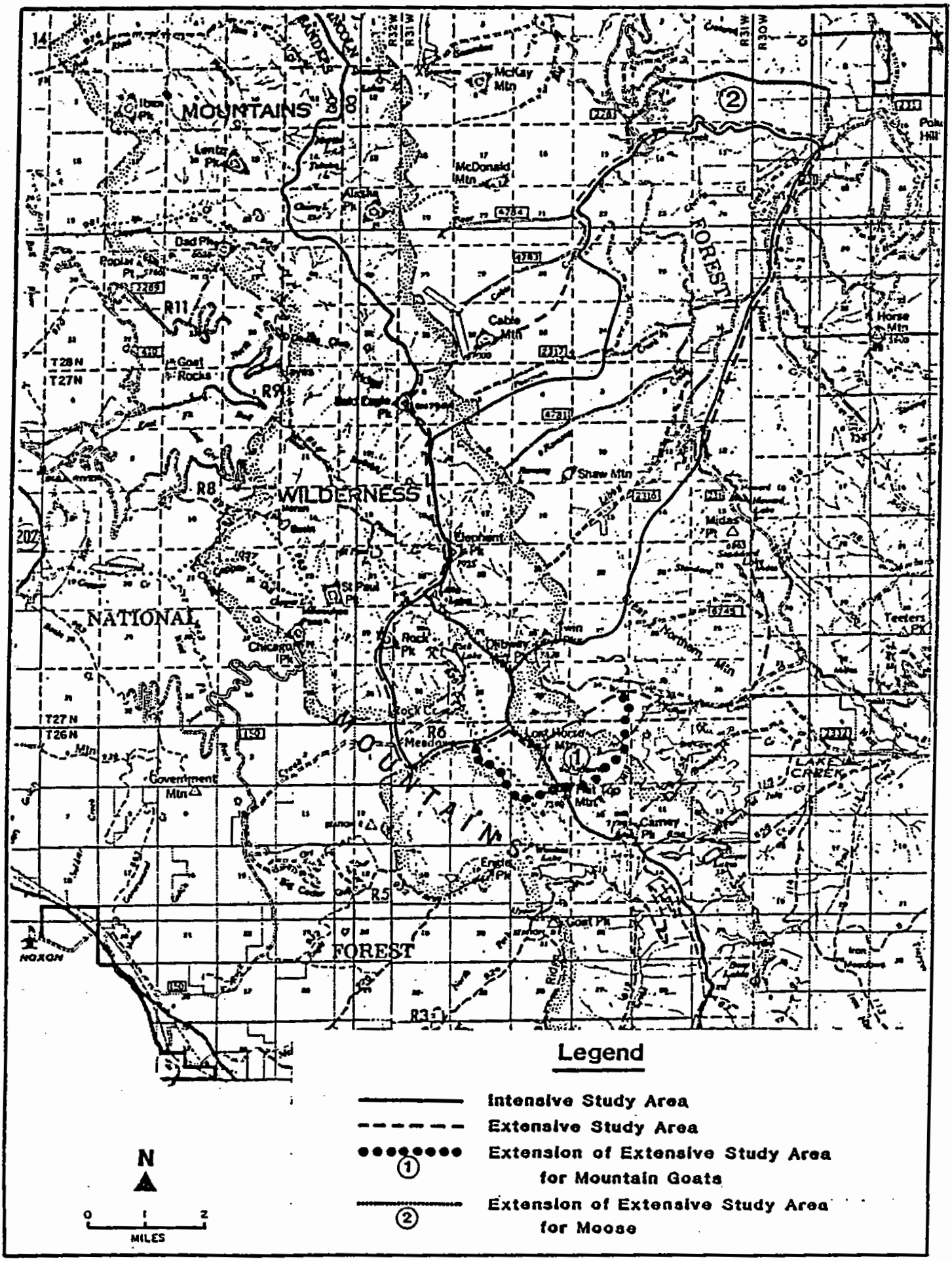

Figure 5-1

WILDLIFE BASELINE DATA COLLECTION AREAS

results of the recent ASARCO wildlife baseline study (Westech 1987), whose study area overlaps all of U.S. Borax's proposed western development area, provides a comprehensive analysis of information directly applicable to this study. Other studies, such as Joslin (1980), Kasworm (1986), and Erickson et al. (1987) can also be used, by themselves or in part, to meet study objectives.

5.2.2 Species List

A list of wildlife species which occur or which may occur in the study area will be developed from observations made during field surveys and supplemented with general literature sources (e.g., Skaar 1980, Flath 1984, Thompson 1982) based on habitat availability. Knowledge of local agency biologists should also be used when developing a species list.

5.2.3 Habitat Analysis

Objectives of the habitat analysis will be to:

(1) Identify habitat types. "Habitat types" and "habitat" refer to major habitat types such as western hemlock, subalpine fir or shrub land, which can be one or more vegetation type functioning as one homogeneous unit;

(2) Identify critical and important habitat types for different wildlife species;

(3) Identify the availability of alternative habitats as related to anticipated habitat losses or modifications; and

(4) Quantify the distribution of habitat types and their relative importance to different wildlife groups.

The Forest Service has mapped land types, habitat types, and habitat components for the entire study area (Madel 1982, USFS 1984, Kasworm 1986). This mapping is adequate for the present baseline study and will be used for the identification of habitats in the extensive study area. Habitats will be delineated on 1:24,000 USGS topographic maps. Forest Service mapping will also be used to identify the distribution of habitats in the intensive study area at a 1:24,000 scale on topographic maps; however, this mapping may be refined using results of the vegetation study.

Identification of critical and important habitats for different wildlife species will be based on observed animal distributions during given time periods, indirect evidence of relative use (e.g., browse utilization, tracks, pellets,

etc.), distribution of seasonally important habitats (e.g., low elevation meadows, berry concentrations, etc.), results of quantitative and qualitative surveys, and on habitats of importance as documented in scientific literature.

Alternate or adjacent habitat types will be qualitatively identified based on results of field investigations only as such habitats may be related to anticipated habitat modifications or losses (e.g., calving habitat, winter range, fall berry concentrations, etc.).

Distribution of habitat types within the intensive study area will be determined by planimetering habitat maps. Relative importance of these habitats to different wildlife groups will be based on quantitative and qualitative field survey results and literature review. Acreage of wildlife habitats to be disturbed by the proposed project will be presented in tabular form in the final report.

5.2.4 Big Game

Big game distribution, relative numbers, and seasonal habitat utilization of the intensive and extensive study areas will be evaluated based on results of:

(1) systematic aerial surveys,
(2) vehicle surveys,
(3) ground surveys,
(4) qualitative observations,
(5) literature review, and
(6) discussions with local MDFWP and Forest Service biologists.

Survey routes should be coordinated with local agency biologists to determine where they would be most useful.

"Big game" refers to mule deer (*Odocoileus hemionus*), white-tailed deer (*O. virginianus*), elk (*Cervus elaphus*), moose (*Alces alces*), mountain goats (*Oreamnos americanus*), bighorn sheep (*Ovis canadensis*), mountain lion (*Felis concolor*), black bear (*Ursus americanus*), and grizzly bear (*Ursus arctos*). Caribou (*Rangifer tarandus*) are not present in the study area (Flath 1984, Westech 1987).

A systematic aerial survey will be conducted for one year in the intensive and extensive areas to determine seasonal big game distribution, minimum population estimates, and movement patterns. Flights will begin at sunrise, under as ideal weather conditions as possible. The schedule for helicopter flights will be as follows:

2 flights per month December thru February
1 flight per month March and April
3 flights between May 15 and June 30
1 flight during September
12

The flights will focus on winter range for moose and mountain goats and spring kidding areas. One to two experienced observers will accompany the pilot. Observations will be recorded on 1:24,000 topographic maps. Age and sex composition of groups will be recorded when possible. Distributions of individual species will be summarized by season in final report figures which include observations made during aerial and ground surveys.

Truck and snowmobile surveys will be conducted along routes strategically located throughout the intensive and extensive study areas to collect additional data on big game distribution. After the ground is snow covered, vehicle or snowmobiles will be used to survey tracks along roads (transects) to assess seasonal presence, distribution, movement patterns, to obtain indices (number of trails/km of transect) of wildlife (big game as well as other species) present, and record other qualitative observations. Areas inaccessible to snowmobiles will be surveyed on cross-country skis. Additional ground surveys, covering the intensive study areas most thoroughly, will be conducted monthly to identify wildlife distributions (via tracks, fresh pellets, etc.), locate high use areas (parturition areas, berry concentrations, etc.), make opportunistic sightings, and develop a general understanding of wildlife utilization during that time period. Specific routes may be used; however, monthly systematic coverage of the intensive study area and portions of the extensive study area will be oriented toward areas of seasonal importance to the different wildlife groups during that specific time period.

Relative big game abundance will be evaluated between and within habitats using the NANOVA, ANOVA, SNK, and LSD analyses described below under Breeding Birds. A chi-square analysis will be used to evaluate big game habitat utilization relative to habitat availability in the impact area. Quantitative vegetation data (collected by the vegetation specialist) will be used to support and clarify habitat utilization patterns.

Defecations from other wildlife species (e.g., bears, coyotes, etc.) can also be quantified in conjunction with these surveys; however, low sample sizes may prohibit similar analyses. Nevertheless, such results can be used as an index of abundance and habitat use, directly comparable to relative big game indices.

A great deal of background and site-specific literature is available for the project area as a result of prior studies and inventories. Results of many of these investigations will be used to supplement data collected during the baseline study to evaluate present wildlife use of the study area. Local MDFWP and Forest Service biologists will be

particularly important sources of valuable, unpublished data on wildlife occurrence and use in the area.

5.2.5 Small Mammals

Small mammals will be trapped in the intensive breeding bird study area to document species occurrence and relative abundance. Trapping will be conducted on the proportionally allocated 100 x 200 m breeding bird plots, stratified by major habitat type, in July-August 1988 and utilize a combination of Sherman live traps (8 x 9 x 27 cm) and Museum Specials and/or Victor Woodstream (rat) snap traps. Pitfall traps will not be used because of their low trapping effectiveness. Five live and five snap traps will be attempted in parallel transects where distances between traps and transects will be approximately 10 m. Traps will be baited with a mixture of peanut butter, rolled oats, and bacon/Bacos. Trapping will be conducted on three consecutive days during fair weather.

The three parallel 90 m (10 traps spaced at 10 m intervals) small mammal transects will initially be established at one end of each bird plot, parallel to the plot's long axis. After checking traps on Day 2, transects will be moved forward approximately 110 m such that the location of Trap 1 on Day 3 is 20 m ahead of the location of Trap 10 on Day 2. This procedure is a modification of Stoecker's (1984) moving transect method which maximizes trap success and area sampled, and minimizes recaptures. Sampling will involve 270-450 trap nights in each major habitat. Relative small mammal abundance and species richness will be evaluated between and within habitats using the NANOVA, ANOVA, SNK, and LSD analyses described under Breeding Birds.

Additional data on small mammal presence and distribution in the study area will be collected in conjunction with other fieldwork and from results of other local studies.

5.2.6 Breeding Birds

For breeding bird (and small mammal) sampling, the intensive study area was further reduced in area to include only the potential impact areas (facility sites, portals, waste rock disposal areas, tailings ponds, roads, etc.) and a one-quarter mile buffer zone surrounding these areas. The decision to utilize this approach was made after preliminary qualitative sampling indicated that (1) anticipated, project-related impacts to breeding bird communities would be nondetectable beyond the buffer zone and that (2) occupied habitats beyond these areas were similar to those being sampled, thus permitting data extrapolation to unsampled areas.

The breeding bird study area was stratified by major habitat types and mapped on 1:24,000 USGS topographic maps. Minor types were not surveyed separately. Species associated with these major types were associated with the major habitats surveyed. Similarly, although some species may achieve their maximum densities in ecotones, those species will also occur in two or more homogeneous habitats forming the ecotone.

Three to five 100 x 200 m (2 ha = 4.94 acres) breeding bird plots (strip transects, Emlen 1971, Eberhardt 1978) were randomly established in each of the major habitats in early June 1988. Number of plots per habitat was roughly proportional to total habitat area within the sampling area. Habitat units of sufficient acreage were partitioned into one or more cells large enough to accommodate a 2 ha plot. Cells throughout the project area were consecutively numbered for each habitat type. A random numbers table was used to select the plot locations/type out of all possible sites. Habitat cells selected for sampling had plots oriented medially along the cell's long axis. Plot corners and intermediate points (50 m intervals) along the plot boundary were marked by 1.22 m (4 foot) rebar posts identified with stainless steel adhesive tape and surveyor's flagging. Additional surveyor's flagging was attached to vegetation along boundaries to facilitate identification and observer orientation. Rebar posts, tape, and flagging were left after sampling so the same plots can be used for future monitoring.

Each of the bird plots (3-5 plots/habitat type times 6 types) was sampled five times during the peak of the 1988 breeding season. Observers traversed the 100 x 200 m plots recording all birds seen or heard within plot boundaries during a 15 minute period. Surveys were conducted between 0.5 hours of sunrise and 0930 hours during favorable weather to minimize variation in bird conspicuousness (Conner and Dickson 1980). A schedule of transect replications for each habitat type was established for investigators to minimize among- and within-habitat variation. Daily and seasonal temporal detectability bias was ameliorated by alternating the daily sampling sequence of habitats and by evenly spacing sampling throughout the breeding season. All birds observed on the study area were recorded; however, only those species observed within transect boundaries during surveys and which demonstrated an affinity to the transect area were included in quantitative measurements. For example, a gull flying high over a conifer plot was not included. Young-of-the-year were noted, but not included in quantitative measurements.

Birds demonstrating an affinity towards a plot were considered breeders or transients. Breeders were those birds using habitats in the project area while breeding.

However, this does not imply that breeders utilizing a particular project area habitat were necessarily breeding in that habitat, only that they were using that habitat (e.g., for display purposes, maintenance activities, foraging for young, etc.) while breeding in that or a different habitat nearby. For example, a common flicker observed foraging on a grassland plot was considered a breeder even though it may have been nesting in an adjacent conifer habitat. Transients were late migrants.

Species richness (S) (number of species present on a plot during each replication) and density (number of birds present on a plot during each replication) values derived for species in each plot and in all major habitats were used to evaluate avian habitat utilization.

Mean breeding density for individual species within a habitat will be derived from the average number of birds per plot replication (n = 5) and then from average values for each of the five plots per habitat, where

$$\text{plot mean (n/2 ha)} = \frac{\underset{i=1}{\overset{k}{\sum}} x}{} = \sum_{i=1}^{5} n/5$$

$$\text{habitat mean (n/10 ha)} = \sum_{i=1}^{5} x/5$$

Species richness and abundance data, collected through the aforementioned experimental design, will produce nested analysis of variance (NANOVA) matrices with equal replication (Sokal and Rohlf 1969, Zar 1974). Differences in breeding bird use among the major habitat types will be analyzed by NANOVA. Differences within habitat types will be analyzed by single factor analysis of variance (ANOVA), Student-Newman-Keuls (SNK) multiple range tests, and least significant difference (LSD) tests. If a significant F results from the ANOVA and all possible comparisons between plots were desired, the SNK test will be applied. If only several plot comparisons are intended, the LSD test will be used. Tests of significance will be at alpha = 0.05 unless stated otherwise. Data will be screened for normality prior to testing.

This experimental design will be used to quantify numbers and evaluate relative habitat use of all bird groups on the project area, including nongame birds, galliforms, raptors, and waterbirds. Additional surveys will also be conducted specifically for the two latter groups. Those methodologies are discussed below.

5.2.7 Raptors

Raptor presence, distribution, and relative numbers in the study area will be determined in conjunction with the

(1) 1988 breeding bird surveys;

(2) During systematic helicopter surveys throughout the intensive and extensive study areas, conducted specifically to locate raptor nests; and

(3) In conjunction with other wildlife fieldwork.

Breeding bird results will present raptor densities in the intensive study area by habitat type. The intensive study area will be systematically surveyed by helicopter and ground surveys during spring and early summer 1988 to locate active and inactive nests. Cliffs in the extensive study area will be surveyed by helicopter and through spotting scopes. When raptor nests are located, they will be mapped and monitored periodically until young have fledged in an attempt to determine nest success and number of young produced. Distribution of raptors in the study area will be illustrated in the final report by individual species. Special attention will be placed on surveying for the Boreal owl in late winter and early spring. The northern goshawk will also be of special interest.

5.2.8 Waterfowl

Waterfowl use of ponds and creeks on the intensive study area will be quantified in conjunction with the breeding bird plot surveys and opportunistically during other wildlife fieldwork. Waterfowl use of the extensive study area will be assessed using this latter approach, using results of other studies in the area, and from literature review. Surveys will address the harlequin duck and common loon, both sensitive species for the Kootenai National Forest.

5.2.9 Threatened and Endangered Species

No specific surveys for threatened and endangered species are proposed for the baseline study because

(1) Specific studies covering the proposed project areas have been recently conducted, and

(2) Additional data on the species in question will be conducted in conjunction with other baseline wildlife surveys.

Three threatened or endangered species occur on or in the vicinity of the project area: grizzly bear, bald eagle

(*Haliaeetus leucocephalus*), and peregrine falcon (*Falco peregrinus*). The grizzly bear is a federally threatened species which occurs in low numbers in the Cabinet Mountains. Two recent, intensive studies (Kasworm 1984a, b, 1986, Erickson et al. 1987) have been conducted in the Cabinet Mountains covering the proposed study areas. Some of these studies have been sponsored by U.S. Borax. Those studies have documented relative numbers, home range, and movements, via radiotelemetry, habitat characteristics, and use, and potential impacts to the grizzly population resulting from a similar, adjacent mining proposal. Potential impacts of the proposed mine development to the grizzly bear population will be assessed using

(1) Results obtained and management recommendations developed from those recent studies,

(2) From results of qualitative and quantitative habitat surveys of proposed impact areas, and

(3) From data (sightings, tracks, feces, etc.) obtained in conjunction with other baseline wildlife fieldwork.

Bald eagles are a federally endangered species which breeds in latilong block 1 (Flath 1984); however, they are most common in the study area as migrants, transients, or winter residents (Homer 1976, Kuchera and Ruediger 1978, Flath 1984). Eagle use of the project area will be evaluated based on opportunistic field observations made in conjunction with other fieldwork, on results of other recent, local studies, and on literature review.

Peregrine falcons are a species classified as federally endangered. Historical nesting has been suspected for the latilong blocks covering the study area; however, the lack of recent reported sightings from the region suggests this species may only migrate through the area. No specific surveys are proposed for the baseline study to search for peregrines.

Assessment of presence and potential habitat use by species of special concern in Montana (state threatened and endangered species, Flath 1984) is discussed below under Other Wildlife Groups.

5.2.10 Herpetofauna

Presence and relative number of reptiles and amphibians in the intensive study area will be determined in conjunction with other wildlife fieldwork. Surveys will be conducted through suitable spring habitats surveying ponds, streams, and searching beneath rocks and logs for species such as the Coeur d'Alene salamander (*Plethodon vandykei*) and the tailed

frog (*Ascaphus truei*); however, no systematic searches are proposed.

5.2.11 Human Activity

Relative levels of present and past human use of the study area, including logging, mining, and seasonal recreation, will be determined from data collected by field biologists, data obtained from local Forest Service and MDFWP personnel, and from data collected by socioeconomists as part of the baseline survey. The influence this human activity has and has had on wildlife distributions in the study area will be subjectively evaluated.

5.2.12 Other Wildlife Groups

Presence and level of use of the proposed impact areas and the surrounding area by predators and furbearers (e.g., beaver, coyote, fisher, wolverine, mountain lion, lynx, bobcat, northern goshawk, etc.) and other wildlife species (e.g., pygmy shrew, hoary marmot, blue grouse, western bluebird, etc.) of special concern (Flath 1984) not specifically discussed in this study plan will be determined in conjunction with other wildlife fieldwork. These data, as well as recent and historic records from the area, will be summarized by species in the final report. The Kootenai National Forest Sensitive Species list will be included and addressed. The Nature Conservancy and Montana Heritage Program will be contacted for ecological information.

5.3 TECHNICAL REPORT

The final report shall be suitable for inclusion in U.S. Borax's permit application as a technical appendix.

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5

FLETCHER
ASSOCIATES

17740 East Hinsdale Avenue
Aurora, Colorado 80016
(303) 693-2516

November 15, 1988

Jim Rathbun
Forest Supervisor
Kootenai National Forest
506 U.S. Highway 2 West
Libby, MT 59923

Kit Walther, Chief
Hard Rock Bureau
Montana Dept. of State Lands
1625 Eleventh Avenue
Helena, MT 59620

Re: Montana Mining Venture

Gentlemen:

Enclosed are the modified sections of the Plan of Study for:

1. Section 5 - Wildlife and Aquatic Biology
2. Statement of Work, - Fisheries, Section 5.1.1
3. Section 6 - Vegetation

The Wildlife, Aquatic Biology, and Fisheries sections were prepared, modified, and completed in the field after consultations with the following agency personnel:

1. U.S. Forest Service - Al Bratkovich
   Doug Perkinson
2. Water Quality Bureau - Gary Ingman
3. Fish, Wildlife & Parks - Terry Hightower
   Joe Huston
   Jim Vashro

Also enclosed are the "marked up" sections of Wildlife, Aquatic Biology, and Vegetation, enabling you to see the changes, as well as have clean copies of the finals.

Briefly, the changes were:

1. completed fish study
2. increased number of reaches and techniques for aquatic biology, and
3. reduction of area for birds and small mammals.

If you have any questions, please contact me.

Sincerely,

Gary J. Fletcher

Gary J. Fletcher
GJF:af
Enclosures
cc: Joe Scheuering (w/o enclosures)
Brent Bailey (w/o enclosures)

United States Department of Agriculture | Forest Service | Kootenai NF | 506 US Highway 2 West Libby, MT 59923

Reply to: 2810

Date: January 9, 1989

Joe Scheuering
Noranda Minerals Corp.
P.O. Box 7176
Reno, NV 89510

Re: Plan of Study (POS) - Wildlife, Vegetation and Soils

Dear Joe,

Per letter of November 15 from Gary Fletcher, the agencies accept your proposed modifications/additions to the following sections:

a. Section 5, Wildlife and Aquatic Biology,
b. Section 6, Vegetation,
c. Section 8, Soils.

The agencies request that the proposed modifications be reflected as an addendum to the POS. The addendum should be revised Sections 5, 6 and 8 with appropriate signature page and cover.

If you have any questions, please contact either Kit or me.

Sincerely,

Ron Erickson

Ron Erickson
FS Project Coordinator

cc: Kit Walther, DSL
Brent Bailey
Gary Fletcher

APPENDIX 6.2 FINALIZED FISHERIES STUDY PLAN

WESTERN RESOURCE DEVELOPMENT CORP.
P.O. Box 467
711 Walnut Street
Boulder, Colorado 80306
(303) 449-9009

September 13, 1988

Mr. Kenneth M. Reim
U.S. Borax
3075 Wilshire Boulevard
Los Angeles, CA 90010-1294

Re: Statement of Work - Fisheries

Dear Ken:

The Statement of Work - Fisheries as contained in my letter of September 6, 1988, to you contained a few errors. It should be replaced with the revised and attached copy.

Please call if you have questions.

Sincerely,

David

David L. Johnson
Ecologist

DLJ:ei
Enclosure

cc:
G. Fletcher

STATEMENT OF WORK
FISHERIES

1.0 INTRODUCTION

Electroshocking streams in the State of Montana to assess fisheries occurrence, distribution, and biomass is conducted by the Montana Department of Fish, Wildlife, and Parks (MDFWP). As stated on page 19 of Western Resource Development Corporation's (WRDC) April 5, 1988, proposal to collect environmental baseline data for U.S. Borax's Montana Silver Venture, a study plan for evaluating fisheries resources in the project area would be developed with the MDFWP.

On June 21 and 22, 1988, meetings and site visits occurred with representatives of U.S. Borax (Messrs. Gary Fletcher and Rick Thompson), the U.S. Forest Service (Mr. Ron Erickson), and the MDFWP (Messrs. Joe Huston, Ian Chisholm, and Tim Swant) to develop the scope of the fisheries study. The east side of the project area, including Libby and Ramsey Creeks, was surveyed on June 21; Rock Creek was surveyed on June 22.

Results of the above meetings, site visits, and discussions were incorporated into a draft Plan of Study and submitted to the MDFWP in correspondence dated July 15, 1988. The MDFWP reviewed the draft study plan and responded on August 2, 1988, with modifications. A meeting between representatives of the MDFWP and U.S. Borax was held in Libby on August 18 to finalize the study plan. Results of the above discussions are included in this proposal. The study plan was subsequently revised following an August 26, 1988, field meeting between the latter parties.

2.0 PROJECT ORGANIZATION

Richard W. Thompson, Principal Investigator for wildlife, will supervise the fisheries program. Mr. Terry Hightower, who under contract to the MDFWP conducted the fisheries program for ASARCO's Rock Creek project, will be hired by the MDFWP as their representative to conduct Borax's fisheries field program. Following field data collection Mr. Hightower will be retained under contract to U.S. Borax to conduct data analyses and prepare reports. Mr. Hightower will be supervised by U.S. Borax representatives and Mr. Joe Huston (MDFWP). Local technicians will be hired as required by WRDC.

3.0 STATEMENT OF WORK

3.1 Fieldwork

The sampling program, in conjunction with results of other recent published and unpublished studies, will provide a data base which is adequate for the MDFWP and other state and federal agencies to characterize the baseline condition of areas potentially impacted by U.S. Borax's proposal.

3.1.1 Electroshocking/Gill Netting

Fish in 500-1000 foot control and experimental reaches of selected project area streams will be surveyed by a three man crew (minimum) during August-September 1988 with low conductivity backpack and/or truck/boat mounted electroshockers to determine species composition, age structure, relative numbers, population estimate by age group with reasonable (+/- 20%) confidence, etc. A two-pass sampling design will be used where possible. Reaches will be isolated during sampling using natural barriers and/or seines. The following reaches will be sampled:

Libby Creek	1.	above the potential plant site (control).
	2.	immediately downstream of the potential plant site.
	3.	another downstream, above confluence with Howard Creek.
	4.	on mainstem of creek below confluence with Little Cherry Creek.
Ramsey Creek	1.	above the potential plant site (control).
	2.	immediately downstream of the potential plant site.
	3.	another downstream, above confluence with Libby Creek.
Poorman Creek	1.	above Bear Creek Road (control).
	2.	above Libby Creek.
Little Cherry Creek	1.	above the proposed tailings dam.
	2.	below the proposed tailings dam.
Rock Creek	1.	downstream of Rock Creek gate/trailhead (corresponding to one of ASARCO's reaches).
	2.	in the vicinity of the upper bridge below Rock Creek Meadows.
	3.	in Rock Creek Meadows.

The upper and lower ends of specific reaches will be determined by Messrs. Hightower and Huston prior to sampling. The specific method to be used in Rock Creek Meadows will be determined at the time of sampling.

Rock Lake will be sampled during the same time period using a gill net to determine size distribution and age structure. Age structure will be determined by collecting scales of 20 fish shocked or netted in each size class per reach.

3.1.2 Spawning

Spawning will be evaluated in Libby, Ramsey, Poorman, and Rock Creeks and in Rock Lake by redd counts, ocular surveys, and from electroshocking results.

Bull trout redd surveys will be conducted in upper Libby (above Howard Creek) and Ramsey Creeks approximately three weeks after temperatures drop to 50 degrees F (late September to mid-October). A two-man crew will make two passes down each creek. It is estimated to require one day to survey each creek once (total of eight man-days).

Spawning will be assessed in the main stem of Libby Creek, from Howard Creek downstream to the U.S. Highway 2 bridge, during an appropriate time in November 1988. Observers will walk the creek looking for and enumerating large bull trout that haven't died or are spawning and schools of whitefish that have moved upstream from the Kootenai River. This reach of stream should take at least two days to survey.

3.1.3 Tissue Sampling for Heavy Metals

Heavy metals analysis of fish tissue will be conducted from electroshocked fish collected in Libby Creek below the confluence of Little Cherry Creek. Tissues from three fish in each size class will be analyzed.

3.2 Data Analysis

Data analysis will be conducted by Mr. Hightower and reviewed by appropriate MDFWP personnel and by U.S. Borax representatives Messrs. Thompson and McGuire. Fish scales will also be aged by Mr. Hightower. Montana State University will analyze the fish tissues for heavy metals.

3.3 Report Preparation

A preliminary final report will be prepared by Mr. Hightower in a format to be specified by U.S. Borax. The report will be submitted to U.S. Borax by December 1, 1988. Mr. Thompson and appropriate personnel from the MDFWP will review the report and return it to Mr. Hightower for revision into the final report.

The report will be adequate to meet or exceed requirements of the MDFWP an other state and federal agencies associated with the U.S. Borax baseline program.

The report will incorporate appropriate, pertinent literature review and comparison with other local or regionally applicable studies (e.g., ASARCO's fisheries study).

FLETCHER
ASSOCIATES

17740 East Hinsdale Avenue
Aurora, Colorado 80016
(303) 693-2516

November 15, 1988

Jim Rathbun
Forest Supervisor
Kootenai National Forest
506 U.S. Highway 2 West
Libby, MT 59923

Kit Walther, Chief
Hard Rock Bureau
Montana Dept. of State Lands
1625 Eleventh Avenue
Helena, MT 59620

Re: Montana Mining Venture

Gentlemen:

Enclosed are the modified sections of the Plan of Study for:

1. Section 5 - Wildlife and Aquatic Biology
2. Statement of Work - Fisheries, Section 5.1.1
3. Section 6 - Vegetation

The Wildlife, Aquatic Biology, and Fisheries sections were prepared, modified, and completed in the field after consultations with the following agency personnel:

1. U.S. Forest Service - Al Bratkovich
   Doug Perkinson
2. Water Quality Bureau - Gary Ingman
3. Fish, Wildlife & Parks - Terry Hightower
   Joe Huston
   Jim Vashro

Also enclosed are the "marked up" sections of Wildlife, Aquatic Biology, and Vegetation, enabling you to see the changes, as well as have clean copies of the finals.

Briefly, the changes were:

1. completed fish study
2. increased number of reaches and techniques for aquatic biology, and
3. reduction of area for birds and small mammals.

If you have any questions, please contact me.

Sincerely,

Gary J. Fletcher

Gary J. Fletcher
GJF:af
Enclosures
cc: Joe Scheuering (w/o enclosures)
Brent Bailey (w/o enclosures)

United States Department of Agriculture | Forest Service | Kootenai NF | 506 US Highway 2 West Libby, MT 59923

Reply to: 2810

Date: January 9, 1989

Joe Scheuering
Noranda Minerals Corp.
P.O. Box 7176
Reno, NV 89510

Re: Plan of Study (POS) - Wildlife, Vegetation and Soils

Dear Joe,

Per letter of November 15 from Gary Fletcher, the agencies accept your proposed modifications/additions to the following sections:

a. Section 5, Wildlife and Aquatic Biology,
b. Section 6, Vegetation,
c. Section 8, Soils.

The agencies request that the proposed modifications be reflected as an addendum to the POS. The addendum should be revised Sections 5, 6 and 8 with appropriate signature page and cover.

If you have any questions, please contact either Kit or me.

Sincerely,

Ron Erickson

Ron Erickson
FS Project Coordinator

cc: Kit Walther, DSL
Brent Bailey
Gary Fletcher

APPENDIX 6.3 August, 1988 aquatic macroinvertebrate data and summary parameters by Montana Project area creek and station

MACROINVERTEBRATE DATA							
BEAR CREEK				**STATION 1 - 8/7/88**			
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					8%	25.0	
Heterlimnius corpulentus	14	38	23	75	8%	25.0	12.1
DIPTERA					15%	47.0	
Thienemannimyia group	10	13	6	29	3%	9.7	3.5
Cricotopus spp.	1	0	1	2	0%	0.7	0.6
Eukiefferiella spp.	1	1	2	4	0%	1.3	0.6
Paraphaenocladius sp.	1	2	1	4	0%	1.3	0.6
Rheocricotopus sp.	5	15	16	36	4%	12.0	6.1
Synorthocladius sp.	0	0	1	1	0%	0.3	0.6
Tvetenia sp.	1	0	0	1	0%	0.3	0.6
Polypedilum spp.	1	3	5	9	1%	3.0	2.0
Micropsectra spp.	4	7	5	16	2%	5.3	1.5
Dicranota sp.	1	1	2	4	0%	1.3	0.6
Hexatoma sp.	3	8	4	15	2%	5.0	2.6
Chelifera sp.	4	10	0	14	2%	4.7	5.0
Certatopogonidae	3	0	3	6	1%	2.0	1.7
EPHEMEROPTERA					40%	123.3	
Ameletus spp.	8	5	7	20	2%	6.7	1.5
Baetis tricaudatus	2	35	25	62	7%	20.7	16.9
Drunella coloradensis	8	12	22	42	5%	14.0	7.2
Drunella doddsi	0	6	38	44	5%	14.7	20.4
Drunella spinifera	0	1	0	1	0%	0.3	0.6
Serratella tibialis	7	15	6	28	3%	9.3	4.9
Cinygmula spp.	15	32	25	72	8%	24.0	8.5
Epeorus deceptivus	7	18	8	33	4%	11.0	6.1
Rhithrogena spp.	8	23	29	60	7%	20.0	10.8
Paraleptophlebia spp.	2	3	3	8	1%	2.7	0.6
PLECOPTERA					13%	40.7	
Megarcys sp.	5	3	10	18	2%	6.0	3.6
Skwala sp.	0	1	0	1	0%	0.3	0.6
Kogotus sp.	0	1	0	1	0%	0.3	0.6
Chloroperlinae	11	41	21	73	8%	24.3	15.3
Kathroperla perdita	1	0	0	1	0%	0.3	0.6
Capnia gp.	0	1	1	2	0%	0.7	0.6
Zapada sp. 1	0	4	6	10	1%	3.3	3.1
Perlomyia sp.	4	7	4	15	2%	5.0	1.7
Yoraperla brevis	0	1	0	1	0%	0.3	0.6

MACROINVERTEBRATE DATA							
BEAR CREEK				**STATION 1 - 8/7/88**			
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
TRICHOPTERA					23%	71.0	
Arctopsyche grandis	0	1	3	4	0%	1.3	1.5
Rhyacophila Betteni gp.	2	5	3	10	1%	3.3	1.5
Rhyacophila Brunnea gp.	0	1	0	1	0%	0.3	0.6
Rhyacophila velpulsa	1	4	1	6	1%	2.0	1.7
Rhyacophila Sibrica gp	3	2	3	8	1%	2.7	0.6
Rhyacophila Hylinata gp	1	0	3	4	0%	1.3	1.5
Lepidostoma spp.	0	2	0	2	0%	0.7	1.2
Apatania sp.	18	75	79	172	19%	57.3	34.1
Ecclisomyia sp.	1	4	0	5	1%	1.7	2.1
Glossosoma sp.	0	1	0	1	0%	0.3	0.6
TOTAL ORGANISMS	153	402	366	921		307.0	134.6
TAXA RICHNESS	31	37	32	43		33.3	3.2
SHAN. DIVERSITY	4.40	4.19	4.08	4.32		4.22	0.16
BIOTICINDEX	2.79	2.72	2.40	2.60		2.64	0.21
EPT RICHNESS	18	27	20	33		21.7	4.7
EPT / CHIR.	4.33	7.41	8.03	6.91		6.6	2.0
BIOTIC COND. INDEX				105.2			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	3	2	1				
depth (m)	0.19	0.25	0.2				
velocity (m/s)	0.27	0.29	0.22				
CTQp =				50			
stream width (m)				5			
gradient (%)				3.5			
water temperature (C)				10			
substrate particle size (%)	boulders (>12)			20			
	rubble (3 - 12)			40			
	gravel (.125 - 3)			25			
	fines (< 0.125)			15			

MACROINVERTEBRATE DATA							
BEAR CREEK				**STATION 2 - 8/7/88**			
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					6%	11.3	
Heterlimnius corpulentus	15	12	7	34	6%	11.3	4.0
DIPTERA					21%	40.7	
unassociated midge pupa	2	0	1	3	1%	1.0	1.0
Thienemannimyia group	52	14	15	81	14%	27.0	21.7
Brillia sp.	0	0	2	2	0%	0.7	1.2
Cricotopus spp.	1	0	0	1	0%	0.3	0.6
Eukiefferiella spp.	0	2	0	2	0%	0.7	1.2
Paraphaenocladius sp.	4	0	0	4	1%	1.3	2.3
Rheocricotopus sp.	0	1	0	1	0%	0.3	0.6
Orthocladius spp.	0	1	0	1	0%	0.3	0.6
Thienemanniella sp.	2	0	0	2	0%	0.7	1.2
Tvetenia sp.	1	0	1	2	0%	0.7	0.6
Microtendipes sp	0	0	4	4	1%	1.3	2.3
Micropsectra spp.	5	0	0	5	1%	1.7	2.9
Dicranota sp.	4	2	1	7	1%	2.3	1.5
Hexatoma sp.	1	0	0	1	0%	0.3	0.6
Chelifera sp.	0	2	0	2	0%	0.7	1.2
Simulium sp.	0	1	0	1	0%	0.3	0.6
Certatopogonidae	3	0	0	3	1%	1.0	1.7
EPHEMEROPTERA					27%	52.7	
Ameletus spp.	0	1	0	1	0%	0.3	0.6
Baetis tricaudatus	10	1	5	16	3%	5.3	4.5
Drunella coloradensis	8	4	2	14	2%	4.7	3.1
Drunella doddsi	5	1	2	8	1%	2.7	2.1
Cinygmula spp.	24	10	11	45	8%	15.0	7.8
Epeorus deceptivus	18	5	14	37	6%	12.3	6.7
Rhithrogena spp.	21	2	14	37	6%	12.3	9.6
PLECOPTERA					29%	55.3	
Megarcys sp.	3	0	11	14	2%	4.7	5.7
Doroneuria theodora	0	0	6	6	1%	2.0	3.5
Chloroperlinae	24	8	17	49	8%	16.3	8.0
Zapada sp. 1	10	4	43	57	10%	19.0	21.0
Perlomyia sp.	33	0	6	39	7%	13.0	17.6
Yoraperla brevis	1	0	0	1	0%	0.3	0.6
TRICHOPTERA					17%	33.0	
Parapsyche elsis	1	2	3	6	1%	2.0	1.0
Rhyacophila Betteni gp.	25	21	26	72	12%	24.0	2.6
Rhyacophila Brunnea gp.	0	1	0	1	0%	0.3	0.6
Rhyacophila velpulsa	3	2	2	7	1%	2.3	0.6
Rhyacophila Sibrica gp	0	3	0	3	1%	1.0	1.7
Glossosoma sp.	1	4	5	10	2%	3.3	2.1

MACROINVERTEBRATE DATA							
BEAR CREEK				**STATION 2 - 8/7/88**			
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
TOTAL ORGANISMS	277	104	198	579		193.0	86.6
TAXA RICHNESS	26	23	22	37		23.7	2.1
SHAN. DIVERSITY	3.88	3.83	3.79	4.12		3.83	0.05
BIOTIC INDEX	2.67	2.33	1.42	2.18		2.14	0.64
EPT RICHNESS	15	15	15	23		15.0	0.0
EPT / CHIR.	2.79	3.83	7.26	3.92		4.6	2.3
BIOTIC COND. INDEX				83.7			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	1.5	2.8	4.1				
depth (m)	0.17	0.19	0.14				
velocity (ft/s)	0.35	0.22	0.25				
CTQp =				50			
stream width (m)				8			
gradient (%)				2			
water temperature (C)				12			
substrate particle size (%)	boulders (>12)			25			
	rubble (3 - 12)			50			
	gravel (.125 - 3)			15			
	fines (< 0.125)			10			

MACROINVERTEBRATE DATA							
BEAR CREEK				**STATION 3 - 8/7/88**			
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					5%	5.7	
Heterlimnius corpulentus	3	10	4	17	5%	5.7	3.8
DIPTERA					17%	18.7	
unassociated midge pupa	0	1	1	2	1%	0.7	0.6
Thienemannimyia group	1	1	0	2	1%	0.7	0.6
Pagastia sp	0	0	1	1	0%	0.3	0.6
Sympotthastia ap.	0	0	1	1	0%	0.3	0.6
Thienemanniella sp.	1	1	0	2	1%	0.7	0.6
Cricotopus spp.	0	0	1	1	0%	0.3	0.6
Eukiefferiella spp.	1	0	0	1	0%	0.3	0.6
Paraphaenocladius sp.	1	4	0	5	2%	1.7	2.1
Rheocricotopus sp.	0	0	1	1	0%	0.3	0.6
Orthocladius spp.	2	0	0	2	1%	0.7	1.2
Micropsectra spp.	0	0	2	2	1%	0.7	1.2
Rhabdomastix sp.	0	0	4	4	1%	1.3	2.3
Dicranota sp.	5	7	3	15	5%	5.0	2.0
Hexatoma sp.	1	1	0	2	1%	0.7	0.6
Tipula spp.	0	0	1	1	0%	0.3	0.6
Chelifera sp.	3	0	0	3	1%	1.0	1.7
Oreogeton sp.	0	0	1	1	0%	0.3	0.6
Glutops sp.	1	0	0	1	0%	0.3	0.6
Certatopogonidae	4	0	5	9	3%	3.0	2.6
EPHEMEROPTERA					33%	36.0	
Ameletus spp.	0	0	1	1	0%	0.3	0.6
Baetis tricaudatus	5	8	1	14	4%	4.7	3.5
Drunella coloradensis	4	3	3	10	3%	3.3	0.6
Cinygmula spp.	15	18	10	43	13%	14.3	4.0
Epeorus deceptivus	11	14	2	27	8%	9.0	6.2
Rhithrogena spp.	3	10	0	13	4%	4.3	5.1
PLECOPTERA					35%	38.0	
Megarcys sp.	1	0	1	2	1%	0.7	0.6
Doroneuria theodora	0	0	1	1	0%	0.3	0.6
Chloroperlinae	17	31	10	58	18%	19.3	10.7
Zapada sp. 1	17	4	14	35	11%	11.7	6.8
Doddsia sp.	1	0	0	1	0%	0.3	0.6
Despaxia sp.	1	0	0	1	0%	0.3	0.6
Perlomyia sp.	6	4	6	16	5%	5.3	1.2
TRICHOPTERA					10%	10.7	
Parapsyche elsis	1	0	0	1	0%	0.3	0.6
Rhyacophila Betteni gp.	14	10	4	28	9%	9.3	5.0
Ecclisomyia sp.	0	0	1	1	0%	0.3	0.6
Glossosoma sp.	2	0	0	2	1%	0.7	1.2

MACROINVERTEBRATE DATA							
BEAR CREEK				**STATION 3 - 8/7/88**			
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
ANNELIDA					0%	0.3	
Lumbricidae	0	1	0	1	0%	0.3	0.6
TOTAL ORGANISMS	121	128	79	328		109.3	26.5
TAXA RICHNESS	25	17	24	38		22.0	4.4
SHAN. DIVERSITY	3.93	3.45	3.97	4.06		3.78	0.29
BIOTICINDEX	1.50	1.48	1.78	1.56		1.59	0.17
EPT RICHNESS	14	9	12	21		11.7	2.5
EPT / CHIR.	16.33	14.57	7.71	12.70		12.9	4.6
BIOTIC COND. INDEX				83.0			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	1.5	4	1				
depth (m)	0.33	0.22	0.12				
velocity (m/s)	0.2	0.09	0.16				
CTQp =				50			
stream width (m)				8			
gradient (%)				2			
water temperature (C)				9.5			
substrate particle size (%)	boulders (>12)			15			
	rubble (3 - 12)			45			
	gravel (.125 - 3)			35			
	fines (< 0.125)			5			

MACROINVERTEBRATE DATA							
LITTLE CHERRY CREEK						STATION 1 - 8/7/88	
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					6%	18.7	
Heterlimnius corpulentus	14	23	9	46	5%	15.3	7.1
Hydrovatus sp. ?	1	2	7	10	1%	3.3	3.2
DIPTERA					61%	187.3	
Thienemannimyia group	23	15	22	60	6%	20.0	4.4
Paramerina sp.	7	0	5	12	1%	4.0	3.6
Pagastia sp	4	72	30	106	11%	35.3	34.3
Brillia sp.	0	0	2	2	0%	0.7	1.2
Corynoneura sp	0	1	0	1	0%	0.3	0.6
Cricotopus spp.	21	155	107	283	31%	94.3	67.9
Eukiefferiella spp.	2	14	2	18	2%	6.0	6.9
Paraphaenocladius sp.	2	1	3	6	1%	2.0	1.0
Thienemanniella sp.	0	1	0	1	0%	0.3	0.6
Rheocricotopus sp.	1	2	0	3	0%	1.0	1.0
Orthocladius spp.	1	0	0	1	0%	0.3	0.6
Synorthocladius sp.	0	0	1	1	0%	0.3	0.6
Psectrocladius sp.	0	0	2	2	0%	0.7	1.2
Tvetenia sp.	0	24	2	26	3%	8.7	13.3
Micropsectra spp.	1	17	0	18	2%	6.0	9.5
Antocha sp.	0	0	1	1	0%	0.3	0.6
Dicranota sp.	6	1	2	9	1%	3.0	2.6
Tipula spp.	0	0	1	1	0%	0.3	0.6
Oreogeton sp.	5	0	1	6	1%	2.0	2.6
Simulium sp.	0	1	0	1	0%	0.3	0.6
Certatopogonidae	2	2	0	4	0%	1.3	1.2
EPHEMEROPTERA					11%	35.0	
Ameletus spp.	27	1	29	57	6%	19.0	15.6
Baetis tricaudatus	1	14	6	21	2%	7.0	6.6
Drunella coloradensis	1	1	0	2	0%	0.7	0.6
Serratella tibialis	0	2	3	5	1%	1.7	1.5
Cinygmula spp.	2	5	2	9	1%	3.0	1.7
Epeorus deceptivus	0	0	0	0	0%	0.0	0.0
Rhithrogena spp.	0	0	0	0	0%	0.0	0.0
Paraleptophlebia spp.	4	0	7	11	1%	3.7	3.5
PLECOPTERA					11%	34.7	
Isoperla sp.	0	3	1	4	0%	1.3	1.5
Doroneuria theodora	9	2	0	11	1%	3.7	4.7
Chloroperlinae	12	19	20	51	6%	17.0	4.4
Visoka sp.	6	5	6	17	2%	5.7	0.6
Zapada sp. 1	2	1	2	5	1%	1.7	0.6
Despaxia sp.	6	1	5	12	1%	4.0	2.6
Perlomyia sp.	1	1	2	4	0%	1.3	0.6

MACROINVERTEBRATE DATA							
LITTLE CHERRY CREEK						STATION 1 - 8/7/88	
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
TRICHOPTERA					10%	29.3	
Parapsyche elsis	0	1	0	1	0%	0.3	0.6
Rhyacophila verrula	0	2	2	4	0%	1.3	1.2
Rhyacophila velpulsa	0	6	12	18	2%	6.0	6.0
Rhyacophila Betteni gp.	10	20	5	35	4%	11.7	7.6
Rhyacophila Brunnea gp.	3	6	3	12	1%	4.0	1.7
Apatania sp.	0	3	0	3	0%	1.0	1.7
Ecclisomyia sp.	1	0	0	1	0%	0.3	0.6
Glossosoma sp.	0	3	1	4	0%	1.3	1.5
Dolophilodes sp.	1	0	0	1	0%	0.3	0.6
Micrasema sp.	0	8	1	9	1%	3.0	4.4
ANNELIDA					1%	3.0	
Lumbricidae	1	2	0	3	0%	1.0	1.0
Lumbriculidae	4	0	2	6	1%	2.0	2.0
TOTAL ORGANISMS	181	437	306	924		308.0	128.0
TAXA RICHNESS	31	36	34	50		33.7	2.5
SHAN. DIVERSITY	4.19	3.52	3.67	4.02		3.79	0.35
BIOTIC INDEX	3.40	4.34	4.01	4.05		3.92	0.48
EPT RICHNESS	15	19	16	29		16.7	2.1
EPT / CHIR.	1.37	0.32	0.60	0.53		0.8	0.5
BIOTIC COND. INDEX				84.9			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	0.8	0.75	0.75				
depth (m)	0.11	0.1	0.18				
velocity (ft/s)	0.07	0.19	0.12				
CTQp =				50			
stream width (m)				1.5			
gradient (%)				3			
water temperature (C)				11.5			
substrate particle size (%)	boulders (>12)			15			
	rubble (3 - 12)			30			
	gravel (.125 - 3)			35			
	fines (< 0.125)			15			

MACROINVERTEBRATE DATA							
LITTLE CHERRY CREEK					STATION 2 - 8/8/88		
samples #1 and 2 = 30 second kick samples, #3 = hand picked							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					1%	1.3	
Heterlimnius corpulentus	1	0	0	1	0%	0.3	0.6
Hydrophilidae	1	0	2	3	1%	1.0	1.0
DIPTERA					10%	9.3	
Pagastia sp	0	1	0	1	0%	0.3	0.6
Psuedodiamesa sp.	4	0	0	4	1%	1.3	2.3
Brillia sp.	0	1	0	1	0%	0.3	0.6
Eukiefferiella spp.	2	0	0	2	1%	0.7	1.2
Paraphaenocladius sp.	6	0	0	6	2%	2.0	3.5
Micropsectra spp.	1	2	0	3	1%	1.0	1.0
Dicranota sp.	1	1	0	2	1%	0.7	0.6
Oreogeton sp.	1	0	0	1	0%	0.3	0.6
Simulium sp.	5	0	0	5	2%	1.7	2.9
Certatopogonidae	2	0	1	3	1%	1.0	1.0
EPHEMEROPTERA					18%	17.3	
Ameletus spp.	3	1	1	5	2%	1.7	1.2
Baetis tricaudatus	2	0	0	2	1%	0.7	1.2
Drunella coloradensis	1	0	0	1	0%	0.3	0.6
Cinygmula spp.	8	3	2	13	4%	4.3	3.2
Rhithrogena spp.	2	0	1	3	1%	1.0	1.0
Paraleptophlebia spp.	8	10	3	21	7%	7.0	3.6
Cinygma sp.	0	6	1	7	2%	2.3	3.2
PLECOPTERA					51%	49.3	
Megarcys sp.	0	4	0	4	1%	1.3	2.3
Setvenia bradleyi	1	0	0	1	0%	0.3	0.6
Isoperla sp.	0	0	1	1	0%	0.3	0.6
Chloroperlinae	21	8	3	32	11%	10.7	9.3
Kathroperla perdita	8	0	1	9	3%	3.0	4.4
Visoka sp.	5	6	0	11	4%	3.7	3.2
Zapada sp. 1	12	9	3	24	8%	8.0	4.6
Perlomyia sp.	0	5	0	5	2%	1.7	2.9
Yoraperla brevis	36	24	1	61	21%	20.3	17.8

MACROINVERTEBRATE DATA							
LITTLE CHERRY CREEK						STATION 2 - 8/8/88	
samples #1 and 2 = 30 second kick samples, #3 = hand picked							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
TRICHOPTERA					18%	17.0	
Parapsyche elsis	5	5	1	11	4%	3.7	2.3
Rhyacophila Betteni gp.	0	2	0	2	1%	0.7	1.2
Rhyacophila Brunnea gp.	1	0	0	1	0%	0.3	0.6
Rhyacophila Coloradensis	3	0	0	3	1%	1.0	1.7
Rhyacophila velpulsa	1	0	0	1	0%	0.3	0.6
Rhyacophila Sibrica gp	3	0	0	3	1%	1.0	1.7
Lepidostoma spp.	11	7	0	18	6%	6.0	5.6
Apatania sp.	0	3	1	4	1%	1.3	1.5
Chryandra sp. sp.	0	0	1	1	0%	0.3	0.6
Dicoesmoecus sp.	0	0	1	1	0%	0.3	0.6
Wormaldia sp.	5	0	1	6	2%	2.0	2.6
ANNELIDA					2%	2.0	
Enchytraeidae	2	0	0	2	1%	0.7	1.2
Lumbriculidae	0	3	0	3	1%	1.0	1.7
Naididae	1	0	0	1	0%	0.3	0.6
OTHER							
Turbellaria	2	0	0	2	1%	0.7	1.2
TOTAL ORGANISMS	165	101	25	291		97.0	70.1
TAXA RICHNESS	32	19	17	43		22.7	8.1
SHAN. DIVERSITY	4.17	3.73	3.91	4.38		3.94	0.22
BIOTIC INDEX	1.06	0.90	1.16	1.01		1.04	0.13
EPT RICHNESS	19	14	15	32		16.0	2.6
EPT / CHIR.	10.08	23.25	100.00	14.41		44.4	48.6
BIOTIC COND. INDEX				96.7			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	0	0	na				
depth (m)	0.1	0.1	na				
velocity (ft/s)	to shallow to measure						
CTQp =				50			
stream width (m)				0.5			
gradient (%)				6			
water temperature (C)				11.5			
substrate particle size (%)	boulders (>12)			30			
	rubble (3 - 12)			35			
	gravel (.125 - 3)			20			
	fines (< 0.125)			15			

.	MACROINVERTEBRATE DATA						
POORMAN CREEK					**STATION 1 - 8/5/88**		
.							
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					1%	1.7	
Heterlimnius corpulentus	1	3	1	5	1%	1.7	1.2
DIPTERA					20%	36.7	
Thienemannimyia group	2	4	0	6	1%	2.0	2.0
Paramerina sp.	5	1	0	6	1%	2.0	2.6
Pagastia sp	1	2	0	3	1%	1.0	1.0
Psuedodiamesa sp.	0	0	1	1	0%	0.3	0.6
Brillia sp.	2	1	1	4	1%	1.3	0.6
Corynoneura sp	0	2	0	2	0%	0.7	1.2
Cricotopus spp.	0	1	0	1	0%	0.3	0.6
Eukiefferiella spp.	1	4	4	9	2%	3.0	1.7
Krenosmittia sp.	0	2	0	2	0%	0.7	1.2
Thienemanniella sp.	1	1	0	2	0%	0.7	0.6
Paraphaenocladius sp.	5	1	0	6	1%	2.0	2.6
Rheocricotopus sp.	3	4	0	7	1%	2.3	2.1
Orthocladius spp.	0	1	0	1	0%	0.3	0.6
Tvetenia sp.	2	2	2	6	1%	2.0	0.0
Polypedilum spp.	7	8	5	20	4%	6.7	1.5
Micropsectra spp.	7	5	0	12	2%	4.0	3.6
Dicranota sp.	1	7	3	11	2%	3.7	3.1
Chelifera sp.	0	0	3	3	1%	1.0	1.7
Oreogeton sp.	0	1	2	3	1%	1.0	1.0
Simulium sp.	1	0	0	1	0%	0.3	0.6
Certatopogonidae	1	2	1	4	1%	1.3	0.6
EPHEMEROPTERA					22%	40.7	
Ameletus spp.	0	2	0	2	0%	0.7	1.2
Baetis tricaudatus	0	1	3	4	1%	1.3	1.5
Drunella coloradensis	2	1	0	3	1%	1.0	1.0
Drunella doddsi	1	3	1	5	1%	1.7	1.2
Serratella tibialis	0	1	0	1	0%	0.3	0.6
Cinygmula spp.	10	25	11	46	8%	15.3	8.4
Epeorus deceptivus	14	22	3	39	7%	13.0	9.5
Rhithrogena spp.	5	11	6	22	4%	7.3	3.2
PLECOPTERA					41%	75.7	
Megarcys sp.	0	0	6	6	1%	2.0	3.5
Doroneuria theodora	3	2	5	10	2%	3.3	1.5
Chloroperlinae	59	57	39	155	28%	51.7	11.0
Capnia gp.	1	0	0	1	0%	0.3	0.6
Visoka sp.	0	1	0	1	0%	0.3	0.6
Zapada sp. 1	0	2	12	14	3%	4.7	6.4
Doddsia sp.	0	3	3	6	1%	2.0	1.7
Despaxia sp.	0	0	1	1	0%	0.3	0.6
Perlomyia sp.	3	4	26	33	6%	11.0	13.0

MACROINVERTEBRATE DATA							
POORMAN CREEK					STATION 1 - 8/5/88		
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
TRICHOPTERA					17%	31.0	
Parapsyche elsis	0	1	4	5	1%	1.7	2.1
Rhyacophila sp.	0	2	0	2	0%	0.7	1.2
Rhyacophila Betteni gp.	7	24	17	48	9%	16.0	8.5
Rhyacophila velpulsa	1	3	10	14	3%	4.7	4.7
Oligophlebodes sp.	0	0	1	1	0%	0.3	0.6
Glossosoma sp.	2	9	12	23	4%	7.7	5.1
ANNELIDA					0%	0.7	
Lumbricidae	1	0	0	1	0%	0.3	0.6
Lumbriculidae	0	0	1	1	0%	0.3	0.6
TOTAL ORGANISMS	149	226	184	559		186.3	38.6
TAXA RICHNESS	28	38	28	47		31.3	5.8
SHAN. DIVERSITY	3.52	4.07	3.97	4.19		3.85	0.30
BIOTICINDEX	1.79	1.67	1.18	1.54		1.55	0.32
EPT RICHNESS	12	19	17	27		16.0	3.6
EPT / CHIR.	3.00	4.46	12.31	5.02		6.6	5.0
BIOTIC COND. INDEX				79.4			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	1.25	1.5	0.5				
depth (m)	0.16	0.21	0.12				
velocity (ft/s)	0.28	0.22	0.3				
CTQp =				50			
stream width (m)				3			
gradient (%)				3			
water temperature (C)				11			
substrate particle size (%)	boulders (>12)			30			
	rubble (3 - 12)			45			
	gravel (.125 - 3)			15			
	fines (< 0.125)			10			

.	MACROINVERTEBRATE DATA						
POORMAN CREEK						**STATION 2 - 8/5/88**	
.							
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					1%	1.3	
Heterlimnius corpulentus	1	2	1	4	1%	1.3	0.6
DIPTERA					23%	46.7	
unassociated midge pupa	2	1	3	6	1%	2.0	1.0
Thienemannimyia group	4	0	1	5	1%	1.7	2.1
Macropelopia sp.	0	0	0	0	0%	0.0	0.0
Paramerina sp.	4	1	0	5	1%	1.7	2.1
Pagastia sp	1	0	0	1	0%	0.3	0.6
Brillia sp.	2	7	2	11	2%	3.7	2.9
Corynoneura sp	1	0	2	3	0%	1.0	1.0
Cricotopus spp.	0	0	3	3	0%	1.0	1.7
Eukiefferiella spp.	0	3	2	5	1%	1.7	1.5
Paraphaenocladius sp.	3	6	5	14	2%	4.7	1.5
Rheocricotopus sp.	2	2	3	7	1%	2.3	0.6
Tvetenia sp.	1	2	6	9	1%	3.0	2.6
Polypedilum spp.	3	0	0	3	0%	1.0	1.7
Micropsectra spp.	15	2	12	29	5%	9.7	6.8
Antocha sp.	1	0	0	1	0%	0.3	0.6
Pedicia sp.	0	0	1	1	0%	0.3	0.6
Dicranota sp.	5	2	8	15	2%	5.0	3.0
Chelifera sp.	5	0	2	7	1%	2.3	2.5
Oreogeton sp.	1	0	1	2	0%	0.7	0.6
Glutops sp.	2	0	0	2	0%	0.7	1.2
Simulium sp.	1	1	2	4	1%	1.3	0.6
Certatopogonidae	3	2	2	7	1%	2.3	0.6
EPHEMEROPTERA					14%	29.7	
Ameletus spp.	1	0	0	1	0%	0.3	0.6
Baetis bicaudatus	0	0	1	1	0%	0.3	0.6
Baetis tricaudatus	1	0	3	4	1%	1.3	1.5
Drunella coloradensis	0	1	2	3	0%	1.0	1.0
Drunella doddsi	0	2	5	7	1%	2.3	2.5
Cinygmula spp.	12	5	5	22	4%	7.3	4.0
Epeorus deceptivus	5	4	10	19	3%	6.3	3.2
Rhithrogena spp.	13	7	9	29	5%	9.7	3.1
Paraleptophlebia spp.	0	0	3	3	0%	1.0	1.7
PLECOPTERA					44%	91.3	
Megarcys sp.	3	3	1	7	1%	2.3	1.2
Doroneuria theodora	2	2	6	10	2%	3.3	2.3
Chloroperlinae	22	20	22	64	10%	21.3	1.2
Kathroperla perdita	1	0	0	1	0%	0.3	0.6
Visoka sp.	1	0	5	6	1%	2.0	2.6
Zapada sp. 1	12	19	23	54	9%	18.0	5.6
Despaxia sp.	0	0	33	33	5%	11.0	19.1
Perlomyia sp.	16	9	71	96	15%	32.0	34.0
Yoraperla brevis	0	2	1	3	0%	1.0	1.0

MACROINVERTEBRATE DATA							
POORMAN CREEK						**STATION 2 - 8/5/88**	
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
TRICHOPTERA					18%	37.3	
Parapsyche elsis	0	0	1	1	0%	0.3	0.6
Rhyacophila Betteni gp.	10	24	34	68	11%	22.7	12.1
Rhyacophila verrula	1	0	1	2	0%	0.7	0.6
Rhyacophila velpulsa	2	0	1	3	0%	1.0	1.0
Rhyacophila Sibrica gp	0	0	1	1	0%	0.3	0.6
Lepidostoma spp.	1	0	1	2	0%	0.7	0.6
Apatania sp.	0	0	1	1	0%	0.3	0.6
Glossosoma sp.	14	8	11	33	5%	11.0	3.0
Dolophilodes sp.	0	0	1	1	0%	0.3	0.6
ANNELIDA					0%	0.3	
Lumbriculidae	0	1	0	1	0%	0.3	0.6
TOTAL ORGANISMS	174	138	308	620		206.7	89.6
TAXA RICHNESS	36	26	42	51		34.7	8.1
SHAN. DIVERSITY	4.44	3.98	4.17	4.48		4.20	0.23
BIOTICINDEX	2.09	1.39	1.51	1.65		1.66	0.37
EPT RICHNESS	17	13	25	31		18.3	6.1
EPT / CHIR.	3.08	4.42	6.44	4.69		4.6	1.7
BIOTIC COND. INDEX				90.7			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	2	3	1				
depth (m)	0.16	0.09	0.22				
velocity (ft/s)	0.15	0.3	0.17				
CTQp =				50			
stream width (m)				6			
gradient (%)				5			
water temperature (C)				11			
substrate particle size (%)	boulders (>12)			30			
	rubble (3 - 12)			50			
	gravel (.125 - 3)			10			
	fines (< 0.125)			10			

MACROINVERTEBRATE DATA							
RAMSEY CREEK					STATION 2 - 8/4/88		
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					0%	0.7	
Heterlimnius corpulentus	0	1	1	2	0%	0.7	0.6
DIPTERA					35%	56.7	
unassociated midge pupa	4	3	2	9	2%	3.0	1.0
Paramerina sp.	3	4	6	13	3%	4.3	1.5
Pagastia sp	0	1	0	1	0%	0.3	0.6
Psuedodiamesa sp.	0	0	1	1	0%	0.3	0.6
Brillia sp.	1	0	2	3	1%	1.0	1.0
Cricotopus spp.	1	1	2	4	1%	1.3	0.6
Eukiefferiella spp.	23	19	15	57	12%	19.0	4.0
Krenosmittia sp.	0	0	1	1	0%	0.3	0.6
Paraphaenocladius sp.	1	0	3	4	1%	1.3	1.5
Heterotrissocladius sp	0	0	4	4	1%	1.3	2.3
Rheocricotopus sp.	4	5	20	29	6%	9.7	9.0
Orthocladius spp.	0	0	2	2	0%	0.7	1.2
Tvetenia sp.	1	4	2	7	1%	2.3	1.5
Micropsectra spp.	0	9	10	19	4%	6.3	5.5
Dicranota sp.	0	1	2	3	1%	1.0	1.0
Pedicia sp.	0	0	1	1	0%	0.3	0.6
Chelifera sp.	0	0	1	1	0%	0.3	0.6
Oreogeton sp.	1	7	0	8	2%	2.7	3.8
Glutops sp.	0	1	0	1	0%	0.3	0.6
Simulium sp.	0	0	1	1	0%	0.3	0.6
Certatopogonidae	0	1	0	1	0%	0.3	0.6
EPHEMEROPTERA					22%	35.0	
Baetis bicaudatus	1	0	1	2	0%	0.7	0.6
Baetis tricaudatus	9	11	12	32	7%	10.7	1.5
Drunella coloradensis	0	0	1	1	0%	0.3	0.6
Drunella doddsi	0	19	11	30	6%	10.0	9.5
Cinygmula spp.	3	9	4	16	3%	5.3	3.2
Epeorus deceptivus	0	3	0	3	1%	1.0	1.7
Rhithrogena spp.	8	11	2	21	4%	7.0	4.6
PLECOPTERA					36%	58.3	
Megarcys sp.	0	1	0	1	0%	0.3	0.6
Doroneuria theodora	4	0	0	4	1%	1.3	2.3
Chloroperlinae	36	30	43	109	22%	36.3	6.5
Visoka sp.	1	5	12	18	4%	6.0	5.6
Zapada sp. 1	1	3	5	9	2%	3.0	2.0
Despaxia sp.	4	5	1	10	2%	3.3	2.1
Perlomyia sp.	13	10	1	24	5%	8.0	6.2

MACROINVERTEBRATE DATA							
RAMSEY CREEK					**STATION 2 - 8/4/88**		
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
TRICHOPTERA					7%	11.3	
Arctopsyche grandis	0	1	0	1	0%	0.3	0.6
Rhyacophila Betteni gp.	2	5	6	13	3%	4.3	2.1
Rhyacophila velpulsa	0	0	3	3	1%	1.0	1.7
Rhyacophila Sibrica gp	3	0	0	3	1%	1.0	1.7
Lepidostoma spp.	0	0	1	1	0%	0.3	0.6
Limnephilidae pupa	0	0	1	1	0%	0.3	0.6
Ecclisomyia sp.	0	0	2	2	0%	0.7	1.2
Glossosoma sp.	1	7	2	10	2%	3.3	3.2
TOTAL ORGANISMS	125	177	184	486		162.0	32.2
TAXA RICHNESS	22	27	35	44		28.0	6.6
SHAN. DIVERSITY	3.45	4.13	4.14	4.26		3.91	0.39
BIOTICINDEX	2.76	2.51	2.85	2.71		2.71	0.18
EPT RICHNESS	13	14	17	26		14.7	2.1
EPT / CHIR.	2.26	2.61	1.54	2.04		2.1	0.5
BIOTIC COND. INDEX				82.1			
ID's by D. McGuire & G. Jacobi							
PHYSICAL DATA							
distance from shore (m)	2.7	3	1.7				
depth (m)	0.21	0.22	0.2				
velocity (ft/s)	0.18	0.38	0.11				
CTQp =				50			
stream width (m)				7			
gradient (%)				3.4			
water temperature (C)				11			
substrate particle size (%)	boulders (>12)			15			
	rubble (3 - 12)			70			
	gravel (.125 - 3)			10			
	fines (< 0.125)			5			

MACROINVERTEBRATE DATA							
RAMSEY CREEK					**STATION 3 - 8/4/88**		
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					0%	0.3	
Heterlimnius corpulentus	0	1	0	1	0%	0.3	0.6
DIPTERA					33%	53.3	
unassociated midge pupa	0	0	2	2	0%	0.7	1.2
Thienemannimyia group	0	1	2	3	1%	1.0	1.0
Paramerina sp.	0	3	3	6	1%	2.0	1.7
Pagastia sp	1	1	0	2	0%	0.7	0.6
Brillia sp.	0	0	2	2	0%	0.7	1.2
Corynoneura sp	0	1	1	2	0%	0.7	0.6
Eukiefferiella spp.	3	0	6	9	2%	3.0	3.0
Paraphaenocladius sp.	0	0	1	1	0%	0.3	0.6
Heterotrissocladius sp	0	0	3	3	1%	1.0	1.7
Rheocricotopus sp.	23	16	30	69	14%	23.0	7.0
Tvetenia sp.	3	0	5	8	2%	2.7	2.5
Polypedilum spp.	0	0	1	1	0%	0.3	0.6
Micropsectra spp.	12	10	10	32	7%	10.7	1.2
Dicranota sp.	2	4	1	7	1%	2.3	1.5
Chelifera sp.	1	1	4	6	1%	2.0	1.7
Oreogeton sp.	1	2	1	4	1%	1.3	0.6
Certatopogonidae	2	1	0	3	1%	1.0	1.0
EPHEMEROPTERA					8%	13.3	
Ameletus spp.	0	1	1	2	0%	0.7	0.6
Baetis bicaudatus	1	0	0	1	0%	0.3	0.6
Baetis tricaudatus	2	1	3	6	1%	2.0	1.0
Drunella doddsi	2	0	5	7	1%	2.3	2.5
Serratella tibialis	2	1	0	3	1%	1.0	1.0
Cinygmula spp.	2	0	1	3	1%	1.0	1.0
Epeorus deceptivus	2	0	0	2	0%	0.7	1.2
Rhithrogena spp.	10	0	6	16	3%	5.3	5.0
PLECOPTERA					51%	83.7	
Megarcys sp.	3	0	2	5	1%	1.7	1.5
Doroneuria theodora	0	1	0	1	0%	0.3	0.6
Chloroperlinae	21	12	19	52	11%	17.3	4.7
Visoka sp.	10	7	12	29	6%	9.7	2.5
Zapada sp. 1	70	11	41	122	25%	40.7	29.5
Despaxia sp.	1	9	6	16	3%	5.3	4.0
Perlomyia sp.	2	4	8	14	3%	4.7	3.1
Yoraperla brevis	4	1	7	12	2%	4.0	3.0

MACROINVERTEBRATE DATA							
RAMSEY CREEK					**STATION 3 - 8/4/88**		
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
TRICHOPTERA					8%	13.3	
Arctopsyche grandis	3	0	6	9	2%	3.0	3.0
Rhyacophila Betteni gp.	11	2	5	18	4%	6.0	4.6
Rhyacophila verrula	2	1	3	6	1%	2.0	1.0
Rhyacophila velpulsa	0	2	2	4	1%	1.3	1.2
Lepidostoma spp.	1	1	0	2	0%	0.7	0.6
Neothremma sp.	1	0	0	1	0%	0.3	0.6
TOTAL ORGANISMS	198	95	199	492		164.0	59.8
TAXA RICHNESS	28	25	31	40		28.0	3.0
SHAN. DIVERSITY	3.50	3.90	4.11	4.04		3.84	0.31
BIOTIC INDEX	1.74	2.80	2.46	2.24		2.33	0.54
EPT RICHNESS	19	14	16	26		16.3	2.5
EPT / CHIR.	3.57	1.69	1.92	2.36		2.4	1.0
BIOTIC COND. INDEX				83.0			
ID's by D. McGuire &G. Jacobi							
PHYSICAL DATA							
distance from shore (m)	3	1	4				
depth (m)	0.15	0.27	0.18				
velocity (m/s)	0.21	0.05	0.18				
CTQp =				50			
stream width (m)				9			
gradient (%)				7			
water temperature (C)				11			
substrate particle size (%)	boulders (>12)			40			
	rubble (3 - 12)			40			
	gravel (.125 - 3)			10			
	fines (< 0.125)			10			

MACROINVERTEBRATE DATA							
RAMSEY CREEK					**STATION 4 - 8/4/88**		
.							
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					1%	1.0	
Heterlimnius corpulentus	0	0	3	3	1%	1.0	1.7
DIPTERA					22%	36.7	
unassociated midge pupa	0	0	1	1	0%	0.3	0.6
Thienemannimyia group	1	0	0	1	0%	0.3	0.6
Macropelopia sp.	1	0	0	1	0%	0.3	0.6
Pagastia sp	0	1	0	1	0%	0.3	0.6
Psuedodiamesa sp.	0	0	1	1	0%	0.3	0.6
Brillia sp.	0	0	4	4	1%	1.3	2.3
Corynoneura sp	0	4	0	4	1%	1.3	2.3
Cricotopus spp.	0	1	0	1	0%	0.3	0.6
Eukiefferiella spp.	1	3	2	6	1%	2.0	1.0
Paraphaenocladius sp.	2	1	2	5	1%	1.7	0.6
Rheocricotopus sp.	1	3	0	4	1%	1.3	1.5
Tvetenia sp.	8	20	6	34	7%	11.3	7.6
Micropsectra spp.	12	12	9	33	7%	11.0	1.7
Dicranota sp.	0	0	1	1	0%	0.3	0.6
Pedicia sp.	0	1	0	1	0%	0.3	0.6
Rhabdomastix sp.	0	0	1	1	0%	0.3	0.6
Chelifera sp.	0	2	0	2	0%	0.7	1.2
Oreogeton sp.	0	2	1	3	1%	1.0	1.0
Simulium sp.	0	3	1	4	1%	1.3	1.5
Certatopogonidae	1	1	0	2	0%	0.7	0.6
EPHEMEROPTERA					24%	39.3	
Ameletus spp.	1	8	0	9	2%	3.0	4.4
Baetis tricaudatus	5	13	2	20	4%	6.7	5.7
Drunella coloradensis	9	11	18	38	8%	12.7	4.7
Cinygmula spp.	0	0	2	2	0%	0.7	1.2
Epeorus deceptivus	6	19	12	37	7%	12.3	6.5
Rhithrogena spp.	0	5	7	12	2%	4.0	3.6
PLECOPTERA					38%	62.7	
Megarcys sp.	8	12	6	26	5%	8.7	3.1
Doroneuria theodora	0	1	0	1	0%	0.3	0.6
Chloroperlinae	11	12	24	47	9%	15.7	7.2
Zapada frigida ?	26	0	1	27	5%	9.0	14.7
Despaxia sp.	7	6	10	23	5%	7.7	2.1
Perlomyia sp.	2	1	0	3	1%	1.0	1.0
Yoraperla brevis	15	25	21	61	12%	20.3	5.0

MACROINVERTEBRATE DATA							
RAMSEY CREEK					**STATION 4 - 8/4/88**		
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
TRICHOPTERA					3%	5.3	
Parapsyche elsis	3	1	1	5	1%	1.7	1.2
Rhyacophila Betteni gp.	0	3	3	6	1%	2.0	1.7
Rhyacophila Sibrica gp	0	0	3	3	1%	1.0	1.7
Neothremma sp.	1	0	0	1	0%	0.3	0.6
Glossosoma sp.	0	0	1	1	0%	0.3	0.6
MOLLUSCA							
Sphaeriidae	0	0	1	1	0%	0.3	0.6
ANNELIDA					11%	18.3	
Tubificidae	6	18	31	55	11%	18.3	12.5
OTHER							
Turbellaria	0	4	0	4	1%	1.3	2.3
TOTAL ORGANISMS	127	193	175	495		165.0	34.1
TAXA RICHNESS	21	28	28	42		25.7	4.0
SHAN. DIVERSITY	3.76	4.15	3.93	4.30		3.95	0.20
BIOTIC INDEX	2.13	3.15	3.02	2.84		2.77	0.56
EPT RICHNESS	12	13	14	22		13.0	1.0
EPT / CHIR.	3.62	2.60	4.44	3.35		3.6	0.9
BIOTIC COND. INDEX				91.7			
ID's by D. McGuire & G. Jacobi							
PHYSICAL DATA							
distance from shore (m)	1.4	1	0.8				
depth (m)	0.09	0.12	0.15				
velocity (ft/s)	0.34	0.51	0.5				
CTQp =				60			
stream width (m)				5			
gradient (%)				1			
water temperature (C)				11.5			
substrate particle size (%)	boulders (>12)			0			
	rubble (3 - 12)			0			
	gravel (.125 - 3)			30			
	fines (< 0.125)			70			

MACROINVERTEBRATE DATA							
LIBBY CREEK				STATION 1 - 8/1/88			
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					1%	4.7	
Heterlimnius corpulentus	0	9	0	9	1%	3.0	5.2
Narpus concolor	0	1	0	1	0%	0.3	0.6
Cleptelmis ornata	2	1	0	3	0%	1.0	1.0
unidentified larva	1	0	0	1	0%	0.3	0.6
DIPTERA					41%	148.0	
unassociated midge pupa	0	3	2	5	0%	1.7	1.5
Thienemannimyia group	54	23	39	116	11%	38.7	15.5
Pagastia sp	0	5	0	5	0%	1.7	2.9
Corynoneura sp	0	1	0	1	0%	0.3	0.6
Cricotopus (Isocladius) sp.	1	1	0	2	0%	0.7	0.6
Eukiefferiella spp.	9	25	8	42	4%	14.0	9.5
Paraphaenocladius sp.	4	1	5	10	1%	3.3	2.1
Rheocricotopus sp.	31	48	68	147	14%	49.0	18.5
Orthocladius (Euortho.) sp.	0	17	9	26	2%	8.7	8.5
Orthocladius (Eudactylo.) s	0	1	0	1	0%	0.3	0.6
Synorthocladius sp.	0	2	0	2	0%	0.7	1.2
Tvetenia sp.	2	2	3	7	1%	2.3	0.6
Polypedilum spp.	1	1	1	3	0%	1.0	0.0
Micropsectra spp.	27	10	19	56	5%	18.7	8.5
Antocha sp.	0	2	0	2	0%	0.7	1.2
Hexatoma sp.	0	4	3	7	1%	2.3	2.1
Chelifera sp.	1	2	1	4	0%	1.3	0.6
Certatopogonidae	0	7	1	8	1%	2.7	3.8
EPHEMEROPTERA					32%	113.0	
Ameletus spp.	0	0	1	1	0%	0.3	0.6
Baetis bicaudatus	1	4	0	5	0%	1.7	2.1
Baetis tricaudatus	0	0	1	1	0%	0.3	0.6
Drunella coloradensis	0	1	1	2	0%	0.7	0.6
Drunella doddsi	1	2	0	3	0%	1.0	1.0
Serratella tibialis	6	7	15	28	3%	9.3	4.9
Cinygmula spp.	54	35	29	118	11%	39.3	13.1
Epeorus deceptivus	5	0	2	7	1%	2.3	2.5
Rhithrogena sp.	51	37	20	108	10%	36.0	15.5
Paraleptophlebia spp.	7	36	23	66	6%	22.0	14.5
PLECOPTERA					12%	44.0	
Megarcys sp.	0	1	0	1	0%	0.3	0.6
Doroneuria theodora	0	1	1	2	0%	0.7	0.6
Chloroperlinae	45	37	27	109	10%	36.3	9.0
Capnia gp.	0	0	1	1	0%	0.3	0.6
Visoka sp.	0	0	1	1	0%	0.3	0.6
Zapada sp. 1	0	0	2	2	0%	0.7	1.2
Doddsia sp.	1	0	1	2	0%	0.7	0.6
Perlomyia sp.	4	3	7	14	1%	4.7	2.1

MACROINVERTEBRATE DATA							
LIBBY CREEK				**STATION 1 - 8/1/88**			
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
TRICHOPTERA					13%	48.0	
Arctopsyche grandis	3	3	6	12	1%	4.0	1.7
Rhyacophila sp.	0	1	3	4	0%	1.3	1.5
Rhyacophila Betteni gp.	0	5	0	5	0%	1.7	2.9
Rhyacophila Brunnea gp.	1	0	1	2	0%	0.7	0.6
Rhyacophila Sibrica gp	0	0	1	1	0%	0.3	0.6
Rhyacophila Hylinata gp	0	0	1	1	0%	0.3	0.6
Apatania sp.	43	35	27	105	10%	35.0	8.0
Neophylax sp.	0	1	0	1	0%	0.3	0.6
Agapetus sp.	2	5	6	13	1%	4.3	2.1
TOTAL ORGANISMS	357	380	336	1073		357.7	22.0
TAXA RICHNESS	25	38	34	49		32.3	6.7
SHAN. DIVERSITY	3.51	4.19	3.98	4.08		3.89	0.35
BIOTICINDEX	3.52	3.45	3.86	3.60		3.61	0.22
EPT RICHNESS	14	17	22	31		17.7	4.0
EPT / CHIR.	1.74	1.53	1.15	1.45		1.5	0.3
BIOTIC COND. INDEX				83.0			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	7.2	9.4	10.3				
depth (m)	0.18	0.25	0.26				
velocity (ft/s)	0.51	0.54	0.28				
CTQp =				50			
stream width (m)				20			
gradient (%)				1.3			
water temperature (C)				13			
substrate particle size (%)	boulders (>12)			10			
	rubble (3 - 12)			35			
	gravel (.125 - 3)			45			
	fines (< 0.125)			10			

MACROINVERTEBRATE DATA							
LIBBY CREEK				**STATION 3 - 8/10/88**			
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					2%	10.3	
Heterlimnius corpulentus	20	5	4	29	2%	9.7	9.0
Optioservus sp.	0	1	1	2	0%	0.7	0.6
DIPTERA					32%	181.0	
unassociated midge pupa	1	2	0	3	0%	1.0	1.0
Thienemannimyia group	34	47	72	153	9%	51.0	19.3
Pagastia sp	0	0	1	1	0%	0.3	0.6
Corynoneura sp	0	2	1	3	0%	1.0	1.0
Cricotopus spp.	1	6	0	7	0%	2.3	3.2
Eukiefferiella spp.	1	1	1	3	0%	1.0	0.0
Krenosmittia sp.	0	0	1	1	0%	0.3	0.6
Paraphaenocladius sp.	0	4	5	9	1%	3.0	2.6
Rheocricotopus sp.	7	37	26	70	4%	23.3	15.2
Synorthocladius sp.	1	0	0	1	0%	0.3	0.6
Tvetenia sp.	4	5	1	10	1%	3.3	2.1
Micropsectra spp.	48	96	109	253	15%	84.3	32.1
Antocha sp.	0	1	1	2	0%	0.7	0.6
Hexatoma sp.	3	3	5	11	1%	3.7	1.2
Chelifera sp.	0	1	5	6	0%	2.0	2.6
Pericoma sp.	0	1	1	2	0%	0.7	0.6
Tabanus sp.	0	1	1	2	0%	0.7	0.6
Simulium sp.	0	0	1	1	0%	0.3	0.6
Certatopogonidae	0	3	2	5	0%	1.7	1.5
EPHEMEROPTERA					32%	184.0	
Ameletus spp.	3	0	5	8	0%	2.7	2.5
Baetis bicaudatus	0	9	6	15	1%	5.0	4.6
Baetis tricaudatus	11	3	2	16	1%	5.3	4.9
Drunella doddsi	16	13	4	33	2%	11.0	6.2
Drunella coloradensis	0	2	0	2	0%	0.7	1.2
Serratella tibialis	1	7	3	11	1%	3.7	3.1
Cinygmula spp.	66	45	53	164	10%	54.7	10.6
Epeorus deceptivus	48	30	27	105	6%	35.0	11.4
Rhithrogena spp.	60	46	36	142	8%	47.3	12.1
Paraleptophlebia spp.	7	17	32	56	3%	18.7	12.6
PLECOPTERA					10%	57.3	
Megarcys sp.	3	1	0	4	0%	1.3	1.5
Skwala sp.	0	3	1	4	0%	1.3	1.5
Chloroperlinae	25	31	70	126	7%	42.0	24.4
Nemouridae	0	9	4	13	1%	4.3	4.5
Zapada sp. 1	0	1	0	1	0%	0.3	0.6
Doddsia sp.	6	6	1	13	1%	4.3	2.9
Perlomyia sp.	3	4	4	11	1%	3.7	0.6

.	MACROINVERTEBRATE DATA						
LIBBY CREEK				**STATION 3 - 8/10/88**			
.							
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
TRICHOPTERA					24%	137.3	
Arctopsyche grandis	14	24	9	47	3%	15.7	7.6
Rhyacophila vernula	0	0	1	1	0%	0.3	0.6
Rhyacophila Brunnea gp.	0	2	4	6	0%	2.0	2.0
Rhyacophila Sibrica gp	0	1	0	1	0%	0.3	0.6
Lepidostoma spp.	0	1	1	2	0%	0.7	0.6
Agraylea sp.	0	1	0	1	0%	0.3	0.6
Apatania sp.	126	147	77	350	20%	116.7	35.9
Ecclisomyia sp.	0	1	0	1	0%	0.3	0.6
Neothremma sp.	1	0	0	1	0%	0.3	0.6
Neophylax sp.	0	1	0	1	0%	0.3	0.6
Psychoglypha sp.	0	1	0	1	0%	0.3	0.6
TOTAL ORGANISMS	510	622	578	1710		570.0	56.4
TAXA RICHNESS	25	42	37	49		34.7	8.7
SHAN. DIVERSITY	3.54	3.90	3.75	3.87		3.73	0.18
BIOTICINDEX	3.08	3.77	3.76	3.56		3.54	0.39
EPT RICHNESS	15	25	19	32		19.7	5.0
EPT / CHIR.	4.02	2.03	1.57	2.21		2.5	1.3
BIOTIC COND. INDEX				86.7			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	2	7	2				
depth (m)	0.15	0.17	0.23				
velocity (ft/s)	1.25	0.62	0.66				
CTQp =				50			
stream width (m)				20			
gradient (%)				1.2			
water temperature (C)				12			
substrate particle size (%)	boulders (>12)			10			
	rubble (3 - 12)			65			
	gravel (.125 - 3)			15			
	fines (< 0.125)			10			

MACROINVERTEBRATE DATA							
LIBBY CREEK					STATION 4 - 8/1/88		
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					1%	6.0	
Heterlimnius corpulentus	2	8	7	17	1%	5.7	3.2
Lara avara	0	0	1	1	0%	0.3	0.6
DIPTERA					31%	143.3	
unassociated midge pupa	4	5	10	19	1%	6.3	3.2
Thienemannimyia group	12	22	6	40	3%	13.3	8.1
Pagastia sp	0	1	0	1	0%	0.3	0.6
Corynoneura sp	0	1	0	1	0%	0.3	0.6
Cricotopus spp.	0	0	1	1	0%	0.3	0.6
Eukiefferiella spp.	10	6	7	23	2%	7.7	2.1
Krenosmittia sp.	2	1	0	3	0%	1.0	1.0
Paraphaenocladius sp.	3	8	4	15	1%	5.0	2.6
Rheocricotopus sp.	6	16	18	40	3%	13.3	6.4
Synorthocladius sp.	3	1	0	4	0%	1.3	1.5
Tvetenia sp.	6	1	3	10	1%	3.3	2.5
Polypedilum spp.	3	4	4	11	1%	3.7	0.6
Micropsectra spp.	75	136	39	250	18%	83.3	49.0
Dicranota sp.	0	3	1	4	0%	1.3	1.5
Glutops sp.	0	3	0	3	0%	1.0	1.7
Simulium sp.	0	2	0	2	0%	0.7	1.2
Certatopogonidae	3	0	0	3	0%	1.0	1.7
EPHEMEROPTERA					40%	188.0	
Ameletus spp.	1	2	0	3	0%	1.0	1.0
Baetis bicaudatus	2	1	9	12	1%	4.0	4.4
Baetis tricaudatus	5	35	18	58	4%	19.3	15.0
Drunella coloradensis	0	0	1	1	0%	0.3	0.6
Drunella doddsi	26	23	37	86	6%	28.7	7.4
Serratella tibialis	2	2	3	7	0%	2.3	0.6
Cinygmula spp.	33	17	6	56	4%	18.7	13.6
Epeorus deceptivus	36	54	41	131	9%	43.7	9.3
Rhithrogena spp.	21	78	108	207	15%	69.0	44.2
Paraleptophlebia spp.	2	1	0	3	0%	1.0	1.0
PLECOPTERA					21%	97.0	
Megarcys sp.	5	4	12	21	1%	7.0	4.4
Doroneuria theodora	1	1	4	6	0%	2.0	1.7
Chloroperlinae	31	66	36	133	9%	44.3	18.9
Zapada sp. 1	0	0	2	2	0%	0.7	1.2
Taeniopterygidae? (small)	10	37	78	125	9%	41.7	34.2
Perlomyia sp.	1	1	2	4	0%	1.3	0.6

MACROINVERTEBRATE DATA							
LIBBY CREEK				**STATION 4 - 8/1/88**			
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
TRICHOPTERA					7%	33.7	
Arctopsyche grandis	7	0	8	15	1%	5.0	4.4
Rhyacophila Betteni gp.	0	3	1	4	0%	1.3	1.5
Rhyacophila verrula	0	0	1	1	0%	0.3	0.6
Rhyacophila Sibrica gp	0	0	1	1	0%	0.3	0.6
Rhyacophila Hylinata gp	1	0	0	1	0%	0.3	0.6
Lepidostoma spp.	1	0	0	1	0%	0.3	0.6
Apatania sp.	37	28	4	69	5%	23.0	17.1
Glossosoma sp.	2	5	2	9	1%	3.0	1.7
TOTAL ORGANISMS	353	576	475	1404		468.0	111.7
TAXA RICHNESS	31	33	32	43		32.0	1.0
SHAN. DIVERSITY	3.92	3.74	3.79	3.99		3.82	0.10
BIOTICINDEX	3.38	3.30	2.31	2.99		3.00	0.60
EPT RICHNESS	19	17	20	28		18.7	1.5
EPT / CHIR.	1.81	1.77	4.07	2.29		2.5	1.3
BIOTIC COND. INDEX				86.5			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	4	3	6				
depth (m)	0.24	0.29	0.29				
velocity (ft/s)	1.35	1.21	1.31				
CTQp =				50			
stream width (m)				20			
gradient (%)				1.2			
water temperature (C)				12			
substrate particle size (%)	boulders (>12)			15			
	rubble (3 - 12)			40			
	gravel (.125 - 3)			35			
	fines (< 0.125)			10			

MACROINVERTEBRATE DATA							
LIBBY CREEK				STATION 5 - 8/2/88			
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					3%	13.3	
Heterlimnius corpulentus	5	26	8	39	3%	13.0	11.4
Narpus concolor	0	0	1	1	0%	0.3	0.6
DIPTERA					58%	283.3	
unassociated midge pupa	4	4	1	9	1%	3.0	1.7
Thienemannimyia group	43	40	18	101	7%	33.7	13.7
Pagastia sp	2	4	1	7	0%	2.3	1.5
Corynoneura sp	5	1	2	8	1%	2.7	2.1
Cricotopus spp.	0	5	0	5	0%	1.7	2.9
Eukiefferiella spp.	80	124	23	227	15%	75.7	50.6
Krenosmittia sp.	5	0	1	6	0%	2.0	2.6
Paraphaenocladius sp.	5	3	5	13	1%	4.3	1.2
Rheocricotopus sp.	14	34	7	55	4%	18.3	14.0
Synorthocladius sp.	1	1	1	3	0%	1.0	0.0
Thienemanniella sp.	3	0	0	3	0%	1.0	1.7
Tvetenia sp.	2	16	3	21	1%	7.0	7.8
Microtendipes sp	0	0	0	0	0%	0.0	0.0
Phaenopsectra sp	0	0	0	0	0%	0.0	0.0
Tanytarsus sp	0	0	0	0	0%	0.0	0.0
Polypedilum spp.	6	20	12	38	3%	12.7	7.0
Micropsectra spp.	131	87	127	345	23%	115.0	24.3
Dicranota sp.	1	0	0	1	0%	0.3	0.6
Hexatoma sp.	1	1	0	2	0%	0.7	0.6
Hemerodromia sp.	1	0	0	1	0%	0.3	0.6
Glutops sp.	0	1	1	2	0%	0.7	0.6
Simulium sp.	0	0	1	1	0%	0.3	0.6
Certatopogonidae	2	0	0	2	0%	0.7	1.2
EPHEMEROPTERA					19%	93.0	
Ameletus spp.	0	0	5	5	0%	1.7	2.9
Baetis tricaudatus	11	20	24	55	4%	18.3	6.7
Drunella coloradensis	0	0	2	2	0%	0.7	1.2
Drunella doddsi	4	31	19	54	4%	18.0	13.5
Serratella tibialis	1	5	2	8	1%	2.7	2.1
Cinygmula spp.	19	9	15	43	3%	14.3	5.0
Epeorus deceptivus	8	15	22	45	3%	15.0	7.0
Rhithrogena spp.	6	31	30	67	5%	22.3	14.2
PLECOPTERA					15%	74.0	
Megarcys sp.	3	0	0	3	0%	1.0	1.7
Doroneuria theodora	4	2	0	6	0%	2.0	2.0
Chloroperlinae	44	64	68	176	12%	58.7	12.9
Zapada sp. 1	1	0	0	1	0%	0.3	0.6
Taeniopterygidae	10	6	8	24	2%	8.0	2.0
Perlomyia sp.	4	2	6	12	1%	4.0	2.0

MACROINVERTEBRATE DATA							
LIBBY CREEK						**STATION 5 - 8/2/88**	
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
TRICHOPTERA					6%	29.0	
Arctopsyche grandis	1	9	3	13	1%	4.3	4.2
Rhyacophila Alberta gp.	0	0	1	1	0%	0.3	0.6
Rhyacophila Betteni gp.	2	2	3	7	0%	2.3	0.6
Rhyacophila Sibrica gp	0	1	0	1	0%	0.3	0.6
Lepidostoma spp.	1	2	0	3	0%	1.0	1.0
Apatania sp.	13	18	26	57	4%	19.0	6.6
Glossosoma sp.	0	2	3	5	0%	1.7	1.5
TOTAL ORGANISMS	443	586	449	1478		492.7	80.9
TAXA RICHNESS	34	31	32	46		32.3	1.5
SHAN. DIVERSITY	3.59	3.87	3.75	3.90		3.74	0.14
BIOTIC INDEX	5.32	4.70	3.85	4.63		4.63	0.74
EPT RICHNESS	16	16	16	25		16.0	0.0
EPT / CHIR.	0.44	0.65	1.18	0.70		0.8	0.4
BIOTIC COND. INDEX				78.0			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	2.3	3.5	2.2				
depth (m)	0.2	0.25	0.31				
velocity (ft/s)	0.27	1.07	0.91				
CTQp =				50			
stream width (m)				9			
gradient (%)				2			
water temperature (C)				14			
substrate particle size (%)	boulders (>12)			10			
	rubble (3 - 12)			45			
	gravel (.125 - 3)			30			
	fines (< 0.125)			15			

MACROINVERTEBRATE DATA							
LIBBY CREEK				STATION 8 - 8/3/88			
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					2%	4.0	
Heterlimnius corpulentus	2	3	7	12	2%	4.0	2.6
DIPTERA					22%	48.0	
unassociated midge pupa	2	0	3	5	1%	1.7	1.5
Thienemannimyia group	1	1	0	2	0%	0.7	0.6
Pagastia sp	0	0	2	2	0%	0.7	1.2
Psuedodiamesa sp.	0	0	1	1	0%	0.3	0.6
Brillia sp.	1	0	0	1	0%	0.3	0.6
Corynoneura sp	0	0	1	1	0%	0.3	0.6
Cricotopus spp.	0	0	1	1	0%	0.3	0.6
Eukiefferiella spp.	1	1	3	5	1%	1.7	1.2
Paraphaenocladius sp.	3	3	2	8	1%	2.7	0.6
Rheocricotopus sp.	1	0	0	1	0%	0.3	0.6
Tvetenia sp.	4	2	5	11	2%	3.7	1.5
Polypedilum spp.	0	1	5	6	1%	2.0	2.6
Micropsectra spp.	12	16	51	79	12%	26.3	21.5
Dicranota sp.	6	3	4	13	2%	4.3	1.5
Hexatoma sp.	0	0	1	1	0%	0.3	0.6
Pedicia sp.	0	0	1	1	0%	0.3	0.6
Chelifera sp.	0	1	2	3	0%	1.0	1.0
Oreogeton sp.	0	1	0	1	0%	0.3	0.6
Simulium sp.	0	1	1	2	0%	0.7	0.6
EPHEMEROPTERA					38%	81.7	
Baetis tricaudatus	4	2	4	10	2%	3.3	1.2
Drunella coloradensis	5	0	3	8	1%	2.7	2.5
Drunella doddsi	1	2	3	6	1%	2.0	1.0
Serratella tibialis	8	3	4	15	2%	5.0	2.6
Cinygmula spp.	24	18	24	66	10%	22.0	3.5
Epeorus deceptivus	10	15	37	62	10%	20.7	14.4
Rhithrogena spp.	25	35	18	78	12%	26.0	8.5
PLECOPTERA					31%	66.7	
Megarcys sp.	7	3	3	13	2%	4.3	2.3
Doroneuria theodora	3	4	0	7	1%	2.3	2.1
Chloroperlinae	42	27	49	118	18%	39.3	11.2
Zapada sp. 1	16	7	5	28	4%	9.3	5.9
Taeniopterygidae ?	3	14	12	29	4%	9.7	5.9
Perlomyia sp.	0	4	1	5	1%	1.7	2.1

MACROINVERTEBRATE DATA							
LIBBY CREEK					**STATION 8 - 8/3/88**		
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
TRICHOPTERA					7%	15.7	
Arctopsyche grandis	3	0	1	4	1%	1.3	1.5
Parapsyche elsis	0	1	4	5	1%	1.7	2.1
Rhyacophila Betteni gp.	3	3	1	7	1%	2.3	1.2
Rhyacophila Brunnea gp.	2	0	0	2	0%	0.7	1.2
Rhyacophila Sibrica gp	0	1	0	1	0%	0.3	0.6
Rhyacophila Hylinata gp	1	0	0	1	0%	0.3	0.6
Apatania sp.	0	0	1	1	0%	0.3	0.6
Glossosoma sp.	11	10	5	26	4%	8.7	3.2
TOTAL ORGANISMS	201	182	265	648		216.0	43.5
TAXA RICHNESS	27	27	33	41		29.0	3.5
SHAN. DIVERSITY	3.93	3.87	3.85	4.06		3.88	0.04
BIOTICINDEX	1.50	1.73	2.64	2.03		1.96	0.60
EPT RICHNESS	17	16	17	25		16.7	0.6
EPT / CHIR.	6.72	6.21	2.36	4.00		5.1	2.4
BIOTIC COND. INDEX				86.2			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	missing	missing	missing				
depth (m)	missing	missing	missing				
velocity (ft/s)	missing	missing	missing				
CTQp =				50			
stream width (m)				5			
gradient (%)				2			
water temperature (C)				8.5			
substrate particle size (%)	boulders (>12)			5			
	rubble (3 - 12)			40			
	gravel (.125 - 3)			50			
	fines (< 0.125)			5			

MACROINVERTEBRATE DATA							
LIBBY CREEK				STATION-10 - 8/3/88			
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					0%	0.3	
Heterlimnius corpulentus	1	0	0	1	0%	0.3	0.6
DIPTERA					21%	37.7	
Psuedodiamesa sp.	1	1	0	2	0%	0.7	0.6
Brillia sp.	1	0	0	1	0%	0.3	0.6
Cricotopus spp.	1	1	1	3	1%	1.0	0.0
Eukiefferiella spp.	2	1	3	6	1%	2.0	1.0
Rheocricotopus sp.	2	3	7	12	2%	4.0	2.6
Tvetenia sp.	6	5	8	19	4%	6.3	1.5
Micropsectra spp.	5	4	20	29	5%	9.7	9.0
Hesperoconopa sp.	0	1	0	1	0%	0.3	0.6
Dicranota sp.	0	2	0	2	0%	0.7	1.2
Chelifera sp.	0	0	1	1	0%	0.3	0.6
Oreogeton sp.	11	12	3	26	5%	8.7	4.9
Simulium sp.	2	0	0	2	0%	0.7	1.2
Certatopogonidae	0	2	7	9	2%	3.0	3.6
EPHEMEROPTERA					31%	54.3	
Baetis bicaudatus	0	0	1	1	0%	0.3	0.6
Baetis tricaudatus	1	12	10	23	4%	7.7	5.9
Drunella coloradensis	1	1	2	4	1%	1.3	0.6
Drunella doddsi	0	2	2	4	1%	1.3	1.2
Cinygmula spp.	6	11	8	25	5%	8.3	2.5
Epeorus deceptivus	12	21	17	50	9%	16.7	4.5
Rhithrogena spp.	17	19	20	56	11%	18.7	1.5
PLECOPTERA					31%	55.0	
Megarcys sp.	0	4	3	7	1%	2.3	2.1
Doroneuria theodora	0	1	0	1	0%	0.3	0.6
Chloroperlinae	48	20	40	108	20%	36.0	14.4
Zapada sp. 1	15	1	23	39	7%	13.0	11.1
Perlomyia sp.	0	0	1	1	0%	0.3	0.6
Yoraperla brevis	0	3	6	9	2%	3.0	3.0
TRICHOPTERA					16%	28.7	
Arctopsyche grandis	0	1	0	1	0%	0.3	0.6
Parapsyche elsis	1	1	1	3	1%	1.0	0.0
Rhyacophila Betteni gp.	14	14	10	38	7%	12.7	2.3
Rhyacophila Brunnea gp.	0	1	0	1	0%	0.3	0.6
Rhyacophila verrula	1	0	2	3	1%	1.0	1.0
Lepidostoma spp.	0	1	4	5	1%	1.7	2.1
Limnephilidae (pupa)	0	0	1	1	0%	0.3	0.6
Glossosoma sp.	13	11	10	34	6%	11.3	1.5

MACROINVERTEBRATE DATA							
LIBBY CREEK				STATION 10 - 8/3/88			
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
ANNELIDA					0%	0.7	
Lumbriculidae	0	1	1	2	0%	0.7	0.6
OTHER							
Turbellaria	0	0	1	1	0%	0.3	0.6
TOTAL ORGANISMS	161	157	213	531		177.0	31.2
TAXA RICHNESS	21	28	28	37		25.7	4.0
SHAN. DIVERSITY	3.43	4.00	4.03	4.03		3.82	0.33
BIOTICINDEX	1.20	1.64	1.90	1.61		1.58	0.35
EPT RICHNESS	11	17	18	25		15.3	3.8
EPT / CHIR.	7.17	8.27	4.13	5.75		6.5	2.1
BIOTIC COND. INDEX				95.3			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	1	1.2	2.6				
depth (m)	0.16	0.16	0.18				
velocity (ft/s)	1.1	1.2	1.76				
CTQp =				50			
stream width (m)				5			
gradient (%)				3.5			
water temperature (C)				11			
substrate particle size (%)	boulders (>12)			25			
	rubble (3 - 12)			50			
	gravel (.125 - 3)			15			
	fines (< 0.125)			10			

MACROINVERTEBRATE DATA							
LIBBY CREEK				STATION 11 - 8/3/88			
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
DIPTERA					43%	84.0	
unassociated midge pupa	1	0	3	4	1%	1.3	1.5
Parametrina sp.	1	0	2	3	1%	1.0	1.0
Pagastia sp	5	1	1	7	1%	2.3	2.3
Brillia sp.	0	1	0	1	0%	0.3	0.6
Corynoneura sp	0	0	1	1	0%	0.3	0.6
Cricotopus spp.	0	1	0	1	0%	0.3	0.6
Eukiefferiella spp.	1	1	1	3	1%	1.0	0.0
Paraphaenocladius sp.	1	0	2	3	1%	1.0	1.0
Rheocricotopus sp.	16	4	6	26	4%	8.7	6.4
Psuedoorthocladius sp.	1	0	0	1	0%	0.3	0.6
Tvetenia sp.	42	32	26	100	17%	33.3	8.1
Micropsectra spp.	34	12	27	73	12%	24.3	11.2
Dicranota sp.	3	2	4	9	2%	3.0	1.0
Chelifera sp.	5	0	0	5	1%	1.7	2.9
Oreogeton sp.	7	2	3	12	2%	4.0	2.6
Prosimulium sp.	0	0	1	1	0%	0.3	0.6
Simulium sp.	1	0	0	1	0%	0.3	0.6
Certatopogonidae	0	0	1	1	0%	0.3	0.6
EPHEMEROPTERA					16%	32.0	
Baetis tricaudatus	7	0	0	7	1%	2.3	4.0
Drunella coloradensis	0	2	1	3	1%	1.0	1.0
Drunella doddsi	1	1	0	2	0%	0.7	0.6
Cinygmula spp.	7	8	5	20	3%	6.7	1.5
Epeorus deceptivus	20	11	14	45	8%	15.0	4.6
Rhithrogena spp.	6	9	4	19	3%	6.3	2.5
PLECOPTERA					34%	67.7	
Megarcys sp.	0	1	7	8	1%	2.7	3.8
Chloroperlinae	33	15	13	61	10%	20.3	11.0
Visoka sp.	4	10	7	21	4%	7.0	3.0
Zapada sp. 1	18	19	3	40	7%	13.3	9.0
Despaxia sp.	15	6	14	35	6%	11.7	4.9
Perlomyia sp.	3	0	2	5	1%	1.7	1.5
Yoraperla brevis	24	3	6	33	6%	11.0	11.4
TRICHOPTERA					6%	11.0	
Parapsyche elsis	2	0	0	2	0%	0.7	1.2
Rhyacophila Betteni gp.	6	1	0	7	1%	2.3	3.2
Rhyacophila verrula	8	3	3	14	2%	4.7	2.9
Rhyacophila velpulsa	0	0	3	3	1%	1.0	1.7
Rhyacophila Sibrica gp	0	0	1	1	0%	0.3	0.6
Homophylax sp.	0	0	1	1	0%	0.3	0.6
Neothremma sp.	1	1	1	3	1%	1.0	0.0
Glossosoma sp.	1	1	0	2	0%	0.7	0.6

MACROINVERTEBRATE DATA							
LIBBY CREEK				STATION 11 - 8/3/88			
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
ANNELIDA					1%	2.3	
Lumbriculidae	6	0	1	7	1%	2.3	3.2
TOTAL ORGANISMS	280	147	164	591		197.0	72.4
TAXA RICHNESS	30	24	30	40		28.0	3.5
SHAN. DIVERSITY	4.09	3.76	4.11	4.20		3.99	0.19
BIOTICINDEX	2.71	2.44	3.11	2.75		2.75	0.34
EPT RICHNESS	16	15	16	25		15.7	0.6
EPT / CHIR.	1.53	1.75	1.23	1.49		1.5	0.3
BIOTIC COND. INDEX				90.1			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	1	2	0.5				
depth (m)	0.09	0.14	0.17				
velocity (ft/s)	0.99	1.14	0.64				
CTQp =				50			
stream width (m)				7			
gradient (%)				4			
water temperature (C)				11			
substrate particle size (%)	boulders (>12)			40			
	rubble (3 - 12)			30			
	gravel (.125 - 3)			20			
	fines (< 0.125)			10			

MACROINVERTEBRATE DATA							
EAST FORK ROCK CREEK					STATION 1 - 8/9/88		
Kick samples, 1 meter for 45 seconds.							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
COLEOPTERA					4%	9.3	
Heterlimnius corpulentus	3	9	6	18	3%	6.0	3.0
Lara avara	1	1	0	2	0%	0.7	0.6
Zaitzevia parvula	0	5	3	8	1%	2.7	2.5
DIPTERA					40%	89.3	
Chironomidae pupa	0	1	1	2	0%	0.7	0.6
Pagastia sp	1	4	2	7	1%	2.3	1.5
Brillia sp.	13	10	4	27	4%	9.0	4.6
Cricotopus (Isocladius)	1	0	0	1	0%	0.3	0.6
Micropsectra sp.	0	0	1	1	0%	0.3	0.6
Rheocricotopus sp.	1	2	1	4	1%	1.3	0.6
Eukiefferiella spp.	23	9	12	44	7%	14.7	7.4
Tvetenia sp.	9	5	1	15	2%	5.0	4.0
Polypedilum spp.	1	2	0	3	0%	1.0	1.0
Atherix pachypus	2	0	0	2	0%	0.7	1.2
Dicranota sp.	0	0	1	1	0%	0.3	0.6
Hexatoma sp.	0	0	2	2	0%	0.7	1.2
Tabanus sp.	0	0	1	1	0%	0.3	0.6
Simulium sp.	146	11	1	158	24%	52.7	81.0
EPHEMEROPTERA					29%	64.7	
Ameletus spp.	0	9	10	19	3%	6.3	5.5
Baetis tricaudatus	17	19	9	45	7%	15.0	5.3
Drunella coloradensis	0	4	3	7	1%	2.3	2.1
Drunella doddsi	0	3	0	3	0%	1.0	1.7
Serratella tibialis	11	21	19	51	8%	17.0	5.3
Cinygmula spp.	5	8	6	19	3%	6.3	1.5
Epeorus deceptivus	22	6	3	31	5%	10.3	10.2
Rhithrogena spp.	3	11	5	19	3%	6.3	4.2
PLECOPTERA					11%	24.3	
Megarcys sp.	1	3	8	12	2%	4.0	3.6
Doroneuria theodora	3	9	2	14	2%	4.7	3.8
Chloroperlinae	5	9	9	23	3%	7.7	2.3
Zapada sp. 1	7	13	3	23	3%	7.7	5.0
Perlomyia sp.	0	1	0	1	0%	0.3	0.6
TRICHOPTERA					16%	36.0	
Arctopsyche grandis	3	20	2	25	4%	8.3	10.1
Parapsyche elsis	8	19	1	28	4%	9.3	9.1
Rhyacophila Betteni gp.	7	5	0	12	2%	4.0	3.6
Rhyacophila velpulsa	0	2	1	3	0%	1.0	1.0
Lepidostoma spp.	8	5	2	15	2%	5.0	3.0
Agraylea sp.	2	11	9	22	3%	7.3	4.7
Dicosmoecus sp.	0	0	1	1	0%	0.3	0.6
Apatania sp.	0	2	0	2	0%	0.7	1.2

MACROINVERTEBRATE DATA							
EAST FORK ROCK CREEK					STATION 1 - 8/9/88		
Kick samples, 1 meter for 45 seconds.							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
TOTAL ORGANISMS	303	239	129	671		223.7	88.0
TAXA RICHNESS	25	31	30	38		28.7	3.2
SHAN. DIVERSITY	3.06	4.56	4.33	4.27		3.98	0.81
BIOTICINDEX	4.48	2.55	2.98	3.50		3.34	1.02
EPT RICHNESS	14	20	17	25		17.0	3.0
EPT / CHIR.	2.08	5.45	4.23	3.61		3.9	1.7
BIOTIC COND. INDEX				89.2			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	1	2	3				
depth (m)	0.2	0.27	0.64				
velocity (ft/s)	0.34	0.55	0.24				
CTQp =				50			
stream width (m)				6			
gradient (%)				2			
water temperature (C)				11.5			
substrate particle size (%)	boulders (>12)			30			
	rubble (3 - 12)			55			
	gravel (.125 - 3)			10			
	fines (< 0.125)			5			

MACROINVERTEBRATE DATA							
EAST FORK ROCK CREEK					**STATION 3 - 8/9/88**		
Kick samples,1 meter for 45 seconds							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
COLEOPTERA					11%	28.7	
Zaitzevia parvula	36	19	9	64	8%	21.3	13.7
Lara avara	7	0	1	8	1%	2.7	3.8
Cleptelmis ornata	5	5	3	13	2%	4.3	1.2
Dytiscidae	0	1	0	1	0%	0.3	0.6
DIPTERA					41%	107.3	
unassociated midge pupa	3	1	3	7	1%	2.3	1.2
Thienemannimyia group	3	2	3	8	1%	2.7	0.6
Pagastia sp	12	8	3	23	3%	7.7	4.5
Brillia sp.	3	3	7	13	2%	4.3	2.3
Cardiocladius spp.	3	8	3	14	2%	4.7	2.9
Cricotopus (Isocladius)	5	1	1	7	1%	2.3	2.3
Eukiefferiella spp.	7	8	8	23	3%	7.7	0.6
Heterotrissocladius sp.	0	1	0	1	0%	0.3	0.6
Paraphaenocladius sp.	0	0	2	2	0%	0.7	1.2
Psectrocladius (Mesocladius	28	47	37	112	14%	37.3	9.5
Orthocladius spp.	0	4	1	5	1%	1.7	2.1
Tvetenia sp.	2	4	3	9	1%	3.0	1.0
Micropsectra spp.	17	14	15	46	6%	15.3	1.5
Chelifera sp.	4	15	3	22	3%	7.3	6.7
Oreogeton sp.	1	0	0	1	0%	0.3	0.6
Simulium sp.	19	1	9	29	4%	9.7	9.0
EPHEMEROPTERA					8%	20.0	
Baetis tricaudatus	3	5	12	20	3%	6.7	4.7
Drunella coloradensis	1	0	2	3	0%	1.0	1.0
Drunella doddsi	1	0	1	2	0%	0.7	0.6
Serratella tibialis	0	0	1	1	0%	0.3	0.6
Rhithrogena spp.	3	3	8	14	2%	4.7	2.9
Paraleptophlebia spp.	8	12	0	20	3%	6.7	6.1
PLECOPTERA					11%	28.3	
Isoperla sobria	22	24	31	77	10%	25.7	4.7
Alloperla sp.	1	1	2	4	1%	1.3	0.6
Visoka sp.	1	0	0	1	0%	0.3	0.6
Zapada sp. 1	1	0	0	1	0%	0.3	0.6
Despaxia sp.	0	2	0	2	0%	0.7	1.2

MACROINVERTEBRATE DATA							
EAST FORK ROCK CREEK				STATION 3 - 8/9/88			
Kick samples,1 meter for 45 seconds							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
TRICHOPTERA					27%	71.0	
Arctopsyche grandis	0	1	2	3	0%	1.0	1.0
Parapsyche elsis	4	6	5	15	2%	5.0	1.0
Rhyacophila Brunnea gp.	18	6	8	32	4%	10.7	6.4
Rhyacophila verula	2	1	0	3	0%	1.0	1.0
Lepidostoma spp.	4	3	4	11	1%	3.7	0.6
Agraylea sp.	1	11	2	14	2%	4.7	5.5
Dicosmoecus sp.	2	1	0	3	0%	1.0	1.0
Dolophilodes sp.	4	0	1	5	1%	1.7	2.1
Micrasema sp.	7	76	44	127	16%	42.3	34.5
MOLLUSCA							
Sphaeriidae	3	8	1	12	2%	4.0	3.6
OTHER							
Turbellaria	0	1	1	2	0%	0.7	0.6
Porifera present							
TOTAL ORGANISMS	241	303	236	780		260.0	37.3
TAXA RICHNESS	34	33	33	42		33.3	0.6
SHAN. DIVERSITY	4.33	3.94	4.07	4.32		4.11	0.20
BIOTIC INDEX	3.89	3.85	3.72	3.82		3.82	0.09
EPT RICHNESS	16	13	13	25		14.0	1.7
EPT / CHIR.	1.00	1.50	1.43	1.33		1.3	0.3
BIOTIC COND. INDEX				85.7			
ID's by D. McGuire & G. Jacobi							
PHYSICAL DATA							
distance from shore (m)	2	1	2.3				
depth (m)	0.3	0.24	0.35				
velocity (m/s)	0.26	0.45	0.37				
CTQp =				60			
stream width (m)				9			
gradient (%)				1			
water temperature (C)				16			
substrate particle size (%)	boulders (>12)			25			
	rubble (3 - 12)			30			
	gravel (.125 - 3)			25			
	fines (< 0.125)			20			

MACROINVERTEBRATE DATA							
EAST FORK ROCK CREEK					STATION 4 - 8/8/88		
Kick sample, 1 meter for 45 seconds							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					4%	5.7	
Heterlimnius corpulentus	1	0	0	1	0%	0.3	0.6
Lara avara	0	2	0	2	0%	0.7	1.2
Zaitzevia parvula	6	6	2	14	3%	4.7	2.3
DIPTERA					8%	11.0	
Brillia sp.	0	1	5	6	1%	2.0	2.6
Eukiefferiella spp.	0	2	5	7	2%	2.3	2.5
Tvetenia sp.	3	1	7	11	3%	3.7	3.1
Micropsectra spp.	6	0	1	7	2%	2.3	3.2
Oreogeton sp.	0	1	0	1	0%	0.3	0.6
Simulium sp.	0	1	0	1	0%	0.3	0.6
EPHEMEROPTERA					34%	46.7	
Baetis tricaudatus	6	6	10	22	5%	7.3	2.3
Cinygmula spp.	38	22	11	71	17%	23.7	13.6
Epeorus deceptivus	15	10	15	40	10%	13.3	2.9
Rhithrogena spp.	7	0	0	7	2%	2.3	4.0
PLECOPTERA					25%	33.3	
Megarcys sp.	19	10	8	37	9%	12.3	5.9
Doroneuria theodora	10	6	3	19	5%	6.3	3.5
Chloroperlinae	9	5	3	17	4%	5.7	3.1
Zapada sp. 1	1	19	5	25	6%	8.3	9.5
Yoraperla brevis	1	0	1	2	0%	0.7	0.6
TRICHOPTERA					28%	38.3	
Parapsyche elsis	24	15	28	67	17%	22.3	6.7
Rhyacophila Betteni gp.	0	1	2	3	1%	1.0	1.0
Rhyacophila Brunnea gp.	1	1	1	3	1%	1.0	0.0
Rhyacophila Hylinata gp	0	0	1	1	0%	0.3	0.6
Lepidostoma spp.	2	0	2	4	1%	1.3	1.2
Apatania sp.	0	2	0	2	0%	0.7	1.2
Neothremma sp.	10	9	16	35	9%	11.7	3.8
ANNELIDA					0%	0.3	
Lumbricidae	1	0	0	1	0%	0.3	0.6

MACROINVERTEBRATE DATA							
EAST FORK ROCK CREEK				STATION 4 - 8/8/88			
Kick sample, 1 meter for 45 seconds							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
TOTAL ORGANISMS	160	120	126	406		135.3	21.6
TAXA RICHNESS	18	19	19	26		18.7	0.6
SHAN. DIVERSITY	3.47	3.60	3.62	3.78		3.56	0.08
BIOTICINDEX	1.58	1.51	1.76	1.62		1.62	0.13
EPT RICHNESS	13	12	14	20		13.0	1.0
EPT / CHIR.	15.89	26.50	5.89	11.45		16.1	10.3
BIOTIC COND. INDEX				91.8			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	1.1	0.3	1				
depth (m)	0.13	0.11	0.13				
velocity (ft/s)	0.57	0.67	0.13				
CTQp =				50			
stream width (m)				3.5			
gradient (%)				15			
water temperature (C)				11.5			
substrate particle size (%)	bedrock			45			
	boulders (>12)			40			
	rubble (3 - 12)			10			
	gravel (.125 - 3)			5			

APPENDIX 6.4 October, 1988 aquatic macroinvertebrate data and summary parameters by Montana Project area creek and station

MACROINVERTEBRATE DATA							
BEAR CREEK					**STATION 1 - 10/20/88**		
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
COLEOPTERA					5%	18.7	
Heterlimnius corpulentus	17	15	24	56	5%	18.7	4.7
DIPTERA					3%	12.0	
Thienemannimyia group	6	4	3	13	1%	4.3	1.5
Diamesa spp.	1	0	0	1	0%	0.3	0.6
Brillia sp.	3	0	0	3	0%	1.0	1.7
Bryophaenocladius sp. ?	1	0	0	1	0%	0.3	0.6
Eukiefferiella spp.	1	0	0	1	0%	0.3	0.6
Orthocladius spp.	0	0	1	1	0%	0.3	0.6
Synorthocladius sp.	1	0	0	1	0%	0.3	0.6
Psuedoorthocladius sp.	0	0	1	1	0%	0.3	0.6
Antocha sp.	0	2	0	2	0%	0.7	1.2
Dicranota sp.	2	0	2	4	0%	1.3	1.2
Hexatoma sp.	3	0	0	3	0%	1.0	1.7
Oreogeton sp.	5	0	0	5	0%	1.7	2.9
EPHEMEROPTERA					53%	197.7	
Ameletus spp.	0	0	2	2	0%	0.7	1.2
Baetis bicaudatus	58	19	31	108	10%	36.0	20.0
Ephemerella infrequens	17	2	7	26	2%	8.7	7.6
Drunella doddsi	28	20	41	89	8%	29.7	10.6
Drunella spinifera	1	0	0	1	0%	0.3	0.6
Serratella tibialis	3	0	1	4	0%	1.3	1.5
Cinygmula spp.	61	58	148	267	24%	89.0	51.1
Epeorus deceptivus	0	2	0	2	0%	0.7	1.2
Rhithrogena spp.	35	19	24	78	7%	26.0	8.2
Paraleptophlebia spp.	13	1	2	16	1%	5.3	6.7
PLECOPTERA					19%	73.0	
Perlodidae	4	2	0	6	1%	2.0	2.0
Megarcys sp.	0	1	1	2	0%	0.7	0.6
Doroneuria theodora	0	4	3	7	1%	2.3	2.1
Chloroperlinae	32	29	18	79	7%	26.3	7.4
Visoka sp. ?	2	0	0	2	0%	0.7	1.2
Zapada sp. 1	7	0	4	11	1%	3.7	3.5
Zapada cinctipes	33	2	0	35	3%	11.7	18.5
Doddsia sp.	25	13	16	54	5%	18.0	6.2
Perlomyia sp.	3	8	12	23	2%	7.7	4.5

MACROINVERTEBRATE DATA							
BEAR CREEK					**STATION 1 - 10/20/88**		
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
TRICHOPTERA					19%	71.7	
Arctopsyche grandis	2	6	0	8	1%	2.7	3.1
Parapsyche elsis	1	0	8	9	1%	3.0	4.4
Rhyacophila vepulsa ?	2	2	0	4	0%	1.3	1.2
Rhyacophila Betteni gp.	4	2	2	8	1%	2.7	1.2
Rhyacophila Brunnea gp.	2	2	1	5	0%	1.7	0.6
Rhyacophila oreta ?	0	1	2	3	0%	1.0	1.0
Rhyacophila Sibrica gp	0	0	4	4	0%	1.3	2.3
Rhyacophila Hylinata gp	4	3	0	7	1%	2.3	2.1
Lepidostoma spp.	4	2	2	8	1%	2.7	1.2
Apatania sp.	0	2	4	6	1%	2.0	2.0
Ecclisomyia sp.	2	0	0	2	0%	0.7	1.2
Oligophlebbodes sp.	46	24	74	144	13%	48.0	25.1
Glossosoma sp.	3	2	2	7	1%	2.3	0.6
ANNELIDA					0%	0.3	
Lumbriculidae	0	0	1	1	0%	0.3	0.6
OTHER							
Turbellaria	0	0	4	4	0%	1.3	2.3
TOTAL ORGANISMS	**432**	**247**	**445**	**1124**		**374.7**	**110.8**
TAXA RICHNESS	**35**	**27**	**30**	**47**		**30.7**	**4.0**
SHAN. DIVERSITY	**4.09**	**3.79**	**3.40**	**3.95**		**3.76**	**0.35**
BIOTIC INDEX	**1.61**	**1.55**	**1.64**	**1.61**		**1.60**	**0.05**
EPT RICHNESS	**25**	**24**	**23**	**36**		**24.0**	**1.0**
EPT / CHIR.	**30.15**	**56.50**	**81.80**	**46.6818**		**56.2**	**25.8**
BIOTIC COND. INDEX				**114.4**			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	1.5	1	0.7			1.1	0.4
depth (m)	0.3	0.3	0.3			0.30	0.00
velocity (ft/s)	0.68	1.19	0.53			0.80	0.35
CTQp =				50			
stream width (m)				14			
gradient (%)				3			
water temperature (C)				4			
substrate particle size (%)	boulders (>12)			20			
	rubble (3 - 12)			45			
	gravel (.125 - 3)			25			
	fines (< 0.125)			10			

MACROINVERTEBRATE DATA							
BEAR CREEK		STATION 2 - 10/20/88					
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					1%	2.7	
Heterlimnius corpulentus	0	8	0	8	1%	2.7	4.6
DIPTERA					4%	7.0	
Thienemannimyia group	1	2	1	4	1%	1.3	0.6
Brillia sp.	3	0	1	4	1%	1.3	1.5
Bryophaenocladius sp.?	1	0	0	1	0%	0.3	0.6
Paraphaenocladius sp	4	1	0	5	1%	1.7	2.1
Parametriocnemus sp.	1	0	0	1	0%	0.3	0.6
Micropsectra spp.	1	0	0	1	0%	0.3	0.6
Dicranota sp.	1	1	1	3	1%	1.0	0.0
Hexatoma sp.	0	0	1	1	0%	0.3	0.6
Oreogeton sp.	1	0	0	1	0%	0.3	0.6
EPHEMEROPTERA					28%	54.3	
Ameletus spp.	3	0	0	3	1%	1.0	1.7
Baetis bicaudatus	12	18	3	33	6%	11.0	7.5
Drunella doddsi	7	9	6	22	4%	7.3	1.5
Serratella tibialis	1	0	0	1	0%	0.3	0.6
Cinygmula spp.	5	36	3	44	8%	14.7	18.5
Epeorus deceptivus	1	1	0	2	0%	0.7	0.6
Rhithrogena spp.	17	19	11	47	8%	15.7	4.2
Paraleptophlebia spp.	10	1	0	11	2%	3.7	5.5
PLECOPTERA					49%	95.0	
Megarcys sp.	1	1	1	3	1%	1.0	0.0
Doroneuria theodora	1	2	1	4	1%	1.3	0.6
Chloroperlinae	39	35	21	95	16%	31.7	9.5
Kathroperla perdita	0	0	1	1	0%	0.3	0.6
Visoka sp. ?	14	3	0	17	3%	5.7	7.4
Zapada sp. 1	26	9	4	39	7%	13.0	11.5
Doddsia sp.	9	11	7	27	5%	9.0	2.0
Perlomyia sp.	24	63	7	94	16%	31.3	28.7
Yoraperla brevis	4	1	0	5	1%	1.7	2.1
TRICHOPTERA					17%	33.0	
Parapsyche elsis	19	9	0	28	5%	9.3	9.5
Rhyacophila Betteni gp.	9	7	1	17	3%	5.7	4.2
Rhyacophila vagrita ?	0	0	1	1	0%	0.3	0.6
Rhyacophila Sibrica gp	1	0	3	4	1%	1.3	1.5
Lepidostoma spp.	6	0	0	6	1%	2.0	3.5
Glossosoma sp.	13	20	10	43	7%	14.3	5.1
ANNELIDA					0%	0.3	
Lumbricidae	1	0	0	1	0%	0.3	0.6

MACROINVERTEBRATE DATA							
BEAR CREEK		STATION 2 - 10/20/88					
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
TOTAL ORGANISMS	**236**	**257**	**84**	**577**		**192.3**	**94.4**
TAXA RICHNESS	**30**	**21**	**19**	**34**		**23.3**	**5.9**
SHAN. DIVERSITY	**4.09**	**3.49**	**3.53**	**3.98**		**3.70**	**0.33**
BIOTIC INDEX	**0.72**	**1.11**	**0.70**	**0.89**		**0.84**	**0.23**
EPT RICHNESS	**21**	**17**	**15**	**28**		**17.7**	**3.1**
EPT / CHIR.	**20.18**	**81.67**	**40.00**	**34.188**		**47.3**	**31.4**
BIOTIC COND. INDEX				**106.8**			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	1.5	2	7				
depth (m)	0.3	0.3	0.35				
velocity (ft/s)	1.13	1.23	missing				
CTQp =				50			
stream width (m)				12			
gradient (%)				2.5			
water temperature (C)				4			
substrate particle size (%)	boulders (>12)			10			
	rubble (3 - 12)			45			
	gravel (.125 - 3)			35			
	fines (< 0.125)			10			

MACROINVERTEBRATE DATA							
BEAR CREEK		STATION 3 - 10/20/88					
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					3%	6.0	
Heterlimnius corpulentus	5	6	7	18	3%	6.0	1.0
DIPTERA					4%	8.7	
Thienemannimyia group	2	0	2	4	1%	1.3	1.2
Brillia sp.	0	1	0	1	0%	0.3	0.6
Cardiocladius spp.	0	1	0	1	0%	0.3	0.6
Cricotopus spp.	0	0	1	1	0%	0.3	0.6
Parametriocnemus sp.	0	1	0	1	0%	0.3	0.6
Paraphaenocladius sp.	0	1	0	1	0%	0.3	0.6
Psuedorthocladius sp.	5	0	1	6	1%	2.0	2.6
Dicranota sp.	5	1	0	6	1%	2.0	2.6
Glutops sp.	0	0	2	2	0%	0.7	1.2
Tipula spp.	0	0	0	0	0%	0.0	0.0
Chelifera sp.	0	0	2	2	0%	0.7	1.2
Oreogeton sp.	0	1	0	1	0%	0.3	0.6
EPHEMEROPTERA					59%	133.3	
Ameletus spp.	6	0	44	50	7%	16.7	23.9
Baetis bicaudatus	10	91	11	112	17%	37.3	46.5
Ephemerella infrequens	1	1	1	3	0%	1.0	0.0
Drunella doddsi	1	7	1	9	1%	3.0	3.5
Drunella spinifera	1	0	2	3	0%	1.0	1.0
Serratella tibialis	0	1	0	1	0%	0.3	0.6
Cinygmula spp.	44	76	36	156	23%	52.0	21.2
Rhithrogena spp.	19	27	12	58	9%	19.3	7.5
Paraleptophlebia spp.	3	0	5	8	1%	2.7	2.5
PLECOPTERA					21%	48.0	
Megarcys sp.	1	0	2	3	0%	1.0	1.0
Isoperla sp.	0	0	1	1	0%	0.3	0.6
Doroneuria theodora	1	0	2	3	0%	1.0	1.0
Chloroperlinae	12	52	17	81	12%	27.0	21.8
Kathroperla perdita	1	0	1	2	0%	0.7	0.6
Visoka sp. ?	0	0	10	10	1%	3.3	5.8
Zapada sp. 1	1	5	3	9	1%	3.0	2.0
Doddsia sp.	0	14	2	16	2%	5.3	7.6
Perlomyia sp.	2	13	2	17	3%	5.7	6.4
Yoraperla brevis	2	0	0	2	0%	0.7	1.2
TRICHOPTERA					11%	25.7	
Parapsyche elsis	2	2	2	6	1%	2.0	0.0
Rhyacophila Betteni gp.	4	4	0	8	1%	2.7	2.3
Rhyacophila oreta	0	1	1	2	0%	0.7	0.6
Rhyacophila Sibrica gp	3	0	1	4	1%	1.3	1.5
Lepidostoma spp.	1	0	1	2	0%	0.7	0.6
Apatania sp.	1	0	0	1	0%	0.3	0.6
Glossosoma sp.	22	29	3	54	8%	18.0	13.5

MACROINVERTEBRATE DATA							
BEAR CREEK		**STATION 3 - 10/20/88**					
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
ANNELIDA					2%	3.7	
Enchytraeidae	0	1	0	1	0%	0.3	0.6
Lumbricidae	0	0	10	10	1%	3.3	5.8
TOTAL ORGANISMS	**155**	**336**	**185**	**676**		**225.3**	**97.0**
TAXA RICHNESS	**25**	**22**	**29**	**41**		**25.3**	**3.5**
SHAN. DIVERSITY	**3.59**	**3.06**	**3.74**	**3.75**		**3.46**	**0.35**
BIOTIC INDEX	**1.23**	**1.61**	**1.57**	**1.51**		**1.47**	**0.21**
EPT RICHNESS	**21**	**14**	**22**	**30**		**19.0**	**4.4**
EPT / CHIR.	**19.71**	**80.75**	**40.00**	**41.4**		**46.8**	**31.1**
BIOTIC COND. INDEX				**99.1**			
ID's by D. McGuire							
PHYSICAL DATA							
distance from shore (m)	1.4	2	1				
depth (m)	0.3	0.35	0.35				
velocity (ft/s)	1.25	0.8	0.38				
CTQp =				50			
stream width (m)				10			
gradient (%)				2.5			
substrate particle size (%)	boulders (>12)			30			
	rubble (3 - 12)			45			
	gravel (.125 - 3)			23			
	fines (< 0.125)			2			

MACROINVERTEBRATE DATA							
LITTLE CHERRY CREEK					STATION 1 - 10/20/88		
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					6%	15.3	
Heterlimnius corpulentus	6	19	21	46	6%	15.3	8.1
DIPTERA					22%	51.7	
Thienemannimyia group	5	31	33	69	10%	23.0	15.6
Zavrelimyia sp.	0	0	1	1	0%	0.3	0.6
Pagastia sp	0	2	0	2	0%	0.7	1.2
Brillia sp.	1	1	0	2	0%	0.7	0.6
Cricotopus spp.	5	5	1	11	2%	3.7	2.3
Parametriocnemus sp.	7	5	8	20	3%	6.7	1.5
Orthocladius spp.	9	11	5	25	4%	8.3	3.1
Synorthocladius sp.	0	0	2	2	0%	0.7	1.2
Microtendipes sp	0	1	0	1	0%	0.3	0.6
Micropsectra spp.	0	2	4	6	1%	2.0	2.0
Dicranota sp.	0	3	1	4	1%	1.3	1.5
Tipula spp.	0	0	3	3	0%	1.0	1.7
Chelifera sp.	0	0	1	1	0%	0.3	0.6
Oreogeton sp.	0	3	1	4	1%	1.3	1.5
Pericoma sp.	0	1	0	1	0%	0.3	0.6
Simulium sp.	0	2	1	3	0%	1.0	1.0
EPHEMEROPTERA					33%	77.0	
Ameletus spp.	0	2	0	2	0%	0.7	1.2
Baetis bicaudatus	6	4	4	14	2%	4.7	1.2
Baetis tricaudatus	0	20	2	22	3%	7.3	11.0
Ephemerella infrequens	8	28	17	53	7%	17.7	10.0
Drunella doddsi	1	0	0	1	0%	0.3	0.6
Drunella spinifera	14	21	2	37	5%	12.3	9.6
Cinygmula spp.	6	41	28	75	11%	25.0	17.7
Paraleptophlebia spp.	3	20	4	27	4%	9.0	9.5
PLECOPTERA					22%	51.0	
Perlidae	0	1	0	1	0%	0.3	0.6
Perlodidae	2	0	0	2	0%	0.7	1.2
Doroneuria theodora	1	1	2	4	1%	1.3	0.6
Chloroperlinae	12	43	36	91	13%	30.3	16.3
Kathroperla perdita	0	0	1	1	0%	0.3	0.6
Visoka sp. ?	6	17	2	25	4%	8.3	7.8
Zapada sp. 1	5	1	2	8	1%	2.7	2.1
Zapada cinctipes	1	9	1	11	2%	3.7	4.6
Perlomyia sp.	1	8	0	9	1%	3.0	4.4
Yoraperla brevis	0	1	0	1	0%	0.3	0.6

MACROINVERTEBRATE DATA							
LITTLE CHERRY CREEK					STATION 1 - 10/20/88		
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
TRICHOPTERA					16%	37.3	
Parapsyche elsis	1	1	0	2	0%	0.7	0.6
Rhyacophila sp.	0	1	0	1	0%	0.3	0.6
Rhyacophila Betteni gp.	4	3	1	8	1%	2.7	1.5
Rhyacophila Brunnea gp.	0	1	0	1	0%	0.3	0.6
Rhyacophila oreta	1	8	0	9	1%	3.0	4.4
Rhyacophila Sibrica gp	1	0	0	1	0%	0.3	0.6
Lepidostoma spp.	1	4	5	10	1%	3.3	2.1
Agraylea sp.	0	1	3	4	1%	1.3	1.5
Ochrotrichia sp.	1	2	2	5	1%	1.7	0.6
Glossosoma sp.	0	4	2	6	1%	2.0	2.0
Wormaldia sp.	1	0	0	1	0%	0.3	0.6
Micrasema sp.	31	33	0	64	9%	21.3	18.5
ANNELIDA					1%	3.3	
Enchytraeidae	2	3	1	6	1%	2.0	1.0
Lumbricidae	0	1	2	3	0%	1.0	1.0
Lumbriculidae	1	0	0	1	0%	0.3	0.6
OTHER							
Turbellaria	0	0	1	1	0%	0.3	0.6
TOTAL ORGANISMS	143	365	200	708		236.0	115.3
TAXA RICHNESS	29	40	33	51		34.0	5.6
SHAN. DIVERSITY	4.11	4.36	3.91	4.46		4.13	0.23
BIOTIC INDEX	2.03	2.46	3.50	2.67		2.67	0.75
EPT RICHNESS	20	24	17	34		20.3	3.5
EPT / CHIR.	2.78	4.17	2.11	3.10		3.0	1.1
BIOTIC COND. INDEX				82.6			
ID's by D. McGuire							
PHYSICAL DATA							
distance from shore (m)	0.1	0.5	0.1				
depth (m)	0.1	0.1	0.1				
velocity (ft/s)	0.34	0.25	0.21				
CTQp =				50			
stream width (m)				3			
gradient (%)				3			
water temperature (C)				7			
substrate particle size (%)	boulders (>12)			10			
	rubble (3 - 12)			30			
	gravel (.125 - 3)			40			
	fines (< 0.125)			20			

MACROINVERTEBRATE DATA							
LITTLE CHERRY CREEK					STATION 2 - 10/20/88		
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					1%	0.7	
Heterlimnius corpulentus	0	1	0	1	0%	0.3	0.6
Hydrobius sp.	0	1	0	1	0%	0.3	0.6
DIPTERA					9%	11.7	
Thienemannimyia group	6	4	7	17	5%	5.7	1.5
Brillia sp.	0	0	1	1	0%	0.3	0.6
Parametriocnemus sp.	1	0	2	3	1%	1.0	1.0
Orthocladius spp.	3	4	0	7	2%	2.3	2.1
Psuedoorthocladius sp.	0	1	0	1	0%	0.3	0.6
Micropsectra spp.	2	1	0	3	1%	1.0	1.0
Hesperoconopa sp.	1	0	0	1	0%	0.3	0.6
Dicranota sp.	0	0	1	1	0%	0.3	0.6
Simulium sp.	1	0	0	1	0%	0.3	0.6
EPHEMEROPTERA					31%	39.3	
Ameletus spp.	3	3	3	9	2%	3.0	0.0
Baetis bicaudatus	6	3	4	13	3%	4.3	1.5
Ephemerella infrequens	2	2	0	4	1%	1.3	1.2
Drunella doddsi	0	1	0	1	0%	0.3	0.6
Cinygmula spp.	21	15	26	62	16%	20.7	5.5
Rhithrogena spp.	1	2	0	3	1%	1.0	1.0
Paraleptophlebia spp.	11	9	6	26	7%	8.7	2.5
PLECOPTERA					28%	35.3	
Setvenia bradleyi	1	0	0	1	0%	0.3	0.6
Perlodidae	0	0	2	2	1%	0.7	1.2
Chloroperlinae	9	20	14	43	11%	14.3	5.5
Kathroperla perdita	0	4	3	7	2%	2.3	2.1
Visoka sp. ?	0	1	8	9	2%	3.0	4.4
Zapada sp. 1	2	5	3	10	3%	3.3	1.5
Doddsia sp.	1	1	0	2	1%	0.7	0.6
Perlomyia sp.	0	0	1	1	0%	0.3	0.6
Yoraperla brevis	20	10	1	31	8%	10.3	9.5
TRICHOPTERA					7%	9.3	
Parapsyche elsis	0	1	0	1	0%	0.3	0.6
Rhyacophila Betteni gp.	1	1	1	3	1%	1.0	0.0
Rhyacophila oreta	0	1	0	1	0%	0.3	0.6
Rhyacophila Sibrica gp	0	4	0	4	1%	1.3	2.3
Rhyacophila verrula	0	0	2	2	1%	0.7	1.2
Lepidostoma spp.	4	7	0	11	3%	3.7	3.5
Limnephilidae	0	0	1	1	0%	0.3	0.6
Oligophlebbodes sp.	1	0	0	1	0%	0.3	0.6
Glossosoma sp.	1	2	0	3	1%	1.0	1.0
Wormaldia sp.	1	0	0	1	0%	0.3	0.6

MACROINVERTEBRATE DATA							
LITTLE CHERRY CREEK				STATION 2 - 10/20/88			
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
ANNELIDA					6%	7.3	
Enchytraeidae	3	14	0	17	5%	5.7	7.4
Lumbriculidae	1	3	1	5	1%	1.7	1.2
OTHER							
Turbellaria	9	45	12	66	18%	22.0	20.0
TOTAL ORGANISMS	112	166	99	377		125.7	35.5
TAXA RICHNESS	25	28	20	40		24.3	4.0
SHAN. DIVERSITY	3.83	3.82	3.54	4.08		3.73	0.17
BIOTICINDEX	2.05	2.28	2.18	2.19		2.17	0.12
EPT RICHNESS	16	19	14	30		16.3	2.5
EPT / CHIR.	7.00	9.20	7.50	7.84		7.9	1.2
BIOTIC COND. INDEX				104.1			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	0.5	0.6	0.3				
depth (m)	0.1	0.1	0.1				
velocity (ft/s)	0.27	0.29	0.14				
CTQp =				.50			
stream width (m)				1			
gradient (%)				6			
water temperature (C)				3			
substrate particle size (%)	boulders (>12)			25			
	rubble (3 - 12)			35			
	gravel (.125 - 3)			20			
	fines (< 0.125)			20			

MACROINVERTEBRATE DATA							
POORMAN CREEK						**STATION 1 - 10/19/8**	
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					1%	2.0	
Heterlimnius corpulentus	1	4	1	6	1%	2.0	1.7
DIPTERA					10%	28.3	
Thienemannimyia group	5	5	2	12	1%	4.0	1.7
Pagastia sp	0	1	0	1	0%	0.3	0.6
Brillia sp.	6	20	4	30	3%	10.0	8.7
Parametriocnemus sp.	3	2	5	10	1%	3.3	1.5
Rheocricotopus sp.	1	0	1	2	0%	0.7	0.6
Orthocladius spp.	0	0	0	0	0%	0.0	0.0
Synorthocladius sp.	0	2	0	2	0%	0.7	1.2
Psuedoorthocladius sp.	0	4	0	4	0%	1.3	2.3
Tvetenia sp.	0	2	0	2	0%	0.7	1.2
Micropsectra spp.	0	2	0	2	0%	0.7	1.2
Antocha sp.	0	1	0	1	0%	0.3	0.6
Dicranota sp.	2	3	5	10	1%	3.3	1.5
Tipula spp.	2	0	1	3	0%	1.0	1.0
Chelifera sp.	0	0	0	0	0%	0.0	0.0
Oreogeton sp.	0	1	1	2	0%	0.7	0.6
Simulium sp.	1	0	0	1	0%	0.3	0.6
Certatopogonidae	0	2	1	3	0%	1.0	1.0
EPHEMEROPTERA					31%	91.7	
Ameletus spp.	0	2	4	6	1%	2.0	2.0
Baetis bicaudatus	12	20	44	76	9%	25.3	16.7
Ephemerella infrequens	1	4	1	6	1%	2.0	1.7
Drunella doddsi	1	7	3	11	1%	3.7	3.1
Cinygmula spp.	9	43	46	98	11%	32.7	20.6
Epeorus deceptivus	0	1	0	1	0%	0.3	0.6
Rhithrogena spp.	28	12	31	71	8%	23.7	10.2
Paraleptophlebia spp.	0	3	3	6	1%	2.0	1.7
PLECOPTERA					43%	126.0	
Megarcys sp.	0	0	1	1	0%	0.3	0.6
Doroneuria theodora	3	0	1	4	0%	1.3	1.5
Chloroperlinae	66	77	72	215	25%	71.7	5.5
Kathroperla perdita	0	1	0	1	0%	0.3	0.6
Capnia gp.	1	0	0	1	0%	0.3	0.6
Visoka sp. ?	2	1	1	4	0%	1.3	0.6
Zapada sp. 1	2	6	11	19	2%	6.3	4.5
Zapada cinctipes	1	17	8	26	3%	8.7	8.0
Doddsia sp.	12	21	39	72	8%	24.0	13.7
Perlomyia sp.	12	11	11	34	4%	11.3	0.6
Yoraperla brevis	0	1	0	1	0%	0.3	0.6

MACROINVERTEBRATE DATA							
POORMAN CREEK						**STATION 1 - 10/19/88**	
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
TRICHOPTERA					14%	41.7	
Parapsyche elsis	1	1	5	7	1%	2.3	2.3
Rhyacophila Betteni gp.	7	5	4	16	2%	5.3	1.5
Rhyacophila verrula	0	3	1	4	0%	1.3	1.5
Rhyacophila velpulsa.	2	1	8	11	1%	3.7	3.8
Rhyacophila Sibrica gp	3	2	4	9	1%	3.0	1.0
Rhyacophila Hylinata gp	0	3	0	3	0%	1.0	1.7
Lepidostoma spp.	0	0	1	1	0%	0.3	0.6
Apatania sp.	0	3	0	3	0%	1.0	1.7
Chryanda sp.	0	2	0	2	0%	0.7	1.2
Anagapetus sp.	0	2	0	2	0%	0.7	1.2
Glossosoma sp.	24	16	26	66	8%	22.0	5.3
Micrasema sp.	0	0	1	1	0%	0.3	0.6
ANNELIDA					0%	1.0	
Lumbricidae	2	1	0	3	0%	1.0	1.0
OTHER							
Turbellaria	1	1	0	2	0%	0.7	0.6
TOTAL ORGANISMS	211	316	347	874		291.3	71.3
TAXA RICHNESS	28	41	32	51		33.7	6.7
SHAN. DIVERSITY	3.58	4.13	3.76	4.02		3.82	0.28
BIOTIC INDEX	1.16	1.57	1.35	1.38		1.36	0.21
EPT RICHNESS	18	26	22	35		22.0	4.0
EPT / CHIR.	12.47	6.97	27.08	11.95		15.5	10.4
BIOTIC COND. INDEX				96.3			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	1	0.5	0.5				
depth (m)	0.11	0.1	0.15				
velocity (ft/s)	0.89	0.75	0.63				
CTQp =				50			
stream width (m)				2.8	braided channel		
gradient (%)				3			
water temperature (C)				2.5			
substrate particle size (%)	boulders (>12)			20			
	rubble (3 - 12)			45			
	gravel (.125 - 3)			25			
	fines (< 0.125)			10			

MACROINVERTEBRATE DATA							
POORMAN CREEK						**STATION 2 - 10/19/8**	
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					2%	2.7	
Heterlimnius corpulentus	1	3	0	4	1%	1.3	1.5
Stapylinidae	0	0	4	4	1%	1.3	2.3
DIPTERA					8%	12.3	
Thienemannimyia group	1	2	0	3	1%	1.0	1.0
Brundiniella sp.	0	1	0	1	0%	0.3	0.6
Brillia sp.	2	3	2	7	2%	2.3	0.6
Corynoneura sp	0	0	1	1	0%	0.3	0.6
Eukiefferiella spp.	1	0	0	1	0%	0.3	0.6
Parametriocnemus sp.	4	0	0	4	1%	1.3	2.3
Rheocricotopus sp.	0	5	0	5	1%	1.7	2.9
Micropsectra spp.	3	5	1	9	2%	3.0	2.0
Dicranota sp.	2	0	1	3	1%	1.0	1.0
Hesperoconopa sp.	0	0	1	1	0%	0.3	0.6
Syrphidae	0	0	1	1	0%	0.3	0.6
Oreogeton sp.	0	0	1	1	0%	0.3	0.6
EPHEMEROPTERA					34%	49.3	
Ameletus spp.	0	14	1	15	3%	5.0	7.8
Baetis bicaudatus	40	6	4	50	11%	16.7	20.2
Drunella doddsi	5	2	1	8	2%	2.7	2.1
Serratella tibialis	1	0	0	1	0%	0.3	0.6
Cinygmula spp.	39	16	1	56	13%	18.7	19.1
Rhithrogena spp.	9	8	1	18	4%	6.0	4.4
PLECOPTERA					41%	59.3	
Megarcys sp.	0	0	1	1	0%	0.3	0.6
Setvenia bradleyi	0	1	0	1	0%	0.3	0.6
Doroneuria theodora	5	5	0	10	2%	3.3	2.9
Chloroperlinae	32	36	37	105	24%	35.0	2.6
Visoka sp. ?	0	3	0	3	1%	1.0	1.7
Zapada sp. 1	4	5	8	17	4%	5.7	2.1
Doddsia sp.	11	2	3	16	4%	5.3	4.9
Perlomyia sp.	15	7	2	24	5%	8.0	6.6
Yoraperla brevis	1	0	0	1	0%	0.3	0.6
TRICHOPTERA					12%	18.0	
Parapsyche elsis	5	0	0	5	1%	1.7	2.9
Rhyacophila sp.	1	0	0	1	0%	0.3	0.6
Rhyacophila Betteni gp.	15	4	2	21	5%	7.0	7.0
Rhyacophila verrula	1	0	1	2	0%	0.7	0.6
Rhyacophila Sibrica gp	1	0	0	1	0%	0.3	0.6
Lepidostoma spp.	0	1	0	1	0%	0.3	0.6
Neothremma sp.	0	0	1	1	0%	0.3	0.6
Oligophlebbodes sp.	1	0	2	3	1%	1.0	1.0
Anagapetus sp.	0	0	1	1	0%	0.3	0.6
Glossosoma sp.	10	3	5	18	4%	6.0	3.6

MACROINVERTEBRATE DATA							
POORMAN CREEK						**STATION 2 - 10/19/88**	
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
ANNELIDA					2%	2.7	
Enchytraeidae	3	0	1	4	1%	1.3	1.5
Lumbriculidae	1	3	0	4	1%	1.3	1.5
OTHER							
Turbellaria	2	2	0	4	1%	1.3	1.2
Collembola	0	0	1	1	0%	0.3	0.6
TOTAL ORGANISMS	216	137	84	437		145.7	66.4
TAXA RICHNESS	28	23	25	42		25.3	2.5
SHAN. DIVERSITY	3.76	3.82	3.33	4.07		3.64	0.27
BIOTICINDEX	1.67	1.61	0.86	1.49		1.38	0.45
EPT RICHNESS	18	15	16	29		16.3	1.5
EPT / CHIR.	17.82	7.06	17.75	12.26		14.2	6.2
BIOTIC COND. INDEX				94.9			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	2	0.8	4				
depth (m)	0.35	0.15	0.12				
velocity (ft/s)	0.17	0.72	0.74				
CTQp =				50			
stream width (m)				11			
gradient (%)				7			
water temperature (C)				3			
substrate particle size (%)	boulders (>12)			20			
	rubble (3 - 12)			60			
	gravel (.125 - 3)			15			
	fines (< 0.125)			5			

MACROINVERTEBRATE DATA							
RAMSEY CREEK					**STATION 2 - 10/19/88**		
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
COLEOPTERA					1%	1.0	
Heterlimnius corpulentus	1	0	1	2	1%	0.7	0.6
unid. Coleop. larvae ?	1	0	0	1	0%	0.3	0.6
DIPTERA					4%	4.3	
Thienemannimyia group	0	1	0	1	0%	0.3	0.6
Brillia sp.	0	1	1	2	1%	0.7	0.6
Parametriocnemus sp.	2	0	0	2	1%	0.7	1.2
Psilometriocnemus sp.	0	1	0	1	0%	0.3	0.6
Dicranota sp.	4	0	2	6	2%	2.0	2.0
Oreogeton sp.	1	0	0	1	0%	0.3	0.6
EPHEMEROPTERA					41%	50.0	
Ameletus spp.	6	2	0	8	2%	2.7	3.1
Baetis bicaudatus	16	23	7	46	13%	15.3	8.0
Drunella doddsi	0	4	2	6	2%	2.0	2.0
Cinygmula spp.	16	29	15	60	16%	20.0	7.8
Rhithrogena spp.	3	22	4	29	8%	9.7	10.7
Paraleptophlebia spp.	1	0	0	1	0%	0.3	0.6
PLECOPTERA					34%	41.7	
Doroneuria theodora	1	0	3	4	1%	1.3	1.5
Chloroperlinae	17	7	33	57	16%	19.0	13.1
Visoka sp. ?	5	3	1	9	2%	3.0	2.0
Zapada sp. 1	11	4	4	19	5%	6.3	4.0
Doddsia sp.	5	13	5	23	6%	7.7	4.6
Despaxia sp.	0	0	0	0	0%	0.0	0.0
Perlomyia sp.	2	6	4	12	3%	4.0	2.0
Yoraperla brevis	0	0	1	1	0%	0.3	0.6
TRICHOPTERA					20%	24.7	
Parapsyche elsis	5	12	2	19	5%	6.3	5.1
Rhyacophila Betteni gp.	2	0	2	4	1%	1.3	1.2
Rhyacophila Brunnea gp.	0	0	1	1	0%	0.3	0.6
Rhyacophila vagrita	0	1	0	1	0%	0.3	0.6
Rhyacophila Sibrica gp	1	1	3	5	1%	1.7	1.2
Lepidostoma spp.	1	0	0	1	0%	0.3	0.6
Anagapetus sp.	1	0	0	1	0%	0.3	0.6
Glossosoma sp.	9	30	3	42	11%	14.0	14.2
MOLLUSCA							
Sphaeriidae	0	0	1	1	0%	0.3	0.6

MACROINVERTEBRATE DATA							
RAMSEY CREEK						**STATION 2 - 10/19/88**	
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
TOTAL ORGANISMS	111	160	95	366		122.0	33.9
TAXA RICHNESS	22	17	20	31		19.7	2.5
SHAN. DIVERSITY	3.79	3.33	3.38	3.78		3.50	0.25
BIOTICINDEX	1.32	1.21	1.06	1.20		1.19	0.13
EPT RICHNESS	17	14	16	26		15.7	1.5
EPT / CHIR.	51.00	52.33	90.00	58.17		64.4	22.1
BIOTIC COND. INDEX				111.4			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	2	5	4				
depth (m)	0.2	0.3	0.1				
velocity (ft/s)	0.75	1.02	0.47				
CTQp =				50			
stream width (m)				12			
gradient (%)				3.4			
water temperature (C)				3.5			
substrate particle size (%)	boulders (>12)			10			
	rubble (3 - 12)			80			
	gravel (.125 - 3)			10			
	fines (< 0.125)			0			

MACROINVERTEBRATE DATA							
RAMSEY CREEK						**STATION 3 - 10/19/88**	
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					0%	1.0	
Heterlimnius corpulentus	1	2	0	3	0%	1.0	1.0
DIPTERA					21%	43.3	
Macropelopia sp.	6	5	0	11	2%	3.7	3.2
Pagastia sp	0	1	0	1	0%	0.3	0.6
Brillia sp.	2	0	2	4	1%	1.3	1.2
Parametriocnemus sp.	12	5	14	31	5%	10.3	4.7
Paraphaenocladius sp.	40	26	1	67	11%	22.3	19.8
Micropsectra spp.	0	2	0	2	0%	0.7	1.2
Dicranota sp.	4	3	1	8	1%	2.7	1.5
Oreogeton sp.	1	3	2	6	1%	2.0	1.0
EPHEMEROPTERA					19%	38.3	
Ameletus spp.	18	1	2	21	3%	7.0	9.5
Baetis bicaudatus	3	6	7	16	3%	5.3	2.1
Ephemerella infrequens	1	0	0	1	0%	0.3	0.6
Drunella doddsi	4	1	1	6	1%	2.0	1.7
Drunella spinifera	0	0	1	1	0%	0.3	0.6
Cinygmula spp.	23	21	6	50	8%	16.7	9.3
Epeorus deceptivus	3	3	1	7	1%	2.3	1.2
Rhithrogena spp.	1	3	0	4	1%	1.3	1.5
Paraleptophlebia spp.	4	2	3	9	1%	3.0	1.0
PLECOPTERA					52%	106.0	
Isoperla sp.	0	0	1	1	0%	0.3	0.6
Chloroperlinae	64	89	38	191	31%	63.7	25.5
Capnia gp.	1	1	0	2	0%	0.7	0.6
Visoka sp. ?	0	2	5	7	1%	2.3	2.5
Zapada sp. 1	12	2	10	24	4%	8.0	5.3
Despaxia sp.	30	21	15	66	11%	22.0	7.5
Perlomyia sp.	7	0	7	14	2%	4.7	4.0
Yoraperla brevis	4	4	5	13	2%	4.3	0.6
TRICHOPTERA					8%	15.7	
Parapsyche elsis	11	3	1	15	2%	5.0	5.3
Rhyacophila Betteni gp.	1	17	2	20	3%	6.7	9.0
Rhyacophila verrula	1	1	1	3	0%	1.0	0.0
Rhyacophila Sibrica gp	0	3	0	3	0%	1.0	1.7
Rhyacophila Hylinata gp	1	0	0	1	0%	0.3	0.6
Lepidostoma spp.	0	2	0	2	0%	0.7	1.2
Glossosoma sp.	0	1	2	3	0%	1.0	1.0

MACROINVERTEBRATE DATA							
RAMSEY CREEK						**STATION 3 - 10/19/88**	
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
OTHER							
Turbellaria	1	1	0	2	0%	0.7	0.6
TOTAL ORGANISMS	256	231	128	615		205.0	67.8
TAXA RICHNESS	26	28	23	34		25.7	2.5
SHAN. DIVERSITY	3.60	3.35	3.58	3.73		3.51	0.14
BIOTICINDEX	1.47	1.16	1.30	1.32		1.31	0.15
EPT RICHNESS	18	19	18	28		18.3	0.6
EPT / CHIR.	3.15	4.69	6.35	4.14		4.7	1.6
BIOTIC COND. INDEX				105.9			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	2	5	4				
depth (m)	0.2	0.3	0.14				
velocity (ft/s)	0.75	1.02	0.47				
CTQp =				50			
stream width (m)				12			
gradient (%)				6			
water temperature (C)				3			
substrate particle size (%)	boulders (>12)			40			
	rubble (3 - 12)			40			
	gravel (.125 - 3)			10			
	fines (< 0.125)			10			

MACROINVERTEBRATE DATA							
RAMSEY CREEK					**STATION 4 - 10/19/88**		
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
DIPTERA					21%	18.3	
Macropelopia sp.	1	2	0	3	1%	1.0	1.0
Zavrelimyia sp.	2	1	0	3	1%	1.0	1.0
Monodiamesa sp.	1	0	0	1	0%	0.3	0.6
Brillia sp.	1	0	0	1	0%	0.3	0.6
Parametriocnemus sp.	2	2	2	6	2%	2.0	0.0
Heterotrissocladius sp	3	1	0	4	2%	1.3	1.5
Rheocricotopus sp.	0	0	1	1	0%	0.3	0.6
Polypedilum spp.	3	0	0	3	1%	1.0	1.7
Micropsectra spp.	4	11	0	15	6%	5.0	5.6
Dicranota sp.	3	2	0	5	2%	1.7	1.5
Hexatoma sp.	1	0	0	1	0%	0.3	0.6
Oreogeton sp.	2	3	0	5	2%	1.7	1.5
Certatopogonidae	4	3	0	7	3%	2.3	2.1
EPHEMEROPTERA					34%	29.7	
Ameletus spp.	0	3	3	6	2%	2.0	1.7
Baetis bicaudatus	0	1	0	1	0%	0.3	0.6
Cinygmula spp.	28	42	12	82	31%	27.3	15.0
PLECOPTERA					27%	23.7	
Megarcys sp.	3	0	0	3	1%	1.0	1.7
Doroneuria theodora	0	1	0	1	0%	0.3	0.6
Chloroperlinae	15	11	6	32	12%	10.7	4.5
Capnia gp.	0	0	3	3	1%	1.0	1.7
Visoka sp. ?	0	0	1	1	0%	0.3	0.6
Zapada sp. 1	0	3	3	6	2%	2.0	1.7
Despaxia sp.	1	4	1	6	2%	2.0	1.7
Yoraperla brevis	9	10	0	19	7%	6.3	5.5
TRICHOPTERA					13%	11.0	
Parapsyche elsis	1	0	1	2	1%	0.7	0.6
Rhyacophila Betteni gp.	1	1	1	3	1%	1.0	0.0
Rhyacophila vagrita	0	1	0	1	0%	0.3	0.6
Rhyacophila verrula	2	0	0	2	1%	0.7	1.2
Ecclisomyia sp.	11	10	0	21	8%	7.0	6.1
Neothremma sp.	2	1	1	4	2%	1.3	0.6
MEGALOPTERA							
Sialis sp.	0	1	0	1	0%	0.3	0.6
ANNELIDA					4%	3.3	
Tubificidae	5	2	3	10	4%	3.3	1.5
OTHER							
Turbellaria	3	1	0	4	2%	1.3	1.5

MACROINVERTEBRATE DATA							
RAMSEY CREEK						**STATION 4 - 10/19/88**	
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
TOTAL ORGANISMS	108	117	38	263		87.7	43.2
TAXA RICHNESS	24	23	13	33		20.0	6.1
SHAN. DIVERSITY	3.78	3.42	3.15	3.83		3.45	0.31
BIOTICINDEX	2.57	2.44	2.11	2.45		2.37	0.24
EPT RICHNESS	10	13	10	22		11.0	1.7
EPT / CHIR.	4.29	5.18	10.67	5.22		6.7	3.5
BIOTIC COND. INDEX				101.6			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	3	2.5	2				
depth (m)	0.2	0.1	0.1				
velocity (ft/s)	0.56	0.65	0.7				
CTQp =				60			
stream width (m)				7			
gradient (%)				1			
water temperature (C)				2.5			
substrate particle size (%)	boulders (>12)			0			
	rubble (3 - 12)			0			
	gravel (.125 - 3)			50			
	fines (< 0.125)			50			

MACROINVERTEBRATE DATA							
LIBBY CREEK				STATION 1 - 10/18/88			
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					1%	2.0	
Heterlimnius corpulentus	3	1	1	5	1%	1.7	1.2
Narpus concolor	1	0	0	1	0%	0.3	0.6
DIPTERA					7%	15.3	
Thienemannimyia group	5	7	2	14	2%	4.7	2.5
Pagastia sp	1	1	0	2	0%	0.7	0.6
Cricotopus spp.	1	2	0	3	0%	1.0	1.0
Eukiefferiella spp.	1	2	0	3	0%	1.0	1.0
Parametriocnemus sp.	0	0	2	2	0%	0.7	1.2
Rheocricotopus sp.	3	3	2	8	1%	2.7	0.6
Orthocladius spp.	2	0	0	2	0%	0.7	1.2
Synorthocladius sp.	2	0	0	2	0%	0.7	1.2
Psuedoorthocladius sp.	1	0	0	1	0%	0.3	0.6
Antocha sp.	1	0	0	1	0%	0.3	0.6
Dicranota sp.	0	3	0	3	0%	1.0	1.7
Hexatoma sp.	0	0	1	1	0%	0.3	0.6
Rhabdomastix sp.	1	1	0	2	0%	0.7	0.6
Oreogeton sp.	0	2	0	2	0%	0.7	1.2
EPHEMEROPTERA					42%	98.3	
Ameletus spp.	3	1	2	6	1%	2.0	1.0
Baetis bicaudatus	9	9	14	32	5%	10.7	2.9
Ephemerella infrequens	6	11	9	26	4%	8.7	2.5
Drunella doddsi	1	1	2	4	1%	1.3	0.6
Serratella tibialis	1	0	0	1	0%	0.3	0.6
Cinygmula spp.	48	59	47	154	22%	51.3	6.7
Epeorus deceptivus	0	0	1	1	0%	0.3	0.6
Rhithrogena spp.	18	5	23	46	7%	15.3	9.3
Paraleptophlebia spp.	8	9	8	25	4%	8.3	0.6
PLECOPTERA					38%	88.3	
Skwala sp.	2	3	0	5	1%	1.7	1.5
Doroneuria theodora	1	1	1	3	0%	1.0	0.0
Chloroperlinae	18	32	30	80	11%	26.7	7.6
Visoka sp. ?	5	2	0	7	1%	2.3	2.5
Zapada sp. 1	3	5	2	10	1%	3.3	1.5
Doddsia sp.	22	50	11	83	12%	27.7	20.1
Perlomyia sp.	24	20	33	77	11%	25.7	6.7

MACROINVERTEBRATE DATA							
LIBBY CREEK				STATION 1 - 10/18/88			
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
TRICHOPTERA					12%	27.7	
Arctopsyche grandis	1	1	1	3	0%	1.0	0.0
Hydropsyche (Ceratopsyche	22	16	18	56	8%	18.7	3.1
Rhyacophila Betteni gp.	1	2	0	3	0%	1.0	1.0
Rhyacophila Brunnea gp.	0	1	1	2	0%	0.7	0.6
Lepidostoma spp.	0	4	1	5	1%	1.7	2.1
Apatania sp.	2	0	0	2	0%	0.7	1.2
Ecclisomyia sp.	0	0	1	1	0%	0.3	0.6
Oligophlebodes sp.	4	2	2	8	1%	2.7	1.2
Glossosoma sp.	0	2	1	3	0%	1.0	1.0
ANNELIDA					0%	0.7	
Lumbriculidae	0	2	0	2	0%	0.7	1.2
OTHER							
Turbellaria	0	1	0	1	0%	0.3	0.6
TOTAL ORGANISMS	221	261	216	698		232.7	24.7
TAXA RICHNESS	32	32	25	43		29.7	4.0
SHAN. DIVERSITY	3.94	3.75	3.53	3.89		3.74	0.20
BIOTIC INDEX	1.86	2.07	1.48	1.82		1.80	0.30
EPT RICHNESS	20	21	20	29		20.3	0.6
EPT / CHIR.	12.44	15.73	34.67	17.38		20.9	12.0
BIOTIC COND. INDEX				96.4			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	1	4	5				
depth (m)	0.1	0.3	0.25				
velocity (ft/s)	0.69	0.78	0.38				
CTQp =				50			
stream width (m)				24			
gradient (%)				1.3			
water temperature (C)				5			
substrate particle size (%)	boulders (>12)			10			
	rubble (3 - 12)			35			
	gravel (.125 - 3)			45			
	fines (< 0.125)			15			

MACROINVERTEBRATE DATA							
LIBBY CREEK				STATION 3 - 10/20/88			
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					3%	8.3	
Heterlimnius corpulentus	4	12	7	23	3%	7.7	4.0
Narpus concolor	0	1	0	1	0%	0.3	0.6
Optioservus sp.	0	0	1	1	0%	0.3	0.6
DIPTERA					3%	9.0	
Thienemannimyia group	2	1	6	9	1%	3.0	2.6
Brillia sp.	1	0	0	1	0%	0.3	0.6
Eukiefferiella spp.	0	1	0	1	0%	0.3	0.6
Rheocricotopus sp.	0	1	0	1	0%	0.3	0.6
Synorthocladius sp.	0	0	1	1	0%	0.3	0.6
Phaenopsectra sp	0	1	0	1	0%	0.3	0.6
Antocha sp.	0	2	3	5	1%	1.7	1.5
Dicranota sp.	3	0	0	3	0%	1.0	1.7
Hexatoma sp.	1	0	2	3	0%	1.0	1.0
Pericoma sp.	1	0	1	2	0%	0.7	0.6
EPHEMEROPTERA					55%	161.3	
Ameletus spp.	2	1	1	4	0%	1.3	0.6
Baetis bicaudatus	7	18	14	39	4%	13.0	5.6
Ephemerella infrequens	4	14	15	33	4%	11.0	6.1
Drunella doddsi	3	32	18	53	6%	17.7	14.5
Serratella tibialis	0	1	0	1	0%	0.3	0.6
Cinygmula spp.	62	109	74	245	28%	81.7	24.4
Epeorus deceptivus	0	5	3	8	1%	2.7	2.5
Rhithrogena spp.	9	56	34	99	11%	33.0	23.5
Paraleptophlebia spp.	0	0	2	2	0%	0.7	1.2
PLECOPTERA					30%	89.3	
Megarcys sp.	0	0	1	1	0%	0.3	0.6
Skwala sp.	1	0	2	3	0%	1.0	1.0
Doroneuria theodora	0	3	1	4	0%	1.3	1.5
Chloroperlinae	23	46	38	107	12%	35.7	11.7
Visoka sp. ?	1	3	1	5	1%	1.7	1.2
Zapada sp. 1	0	4	1	5	1%	1.7	2.1
Doddsia sp.	26	62	41	129	15%	43.0	18.1
Perlomyia sp.	4	2	8	14	2%	4.7	3.1
TRICHOPTERA					9%	25.3	
Arctopsyche grandis	3	5	3	11	1%	3.7	1.2
Hydropsyche (Ceratopsyche	1	10	18	29	3%	9.7	8.5
Rhyacophila Betteni gp.	2	3	0	5	1%	1.7	1.5
Rhyacophila Brunnea gp.	1	2	0	3	0%	1.0	1.0
Rhyacophila Coloradensis	0	1	0	1	0%	0.3	0.6
Lepidostoma spp.	1	0	1	2	0%	0.7	0.6
Apatania sp.	0	1	0	1	0%	0.3	0.6
Oligophlebodes sp.	9	7	8	24	3%	8.0	1.0

MACROINVERTEBRATE DATA							
LIBBY CREEK				STATION 3 - 10/20/88			
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
TOTAL ORGANISMS	171	404	305	880		293.3	116.9
TAXA RICHNESS	23	28	27	38		26.0	2.6
SHAN. DIVERSITY	3.23	3.41	3.61	3.54		3.41	0.19
BIOTICINDEX	1.85	1.62	1.73	1.70		1.73	0.12
EPT RICHNESS	17	21	20	29		19.3	2.1
EPT / CHIR.	53.00	96.25	40.57	59.14		63.3	29.2
BIOTIC COND. INDEX				105.8			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	1	0.2	1.2				
depth (m)	0.35	0.35	0.35				
velocity (ft/s)	1.32	0.99	1.12				
CTQp =				50			
stream width (m)				15			
gradient (%)				1.2			
water temperature (C)				3			
substrate particle size (%)	boulders (>12)			10			
	rubble (3 - 12)			65			
	gravel (.125 - 3)			20			
	fines (< 0.125)			5			

MACROINVERTEBRATE DATA							
LIBBY CREEK				STATION 4 - 10/19/88			
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					1%	0.7	
Heterlimnius corpulentus	0	1	0	1	0%	0.3	0.6
Larae avara	1	0	0	1	0%	0.3	0.6
DIPTERA					3%	3.0	
Cricotopus spp.	0	0	1	1	0%	0.3	0.6
Parametriocnemus sp.	1	0	1	2	1%	0.7	0.6
Paraphaenocladius sp.	0	0	1	1	0%	0.3	0.6
Orthocladius spp.	0	0	1	1	0%	0.3	0.6
Micropsectra spp.	0	1	0	1	0%	0.3	0.6
Antocha sp.	0	0	1	1	0%	0.3	0.6
Dicranota sp.	1	0	1	2	1%	0.7	0.6
EPHEMEROPTERA					63%	66.0	
Ameletus spp.	0	3	0	3	1%	1.0	1.7
Baetis bicaudatus	10	6	14	30	10%	10.0	4.0
Ephemerella infrequens	7	7	6	20	6%	6.7	0.6
Drunella doddsi	6	2	8	16	5%	5.3	3.1
Serratella tibialis	0	1	0	1	0%	0.3	0.6
Cinygmula spp.	26	22	15	63	20%	21.0	5.6
Epeorus deceptivus	1	0	1	2	1%	0.7	0.6
Rhithrogena spp.	19	16	24	59	19%	19.7	4.0
Paraleptophlebia spp.	2	1	1	4	1%	1.3	0.6
PLECOPTERA					26%	27.3	
Perlidae	0	1	1	2	1%	0.7	0.6
Chloroperlinae	11	12	5	28	9%	9.3	3.8
Visoka sp. ?	2	0	1	3	1%	1.0	1.0
Zapada sp. 1	2	7	0	9	3%	3.0	3.6
Doddsia sp.	15	16	8	39	12%	13.0	4.4
Perlomyia sp.	1	0	0	1	0%	0.3	0.6
TRICHOPTERA					7%	7.3	
Arctopsyche grandis	3	3	6	12	4%	4.0	1.7
Parapsyche elsis	1	1	0	2	1%	0.7	0.6
Rhyacophila Angelita gp.	1	0	0	1	0%	0.3	0.6
Rhyacophila Betteni gp.	0	1	0	1	0%	0.3	0.6
Rhyacophila Brunnea gp.	0	1	0	1	0%	0.3	0.6
Rhyacophila verrula	0	1	0	1	0%	0.3	0.6
Oligophlebodes sp.	1	2	0	3	1%	1.0	1.0
Wormaldia sp.	1	0	0	1	0%	0.3	0.6

MACROINVERTEBRATE DATA							
LIBBY CREEK				STATION 4 - 10/19/88			
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
TOTAL ORGANISMS	112	105	96	313		104.3	8.0
TAXA RICHNESS	20	20	18	32		19.3	1.2
SHAN. DIVERSITY	3.43	3.50	3.33	3.61		3.42	0.09
BIOTICINDEX	1.60	1.57	1.73	1.63		1.63	0.08
EPT RICHNESS	17	18	12	27		15.7	3.2
EPT / CHIR.	108.00	103.00	22.50	50.17		77.8	48.0
BIOTIC COND. INDEX				116.8			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	12	11	4				
depth (m)	0.2	0.25	0.2				
velocity (ft/s)	0.95	0.83	0.6				
CTQp =				50			
stream width (m)				24			
gradient (%)				2			
water temperature (C)				3			
substrate particle size (%)	boulders (>12)			10			
	rubble (3 - 12)			45			
	gravel (.125 - 3)			30			
	fines (< 0.125)			15			

MACROINVERTEBRATE DATA							
LIBBY CREEK				STATION 5 - 10/18/88			
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					3%	2.3	
Heterlimnius corpulentus	5	0	1	6	3%	2.0	2.6
Lara avara	1	0	0	1	0%	0.3	0.6
DIPTERA					6%	4.3	
Thienemannimyia group	2	1	0	3	1%	1.0	1.0
Parametriocnemus sp.	0	1	3	4	2%	1.3	1.5
Rheocricotopus sp.	0	0	1	1	0%	0.3	0.6
Psuedoorthocladius sp.	1	0	0	1	0%	0.3	0.6
Micropsectra spp.	1	0	0	1	0%	0.3	0.6
Dicranota sp.	1	1	0	2	1%	0.7	0.6
Hexatoma sp.	0	0	1	1	0%	0.3	0.6
EPHEMEROPTERA					46%	34.3	
Ameletus spp.	0	0	1	1	0%	0.3	0.6
Baetis bicaudatus	6	10	5	21	9%	7.0	2.6
Ephemerella infrequens	0	1	1	2	1%	0.7	0.6
Drunella doddsi	0	1	2	3	1%	1.0	1.0
Cinygmula spp.	19	22	20	61	27%	20.3	1.5
Rhithrogena spp.	1	5	8	14	6%	4.7	3.5
Paraleptophlebia spp.	1	0	0	1	0%	0.3	0.6
PLECOPTERA					32%	24.0	
Doroneuria theodora	1	0	0	1	0%	0.3	0.6
Chloroperlinae	10	14	6	30	13%	10.0	4.0
Visoka sp. ?	0	0	2	2	1%	0.7	1.2
Zapada sp. 1	0	0	1	1	0%	0.3	0.6
Doddsia sp.	9	11	15	35	16%	11.7	3.1
Yoroperla brevis	2	0	0	2	1%	0.7	1.2
Perlomyia sp.	0	0	1	1	0%	0.3	0.6
TRICHOPTERA					13%	9.3	
Arctopsyche grandis	1	1	3	5	2%	1.7	1.2
Parapsyche elsis	0	2	0	2	1%	0.7	1.2
Rhyacophila Betteni gp.	1	0	1	2	1%	0.7	0.6
Rhyacophila Brunnea gp.	0	1	0	1	0%	0.3	0.6
Rhyacophila oreta	0	1	1	2	1%	0.7	0.6
Rhyacophila Sibrica gp	1	1	1	3	1%	1.0	0.0
Rhyacophila vagrita	2	0	0	2	1%	0.7	1.2
Lepidostoma spp.	0	1	0	1	0%	0.3	0.6
Oligophlebodes sp.	2	0	3	5	2%	1.7	1.5
Glossosoma sp.	0	2	2	4	2%	1.3	1.2
Wormaldia sp.	0	0	1	1	0%	0.3	0.6
ANNELIDA					0%	0.3	
Lumbricidae	0	0	1	1	0%	0.3	0.6

MACROINVERTEBRATE DATA							
LIBBY CREEK				STATION 5 - 10/18/88			
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
TOTAL ORGANISMS	67	76	81	224		74.7	7.1
TAXA RICHNESS	19	17	23	35		19.7	3.1
SHAN. DIVERSITY	3.42	3.11	3.67	3.70		3.40	0.28
BIOTIC INDEX	2.09	1.70	1.85	1.87		1.88	0.20
EPT RICHNESS	13	14	18	29		15.0	2.6
EPT / CHIR.	14.00	36.50	18.25	20.20		22.9	12.0
BIOTIC COND. INDEX				115.4			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	1	4	4				
depth (m)	0.15	0.33	0.25				
velocity (ft/s)	0.62	0.42	0.71				
CTQp =				50			
stream width (m)				11			
gradient (%)				3			
water temperature (C)				5			
substrate particle size (%)	boulders (>12)			10			
	rubble (3 - 12)			45			
	gravel (.125 - 3)			30			
	fines (< 0.125)			15			

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MACROINVERTEBRATE DATA							
LIBBY CREEK				**STATION 8 - 10/18/88**			
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
DIPTERA					5%	3.3	
Brillia sp.	1	2	1	4	2%	1.3	0.6
Parametriocnemus sp.	0	2	0	2	1%	0.7	1.2
Dicranota sp.	1	1	1	3	2%	1.0	0.0
Oreogeton sp.	0	0	1	1	1%	0.3	0.6
EPHEMEROPTERA					53%	34.3	
Ameletus spp.	0	2	1	3	2%	1.0	1.0
Baetis bicaudatus	1	1	4	6	3%	2.0	1.7
Drunella doddsi	0	3	1	4	2%	1.3	1.5
Claygmula spp.	10	29	30	69	36%	23.0	11.3
Rhithrogena spp.	3	8	10	21	11%	7.0	3.6
PLECOPTERA					35%	22.3	
Megarcys sp.	0	1	3	4	2%	1.3	1.5
Doroneuria theodora	0	0	2	2	1%	0.7	1.2
Chloroperlinae	2	1	6	9	5%	3.0	2.6
Zapada sp. 1	1	0	0	1	1%	0.3	0.6
Doddsia sp.	6	20	25	51	26%	17.0	9.8
TRICHOPTERA					7%	4.3	
Arctopsyche grandis	0	0	3	3	2%	1.0	1.7
Parapsyche elsis	0	1	1	2	1%	0.7	0.6
Rhyacophila Betteni gp.	0	1	1	2	1%	0.7	0.6
Rhyacophila verrula	0	0	1	1	1%	0.3	0.6
Rhyacophila Sibrica gp	0	1	1	2	1%	0.7	0.6
Glossosoma sp.	0	1	2	3	2%	1.0	1.0
ANNELIDA					1%	0.3	
Lumbricidae	1	0	0	1	1%	0.3	0.6
TOTAL ORGANISMS	26	74	94	194		64.7	34.9
TAXA RICHNESS	9	15	18	21		14.0	4.6
SHAN. DIVERSITY	2.57	2.67	3.01	2.96		2.75	0.23
BIOTICINDEX	2.04	1.99	1.84	1.92		1.96	0.10
EPT RICHNESS	6	12	15	20		11.0	4.6
EPT / CHIR.	23.00	17.25	91.00	30.50		43.8	41.0
BIOTIC COND. INDEX				126.1			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	2	2.9	1.8				
depth (m)	0.25	0.3	0.15				
velocity (ft/s)	0.71	1.2	0.79				
CTQp =				50			
stream width (m)				14			
gradient (%)				2.3			
water temperature (C)				4			
substrate particle size (%)	boulders (>12)			5			
	rubble (3 - 12)			25			
	gravel (.125 - 3)			50			
	fines (< 0.125)			20			

MACROINVERTEBRATE DATA							
LIBBY CREEK					**STATION 10 - 10/18/88**		
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
DIPTERA					6%	9.3	
Krenopelopia sp. ?	0	1	0	1	0%	0.3	0.6
Brillia sp.	1	1	1	3	1%	1.0	0.0
Parametriocnemus sp.	0	0	7	7	1%	2.3	4.0
Paraphaenocladius sp.	0	0	1	1	0%	0.3	0.6
Heterotrissocladius sp	0	0	1	1	0%	0.3	0.6
Rheocricotopus sp.	1	3	0	4	1%	1.3	1.5
Tvetenia sp.	1	0	0	1	0%	0.3	0.6
Micropsectra spp.	1	0	2	3	1%	1.0	1.0
Dicranota sp.	0	0	1	1	0%	0.3	0.6
Pedicia sp.?	0	0	1	1	0%	0.3	0.6
Oreogeton sp.	0	0	5	5	1%	1.7	2.9
EPHEMEROPTERA					45%	71.7	
Ameletus spp.	0	6	13	19	4%	6.3	6.5
Baetis bicaudatus	12	17	26	55	11%	18.3	7.1
Drunella doddsi	0	0	1	1	0%	0.3	0.6
Cinygmula spp.	7	31	67	105	22%	35.0	30.2
Epeorus deceptivus	2	0	0	2	0%	0.7	1.2
Rhithrogena spp.	3	8	12	23	5%	7.7	4.5
Paraleptophlebia spp.	0	1	9	10	2%	3.3	4.9
PLECOPTERA					40%	63.3	
Doroneuria theodora	0	0	1	1	0%	0.3	0.6
Chloroperlinae	34	39	41	114	24%	38.0	3.6
Capnia gp.	1	1	1	3	1%	1.0	0.0
Visoka sp. ?	2	3	4	9	2%	3.0	1.0
Zapada sp. 1	5	9	14	28	6%	9.3	4.5
Doddsia sp.	6	8	7	21	4%	7.0	1.0
Despaxia sp.	3	1	2	6	1%	2.0	1.0
Perlomyia sp.	1	0	0	1	0%	0.3	0.6
Yoraperla brevis	2	5	0	7	1%	2.3	2.5
TRICHOPTERA					10%	15.7	
Parapsyche elsis	4	1	5	10	2%	3.3	2.1
Rhyacophila Betteni gp.	0	0	3	3	1%	1.0	1.7
Rhyacophila Brunnea gp.	1	0	0	1	0%	0.3	0.6
Rhyacophila verrula	2	0	4	6	1%	2.0	2.0
Rhyacophila Sibrica gp	1	1	0	2	0%	0.7	0.6
Rhyacophila Hylinata gp	0	0	1	1	0%	0.3	0.6
Lepidostoma spp.	0	0	1	1	0%	0.3	0.6
Neothremma sp.	0	1	1	2	0%	0.7	0.6
Chyranda sp.	0	1	0	1	0%	0.3	0.6
Glossosoma sp.	6	11	2	19	4%	6.3	4.5
Wormaldia sp.	0	0	1	1	0%	0.3	0.6

MACROINVERTEBRATE DATA							
LIBBY CREEK				STATION 10 - 10/18/88			
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
TOTAL ORGANISMS	96	149	235	480		160.0	70.1
TAXA RICHNESS	21	20	29	38		23.3	4.9
SHAN. DIVERSITY	3.42	3.32	3.58	3.69		3.44	0.13
BIOTIC INDEX	1.08	1.22	1.50	1.33		1.27	0.21
EPT RICHNESS	17	17	21	31		18.3	2.3
EPT / CHIR.	23.00	28.80	17.92	21.48		23.2	5.4
BIOTIC COND. INDEX				116.4			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	3	4	0.2				
depth (m)	0.25	0.25	0.1				
velocity (ft/s)	0.52	0.4	0.34				
CTQp =				50			
stream width (m)				8			
gradient (%)				3.5			
water temperature (C)				5			
substrate particle size (%)	boulders (>12)			30			
	rubble (3 - 12)			54			
	gravel (.125 - 3)			10			
	fines (< 0.125)			1			

MACROINVERTEBRATE DATA							
LIBBY CREEK				STATION 11 - 10/18/88			
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
DIPTERA					20%	23.3	
Paramerina sp. ?	0	0	1	1	0%	0.3	0.6
Monodiamesa sp.	4	0	36	40	11%	13.3	19.7
Pagastia sp	1	0	0	1	0%	0.3	0.6
Brillia sp.	0	1	0	1	0%	0.3	0.6
Bryophaenocladius sp.	0	1	0	1	0%	0.3	0.6
Parametriocnemus sp.	2	8	1	11	3%	3.7	3.8
Zalutshia sp.	0	1	0	1	0%	0.3	0.6
Polypedilum spp.	0	0	1	1	0%	0.3	0.6
Micropsectra spp.	3	2	0	5	1%	1.7	1.5
Dicranota sp.	0	1	0	1	0%	0.3	0.6
Hesperoconopa sp.	0	0	2	2	1%	0.7	1.2
Chelifera sp.	1	0	0	1	0%	0.3	0.6
Oreogeton sp.	1	0	1	2	1%	0.7	0.6
Certatopogonidae	0	0	2	2	1%	0.7	1.2
EPHEMEROPTERA					56%	66.7	
Ameletus spp.	25	0	36	61	17%	20.3	18.4
Baetis bicaudatus	3	0	0	3	1%	1.0	1.7
Cinygmula spp.	95	15	11	121	34%	40.3	47.4
Rhithrogena spp.	8	1	1	10	3%	3.3	4.0
Paraleptophlebia spp.	2	3	0	5	1%	1.7	1.5
PLECOPTERA					16%	19.0	
Chloroperlinae	16	3	5	24	7%	8.0	7.0
Visoka sp. ?	0	1	0	1	0%	0.3	0.6
Zapada sp. 1	1	3	1	5	1%	1.7	1.2
Despaxia sp.	2	0	0	2	1%	0.7	1.2
Yoraperla brevis	14	5	6	25	7%	8.3	4.9
TRICHOPTERA					7%	8.0	
Parapsyche elsis	0	1	0	1	0%	0.3	0.6
Rhyacophila Brunnea gp.	1	0	0	1	0%	0.3	0.6
Rhyacophila verrula	2	3	0	5	1%	1.7	1.5
Rhyacophila vagrita	1	0	0	1	0%	0.3	0.6
Ecclisomyia sp.	9	0	0	9	3%	3.0	5.2
Homophylax sp.	1	0	1	2	1%	0.7	0.6
Neothremma sp.	3	2	0	5	1%	1.7	1.5
ANNELIDA					1%	1.7	
Enchytraeidae	2	0	0	2	1%	0.7	1.2
Tubificidae	1	0	2	3	1%	1.0	1.0

MACROINVERTEBRATE DATA							
LIBBY CREEK				STATION 11 - 10/18/88			
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
TOTAL ORGANISMS	198	51	107	356		118.7	74.2
TAXA RICHNESS	23	16	15	33		18.0	4.4
SHAN. DIVERSITY	2.87	3.37	2.60	3.37		2.95	0.39
BIOTICINDEX	1.71	2.12	3.40	2.28		2.41	0.88
EPT RICHNESS	15	10	7	21		10.7	4.0
EPT / CHIR.	18.30	2.85	1.56	4.53		7.6	9.3
BIOTIC COND. INDEX				84.0			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	1	1	2				
depth (m)	0.3	0.25	0.15				
velocity (ft/s)	0.37	0.32	0.68				
CTQp =				50			
stream width (m)				7			
gradient (%)				4			
water temperature (C)				5			
substrate particle size (%)	boulders (>12)			20			
	rubble (3 - 12)			30			
	gravel (.125 - 3)			30			
	fines (< 0.125)			20			

MACROINVERTEBRATE DATA							
EAST FORK ROCK CREEK					STATION 1 - 10/17/88		
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					5%	2.7	
Heterlimnius corpulentus	1	0	0	1	1%	0.3	0.6
Laraavara	3	2	0	5	3%	1.7	1.5
Dytiscidae	0	2	0	2	1%	0.7	1.2
DIPTERA					9%	5.3	
Thienemannimyia group	1	0	1	2	1%	0.7	0.6
Brillia sp.	4	1	1	6	3%	2.0	1.7
Tvetenia sp.	1	0	0	1	1%	0.3	0.6
Rheotanytarsus sp.	2	1	0	3	2%	1.0	1.0
Micropsectra spp.	1	0	0	1	1%	0.3	0.6
Antocha sp.	0	2	0	2	1%	0.7	1.2
Hexatoma sp.	0	1	0	1	1%	0.3	0.6
EPHEMEROPTERA					29%	16.7	
Ameletus spp.	4	7	4	15	9%	5.0	1.7
Baetis bicaudatus	0	1	0	1	1%	0.3	0.6
Drunella doddsi	0	0	1	1	1%	0.3	0.6
Serratella tibialis	0	1	0	1	1%	0.3	0.6
Cinygmula spp.	4	6	7	17	10%	5.7	1.5
Rhithrogena spp.	5	2	6	13	7%	4.3	2.1
Paraleptophlebia spp.	0	2	0	2	1%	0.7	1.2
PLECOPTERA					30%	17.7	
Megarcys sp.	1	0	5	6	3%	2.0	2.6
Doroneuria theodora	6	1	14	21	12%	7.0	6.6
Chloroperlinae	1	0	3	4	2%	1.3	1.5
Capnia gp.	1	0	0	1	1%	0.3	0.6
Zapada sp. 1	6	2	5	13	7%	4.3	2.1
Zapada cinctipes	6	1	1	8	5%	2.7	2.9
TRICHOPTERA					27%	15.7	
Arctopsyche grandis	4	0	8	12	7%	4.0	4.0
Parapsyche elsis	2	0	1	3	2%	1.0	1.0
Rhyacophila Betteni gp.	0	0	1	1	1%	0.3	0.6
Rhyacophila Brunnea gp.	0	1	0	1	1%	0.3	0.6
Lepidostoma spp.	10	2	2	14	8%	4.7	4.6
Agraylea sp.	1	0	1	2	1%	0.7	0.6
Apatania sp.	1	0	1	2	1%	0.7	0.6
Ecclisomyia sp.	1	0	0	1	1%	0.3	0.6
Oligophlebodes sp.	0	2	0	2	1%	0.7	1.2
Glossosoma sp.	2	0	6	8	5%	2.7	3.1
Dolophilodes sp.	0	0	1	1	1%	0.3	0.6
MOLLUSCA							
Sphaeriidae	0	1	0	1	1%	0.3	0.6

MACROINVERTEBRATE DATA							
EAST FORK ROCK CREEK				STATION 1 - 10/17/88			
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
TOTAL ORGANISMS	68	38	69	175		58.3	17.6
TAXA RICHNESS	23	19	19	35		20.3	2.3
SHAN. DIVERSITY	4.12	3.90	3.70	4.39		3.91	0.21
BIOTICINDEX	1.65	1.87	1.33	1.57		1.62	0.27
EPT RICHNESS	16	12	17	28		15.0	2.6
EPT / CHIR.	6.11	14.00	33.00	11.46		17.7	13.8
BIOTIC COND. INDEX				104.2			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	3	2	5				
depth (m)	0.3	0.15	0.4				
velocity (ft/s)	1.31	0.47	0.91				
CTQp =				50			
stream width (m)				15			
gradient (%)				2			
water temperature (C)				7.5			
substrate particle size (%)	boulders (>12)			30			
	rubble (3 - 12)			55			
	gravel (.125 - 3)			10			
	fines (< 0.125)			5			

MACROINVERTEBRATE DATA							
EAST FORK ROCK CREEK					STATION 3 - 10/17/88		
kick samples, 1 meter, 45 seconds.							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					3%	34.0	
Dytiscidae	0	0	1	1	0%	0.3	0.6
Helophorus sp.	0	0	1	1	0%	0.3	0.6
Hydrobius sp. ?	1	0	1	2	0%	0.7	0.6
Lara avara	3	3	0	6	0%	2.0	1.7
Cleptelmis ornata	45	14	4	63	2%	21.0	21.4
Zaitzevia parvula	14	15	0	29	1%	9.7	8.4
DIPTERA					3%	39.7	
Thienemannimyia group	32	18	4	54	1%	18.0	14.0
Macropelopia sp.	1	0	0	1	0%	0.3	0.6
Brillia sp.	4	1	2	7	0%	2.3	1.5
Paraphaenocladius sp.	10	1	1	12	0%	4.0	5.2
Symposiocladius sp. ?	1	1	0	2	0%	0.7	0.6
Rheotanytarsus sp.	14	6	5	25	1%	8.3	4.9
Micropsectra spp.	1	0	1	2	0%	0.7	0.6
Antocha sp.	0	0	1	1	0%	0.3	0.6
Tipula spp.	4	0	0	4	0%	1.3	2.3
Pericoma sp.	1	4	1	6	0%	2.0	1.7
Simulium sp.	0	0	1	1	0%	0.3	0.6
Certatopogonidae	4	0	0	4	0%	1.3	2.3
EPHEMEROPTERA					14%	184.3	
Ephemerella infrequens	2	7	13	22	1%	7.3	5.5
Drunella spinifera	2	0	2	4	0%	1.3	1.2
Serratella tibialis	2	0	1	3	0%	1.0	1.0
Cinygma sp. ?	1	1	6	8	0%	2.7	2.9
Paraleptophlebia spp.	302	135	79	516	13%	172.0	116.0
PLECOPTERA					3%	38.0	
Skwala sp.	0	0	1	1	0%	0.3	0.6
Isoperla ebria ?	12	18	13	43	1%	14.3	3.2
Chloroperlinae	9	12	46	67	2%	22.3	20.6
Capnia gp.	1	0	0	1	0%	0.3	0.6
Visoka sp. ?	0	0	1	1	0%	0.3	0.6
Zapada sp. 1	1	0	0	1	0%	0.3	0.6
TRICHOPTERA					5%	70.3	
Rhyacophila Brunnea gp.	29	8	9	46	1%	15.3	11.8
Lepidostoma spp.	3	31	0	34	1%	11.3	17.1
Hydroptila sp.	22	17	15	54	1%	18.0	3.6
Apatania sp.	1	1	3	5	0%	1.7	1.2
Dicosmoecus gilvipes	1	0	0	1	0%	0.3	0.6
Limnephilus sp. ?	0	0	1	1	0%	0.3	0.6
Polycentropus sp.	0	5	1	6	0%	2.0	2.6
Dolophilodes sp.	2	0	3	5	0%	1.7	1.5
Micrasema sp.	35	17	7	59	1%	19.7	14.2

MACROINVERTEBRATE DATA							
EAST FORK ROCK CREEK				STATION 3 - 10/17/88			
kick samples, 1 meter, 45 seconds.							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
MEGALOPTERA							
Sialis sp.	1	5	0	6	0%	2.0	2.6
MOLLUSCA							
Sphaeriidae	2400	400	63	2863	71%	954.3	1263.3
Lymnaidae	0	3	3	6	0%	2.0	1.7
Physidae	0	0	1	1	0%	0.3	0.6
ANNELIDA					1%	14.7	
Lumbricidae	2	0	0	2	0%	0.7	1.2
Lumbriculidae	21	11	6	38	1%	12.7	7.6
Glossiphoniidae	3	0	1	4	0%	1.3	1.5
OTHER							
Turbellaria	8	16	4	28	1%	9.3	6.1
TOTAL ORGANISMS	2995	750	302	4047		1349.0	1443.0
TAXA RICHNESS	36	25	34	46		31.7	5.9
SHAN. DIVERSITY	1.32	2.60	3.55	1.89		2.49	1.12
BIOTIC INDEX	6.88	5.39	3.35	6.34		5.21	1.77
EPT RICHNESS	15	10	15	24		13.3	2.9
EPT / CHIR.	6.16	8.70	14.69	7.90		9.9	4.4
BIOTIC COND. INDEX				74.9			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	4	2.6	3.2				
depth (m)	0.5	0.33	0.4				
velocity (ft/s)	0.71	0.35	0.45				
CTQp =				53			
stream width (m)				8			
gradient (%)				1			
water temperature (C)				7			
substrate particle size (%)	boulders (>12)			25			
	rubble (3 - 12)			35			
	gravel (.125 - 3)			25			
	fines (< 0.125)			15			

. MACROINVERTEBRATE DATA							
EAST FORK ROCK CREEK					STATION 3 - 10/17/88		
* EXCLUDING 2863 SPHAERIIDAE .							
kick samples, 1 meter, 45 seconds.							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
COLEOPTERA					9%	34.0	
Dytiscidae	0	0	1	1	0%	0.3	0.6
Helophorus sp.	0	0	1	1	0%	0.3	0.6
Hydrobius sp. ?	1	0	1	2	0%	0.7	0.6
Lara avara	3	3	0	6	1%	2.0	1.7
Cleptelmis ornata	45	14	4	63	5%	21.0	21.4
Zaitzevia parvula	14	15	0	29	2%	9.7	8.4
DIPTERA					10%	39.7	
Thienemannimyia group	32	18	4	54	5%	18.0	14.0
Macropelopia sp.	1	0	0	1	0%	0.3	0.6
Brillia sp.	4	1	2	7	1%	2.3	1.5
Paraphaenocladius sp.	10	1	1	12	1%	4.0	5.2
Symposiocladius sp. ?	1	1	0	2	0%	0.7	0.6
Rheotanytarsus sp.	14	6	5	25	2%	8.3	4.9
Micropsectra spp.	1	0	1	2	0%	0.7	0.6
Antocha sp.	0	0	1	1	0%	0.3	0.6
Tipula spp.	4	0	0	4	0%	1.3	2.3
Pericoma sp.	1	4	1	6	1%	2.0	1.7
Simulium sp.	0	0	1	1	0%	0.3	0.6
Certatopogonidae	4	0	0	4	0%	1.3	2.3
EPHEMEROPTERA					47%	184.3	
Ephemerella infrequens	2	7	13	22	2%	7.3	5.5
Drunella spinifera	2	0	2	4	0%	1.3	1.2
Serratella tibialis	2	0	1	3	0%	1.0	1.0
Cinygma sp. ?	1	1	6	8	1%	2.7	2.9
Paraleptophlebia spp.	302	135	79	516	44%	172.0	116.0
PLECOPTERA					10%	38.0	
Skwala sp.	0	0	1	1	0%	0.3	0.6
Isoperla ebria ?	12	18	13	43	4%	14.3	3.2
Chloroperlinae	9	12	46	67	6%	22.3	20.6
Capnia gp.	1	0	0	1	0%	0.3	0.6
Visoka sp. ?	0	0	1	1	0%	0.3	0.6
Zapada sp. 1	1	0	0	1	0%	0.3	0.6
TRICHOPTERA					18%	70.3	
Rhyacophila Brunnea gp.	29	8	9	46	4%	15.3	11.8
Lepidostoma spp.	3	31	0	34	3%	11.3	17.1
Hydroptila sp.	22	17	15	54	5%	18.0	3.6
Apatania sp.	1	1	3	5	0%	1.7	1.2
Dicosmoecus gilvipes	1	0	0	1	0%	0.3	0.6
Limnephilus sp. ?	0	0	1	1	0%	0.3	0.6
Polycentropus sp.	0	5	1	6	1%	2.0	2.6
Dolophilodes sp.	2	0	3	5	0%	1.7	1.5
Micrasema sp.	35	17	7	59	5%	19.7	14.2

. MACROINVERTEBRATE DATA							
EAST FORK ROCK CREEK					STATION 3 - 10/17/88		
* EXCLUDING 2863 SPHAERIIDAE .							
kick samples, 1 meter, 45 seconds.							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
MEGALOPTERA							
Sialis sp.	1	5	0	6	1%	2.0	2.6
MOLLUSCA							
Lymnaidae	0	3	3	6	1%	2.0	1.7
Physidae	0	0	1	1	0%	0.3	0.6
ANNELIDA					4%	14.7	
Lumbricidae	2	0	0	2	0%	0.7	1.2
Lumbriculidae	21	11	6	38	3%	12.7	7.6
Glossiphoniidae	3	0	1	4	0%	1.3	1.5
OTHER							
Turbellaria	8	16	4	28	2%	9.3	6.1
TOTAL ORGANISMS	595	350	239	1184		394.7	182.2
TAXA RICHNESS	35	24	33	45		30.7	5.9
SHAN. DIVERSITY	3.02	3.44	3.55	3.47		3.33	0.28
BIOTIC INDEX	2.35	2.41	2.12	2.32		2.29	0.15
EPT RICHNESS	15	10	15	24		13.3	2.9
EPT / CHIR.	6.16	8.70	14.69	7.90		9.9	4.4
BIOTIC COND. INDEX				75.8			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	4	2.6	3.2				
depth (m)	0.5	0.33	0.4				
velocity (ft/s)	0.71	0.35	0.45				
CTQp =				53			
stream width (m)				8			
gradient (%)				1			
water temperature (C)				7			
substrate particle size (%)	boulders (>12)			25			
	rubble (3 - 12)			35			
	gravel (.125 - 3)			25			
	fines (< 0.125)			15			

MACROINVERTEBRATE DATA							
EAST FORK ROCK CREEK					**STATION 4 - 10/17/88**		
kick samples, 1 meter, 45 seconds							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					2%	1.7	
unidentified larva	0	1	0	1	0%	0.3	0.6
Staphylinidae	0	0	1	1	0%	0.3	0.6
Lara avara	0	0	1	1	0%	0.3	0.6
Cleptelmis ornata	1	0	0	1	0%	0.3	0.6
Zaitzevia parvula	1	0	0	1	0%	0.3	0.6
DIPTERA					21%	22.3	
Brillia sp.	2	1	1	4	1%	1.3	0.6
Paraphaenocladius sp.	6	2	0	8	2%	2.7	3.1
Psuedoorthocladius sp.	1	0	0	1	0%	0.3	0.6
Tipula spp.	10	0	0	10	3%	3.3	5.8
Hexatoma sp.	2	0	0	2	1%	0.7	1.2
Oreogeton sp.	34	0	0	34	11%	11.3	19.6
Pericoma sp.	8	0	0	8	2%	2.7	4.6
EPHEMEROPTERA					21%	22.3	
Ameletus spp.	11	0	2	13	4%	4.3	5.9
Baetis bicaudatus	0	1	1	2	1%	0.7	0.6
Drunella spinifera	1	0	0	1	0%	0.3	0.6
Cinygmula spp.	5	18	13	36	11%	12.0	6.6
Epeorus deceptivus	0	5	2	7	2%	2.3	2.5
Cinygma sp.	3	1	1	5	2%	1.7	1.2
Paraleptophlebia spp.	1	0	2	3	1%	1.0	1.0
PLECOPTERA					24%	25.7	
Megarcys sp.	0	1	2	3	1%	1.0	1.0
Doroneuria theodora	0	1	2	3	1%	1.0	1.0
Chloroperlinae	16	0	6	22	7%	7.3	8.1
Visoka sp. ?	7	5	6	18	6%	6.0	1.0
Zapada sp. 1	11	12	7	30	9%	10.0	2.6
Despaxia sp.	1	0	0	1	0%	0.3	0.6
TRICHOPTERA					19%	20.3	
Parapsyche elsis	4	7	4	15	5%	5.0	1.7
Rhyacophila Betteni gp.	0	0	1	1	0%	0.3	0.6
Rhyacophila vagrita	1	0	0	1	0%	0.3	0.6
Rhyacophila verrula	2	0	1	3	1%	1.0	1.0
Lepidostoma spp.	1	1	1	3	1%	1.0	0.0
Limnephilidae	1	0	1	2	1%	0.7	0.6
Ecclisomyia sp.	1	0	0	1	0%	0.3	0.6
Cryptochia sp.	2	0	0	2	1%	0.7	1.2
Neothremma sp.	21	2	4	27	8%	9.0	10.4
Anagapetus sp.	1	2	2	5	2%	1.7	0.6
Micrasema sp.	1	0	0	1	0%	0.3	0.6

MACROINVERTEBRATE DATA							
EAST FORK ROCK CREEK					STATION 4 - 10/17/88		
kick samples, 1 meter, 45 seconds							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
MOLLUSCA					1%	1.3	
Sphaeriidae	2	0	0	2	1%	0.7	1.2
Lymnaidae	2	0	0	2	1%	0.7	1.2
ANNELIDA					2%	1.7	
Lumbricidae	2	0	0	2	1%	0.7	1.2
Lumbriculidae	2	1	0	3	1%	1.0	1.0
OTHER							
Turbellaria	32	3	0	35	11%	11.7	17.7
TOTAL ORGANISMS	196	64	61	321		107.0	77.1
TAXA RICHNESS	33	17	21	41		23.7	8.3
SHAN. DIVERSITY	4.05	3.32	3.85	4.37		3.74	0.38
BIOTICINDEX	2.53	1.45	1.20	2.06		1.73	0.71
EPT RICHNESS	18	12	18	28		16.0	3.5
EPT / CHIR.	9.89	18.00	56.00	15.31		28.0	24.6
BIOTIC COND. INDEX				98.5			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	0.1	0.15	2.5				
depth (m)	0.2	0.25	0.33				
velocity (ft/s)	1.13	1.4	0.82				
CTQp =				50			
stream width (m)				5			
gradient (%)				15			
water temperature (C)				7			
substrate particle size (%)	boulders (>12)			75			
	rubble (3 - 12)			20			
	gravel (.125 - 3)			4			
	fines (< 0.125)			1			

APPENDIX 6.5 April, 1989 aquatic macroinvertebrate data and summary parameters by Montana Project area creek and station

MACROINVERTEBRATE DATA							
BEAR CREEK				**STATION 1 - 4/21/89**			
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					1%	1.3	
Heterlimnius corpulentus	1	0	1	2	0%	0.7	0.6
Cleptelmis ornata	0	0	1	1	0%	0.3	0.6
Hydrophilidae	1	0	0	1	0%	0.3	0.6
DIPTERA					8%	19.7	
Diamesa spp.	0	0	1	1	0%	0.3	0.6
Eukiefferiella spp.	1	0	2	3	0%	1.0	1.0
Paraphaenocladius sp.	0	1	3	4	1%	1.3	1.5
Rheocricotopus sp.	6	2	6	14	2%	4.7	2.3
Lopescladius sp.	0	0	1	1	0%	0.3	0.6
Orthocladius sp.	0	0	1	1	0%	0.3	0.6
Psuedoorthocladius sp.	0	0	1	1	0%	0.3	0.6
Tvetenia sp.	1	1	0	2	0%	0.7	0.6
Micropsectra spp.	2	2	0	4	1%	1.3	1.2
Dicranota sp.	1	0	1	2	0%	0.7	0.6
Hexatoma sp.	0	0	4	4	1%	1.3	2.3
Rhabdomastix sp.	0	0	1	1	0%	0.3	0.6
Chelifera sp.	0	1	0	1	0%	0.3	0.6
Oreogeton sp.	0	0	1	1	0%	0.3	0.6
Prosimulium sp.	4	2	12	18	2%	6.0	5.3
Certatopogonidae	0	1	0	4	1%	0.3	0.6
EPHEMEROPTERA					64%	162.3	
Ameletus spp.	0	0	1	1	0%	0.3	0.6
Baetis bicaudatus	10	4	12	26	3%	8.7	4.2
Ephemerella infrequens	0	1	17	18	2%	6.0	9.5
Drunella coloradensis	37	10	56	103	14%	34.3	23.1
Drunella doddsi	12	4	14	30	4%	10.0	5.3
Cinygmula spp.	62	14	47	123	16%	41.0	24.6
Epeorus spp.	34	16	68	118	16%	39.3	26.4
Rhithrogena spp.	23	39	6	68	9%	22.7	16.5
PLECOPTERA					19%	48.7	
Skwala sp.	1	0	0	1	0%	0.3	0.6
Perlodinae	2	0	5	7	1%	2.3	2.5
Isoperla sobria	0	0	1	1	0%	0.3	0.6
Doroneuria theodora	1	0	0	1	0%	0.3	0.6
Chloroperlinae	19	35	21	75	10%	25.0	8.7
Capnia gp.	9	7	11	27	4%	9.0	2.0
Podmosta sp.?	1	1	3	5	1%	1.7	1.2
Zapada sp. 1	0	1	2	3	0%	1.0	1.0
Visoka sp.	0	0	1	1	0%	0.3	0.6
Perlomyia sp.	7	10	8	25	3%	8.3	1.5

.	MACROINVERTEBRATE DATA						
BEAR CREEK				**STATION 1 - 4/21/89**			
.							
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
TRICHOPTERA					7%	17.7	
Hydropsyche(Ceratopsyche	1	0	1	2	0%	0.7	0.6
Rhyacophila Betteni gp.	4	0	3	7	1%	2.3	2.1
Rhyacophila Brunnea gp.	0	0	3	3	0%	1.0	1.7
Rhyacophila Hyalinata gp.	1	0	0	1	0%	0.3	0.6
Lepidostoma spp.	1	2	3	6	1%	2.0	1.0
Apatania sp.	1	1	0	2	0%	0.7	0.6
Ecclisomyia sp.	1	0	1	2	0%	0.7	0.6
Oligophlebodes sp.	20	4	3	27	4%	9.0	9.5
Glossosoma sp.	1	1	1	3	0%	1.0	0.0
ANNELIDA					1%	2.3	
Lumbricidae	0	4	2	6	1%	2.0	2.0
Lumbriculidae	1	0	0	1	0%	0.3	0.6
OTHER							
Ostracoda	0	1	0	1	0%	0.3	0.6
TOTAL ORGANISMS	266	165	326	760		252.3	81.4
TAXA RICHNESS	30	25	38	49		31.0	6.6
SHAN. DIVERSITY	3.67	3.55	3.91	4.01		3.71	0.18
BIOTIC INDEX	1.26	0.99	1.47	1.31		1.24	0.24
EPT RICHNESS	21	16	23	31		20.0	3.6
EPT / CHIR.	24.80	25.00	19.20	22.13		23.0	3.3
BIOTIC COND. INDEX				88.0			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	2	1	4				
depth (m)	0.35	0.3	0.35				
velocity (ft/s)	3	2	3				
CTQp =				50			
stream width (m)				15			
gradient (%)				3			
water temperature (C)				2			
substrate particle size (%)	boulders (>12)			20			
	rubble (3 - 12)			50			
	gravel (.125 - 3)			25			
	fines (< 0.125)			5			
rained last night, stage gauge at 1.65 ft.,							

MACROINVERTEBRATE DATA							
BEAR CREEK				**STATION 2 - 4/17/89**			
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
DIPTERA					35%	53.0	
Thienemannimyia group	0	1	0	1	0%	0.3	0.6
Krenopelopia sp.	1	1	0	2	0%	0.7	0.6
Boreochlus sp.	0	0	1	1	0%	0.3	0.6
Brillia sp.	0	2	0	2	0%	0.7	1.2
Chaetocladius sp.	0	0	1	1	0%	0.3	0.6
Eukiefferiella spp.	0	2	0	2	0%	0.7	1.2
Paraphaenocladius sp.	4	22	21	47	10%	15.7	10.1
Rheocricotopus sp.	0	8	32	40	9%	13.3	16.7
Tvetenia sp.	0	9	16	25	5%	8.3	8.0
Micropsectra spp.	1	7	6	14	3%	4.7	3.2
Stempellina sp.	1	2	2	5	1%	1.7	0.6
Dicranota sp.	0	0	1	1	0%	0.3	0.6
Rhabdomastix sp.	0	1	0	1	0%	0.3	0.6
Oreogeton sp.	1	0	0	1	0%	0.3	0.6
Prosimulium sp.	0	9	2	11	2%	3.7	4.7
Certatopogonidae	0	2	3	5	1%	1.7	1.5
EPHEMEROPTERA					36%	54.0	
Baetis bicaudatus	0	17	12	29	6%	9.7	8.7
Ephemerella infrequens	0	0	1	1	0%	0.3	0.6
Drunella coloradensis	0	5	6	11	2%	3.7	3.2
Drunella doddsi	0	3	1	4	1%	1.3	1.5
Cinygmula spp.	4	31	38	73	16%	24.3	18.0
Epeorus deceptivus	0	11	12	23	5%	7.7	6.7
Rhithrogena spp.	4	8	9	21	5%	7.0	2.6
PLECOPTERA	3		1		25%	38.7	
Megarcys sp.	0	1	0	1	0%	0.3	0.6
Doroneuria theodora	0	1	0	1	0%	0.3	0.6
Chloroperlinae	24	21	28	73	16%	24.3	3.5
Capnia gp.	1	1	1	3	1%	1.0	0.0
Visoka sp.	0	1	7	8	2%	2.7	3.8
Zapada sp. 1	0	5	4	9	2%	3.0	2.6
Podmosta sp. ?	0	1	0	1	0%	0.3	0.6
Doddsia sp.	0	0	2	2	0%	0.7	1.2
Perlomyia sp.	2	5	11	18	4%	6.0	4.6
TRICHOPTERA					3%	4.7	
Cheumatopsyche sp.	0	2	1	3	1%	1.0	1.0
Lepidostoma spp.	0	1	1	2	0%	0.7	0.6
Chryandra sp.	0	1	0	1	0%	0.3	0.6
Ecclisomyia sp.	0	0	1	1	0%	0.3	0.6
Glossosoma sp.	3	0	4	7	2%	2.3	2.1

MACROINVERTEBRATE DATA							
BEAR CREEK				**STATION 2 - 4/17/89**			
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
ANNELIDA					1%	1.7	
Lumbricidae	0	1	0	1	0%	0.3	0.6
Lumbriculidae	0	1	2	3	1%	1.0	1.0
Tubificidae	0	0	1	1	0%	0.3	0.6
TOTAL ORGANISMS	49	183	228	456		153.3	93.1
TAXA RICHNESS	11	31	29	40		23.7	11.0
SHAN. DIVERSITY	2.74	4.10	3.96	4.09		3.60	0.75
BIOTICINDEX	0.88	2.65	2.73	2.52		2.09	1.05
EPT RICHNESS	6	17	17	25		13.3	6.4
EPT / CHIR.	5.43	2.13	1.76	2.09		3.1	2.0
BIOTIC COND. INDEX				83.3			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	4	3	4				
depth (m)	0.3	0.2	0.1				
velocity (ft/s)	1	0.75	0.5				
CTQp =				50			
stream width (m)				15			
gradient (%)				2.5			
water temperature (C)				1.5			
substrate particle size (%)	boulders (>12)			15			
	rubble (3 - 12)			45			
	gravel (.125 - 3)			20			
	fines (< 0.125)			20			
flow approx 40 cfs, clear,							

MACROINVERTEBRATE DATA							
BEAR CREEK					**STATION 3 - 4/17/89**		
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					1%	1.3	
Heterlimnius corpulentus	0	1	1	2	1%	0.7	0.6
Hydrophilidae	0	0	1	1	0%	0.3	0.6
Staphyliniidae	0	1	0	1	0%	0.3	0.6
DIPTERA					33%	34.3	
Krenopelopia sp.	3	1	0	4	1%	1.3	1.5
Tvetenia sp.	8	1	7	16	5%	5.3	3.8
Brillia sp.	0	1	1	2	1%	0.7	0.6
Chaetocladius sp.	0	0	2	2	1%	0.7	1.2
Paraphaenocladius sp.	17	3	19	39	13%	13.0	8.7
Rheocricotopus sp.	5	1	2	8	3%	2.7	2.1
Micropsectra spp.	5	0	1	6	2%	2.0	2.6
Stempellina sp.	2	0	0	2	1%	0.7	1.2
Dicranota sp.	2	0	2	4	1%	1.3	1.2
Ephydridae	4	7	0	11	4%	3.7	3.5
Rhabdomastix sp.	0	2	0	2	1%	0.7	1.2
Oreogeton sp.	1	0	0	1	0%	0.3	0.6
Prosimulium sp.	0	1	1	2	1%	0.7	0.6
Certatopogonidae	1	3	0	4	1%	1.3	1.5
EPHEMEROPTERA					29%	30.0	
Baetis bicaudatus	1	3	12	16	5%	5.3	5.9
Drunella coloradensis	1	4	0	5	2%	1.7	2.1
Drunella doddsi	2	0	0	2	1%	0.7	1.2
Drunella spinifera	0	1	0	1	0%	0.3	0.6
Cinygmula spp.	26	7	13	46	15%	15.3	9.7
Epeorus sp.	1	1	10	12	4%	4.0	5.2
Rhithrogena spp.	4	3	1	8	3%	2.7	1.5
PLECOPTERA					30%	30.7	
Doroneuria theodora	0	0	2	2	1%	0.7	1.2
Chloroperlinae	16	11	13	40	13%	13.3	2.5
Capnia gp.	1	0	0	1	0%	0.3	0.6
Visoka sp.	0	0	7	7	2%	2.3	4.0
Zapada sp. 1	7	0	7	14	5%	4.7	4.0
Podmosta sp.	1	1	1	3	1%	1.0	0.0
Perlomyia sp.	13	3	9	25	8%	8.3	5.0
TRICHOPTERA					5%	4.7	
Parapsyche elsis	0	0	2	2	1%	0.7	1.2
Rhyacophila Betteni gp.	2	0	1	3	1%	1.0	1.0
Lepidostoma spp.	2	0	0	2	1%	0.7	1.2
Glossosoma sp.	6	0	1	7	2%	2.3	3.2

MACROINVERTEBRATE DATA							
BEAR CREEK				**STATION 3 - 4/17/89**			
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
ANNELIDA					2%	2.3	
Lumbriculidae	2	3	2	7	2%	2.3	0.6
TOTAL ORGANISMS	133	59	118	310		103.3	39.1
TAXA RICHNESS	25	21	24	36		23.3	2.1
SHAN. DIVERSITY	3.91	3.92	3.89	4.28		3.91	0.01
BIOTICINDEX	2.38	2.47	2.40	2.41		2.42	0.05
EPT RICHNESS	14	9	13	22		12.0	2.6
EPT / CHIR.	2.08	4.86	2.47	2.48		3.1	1.5
BIOTIC COND. INDEX				86.3			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	2	0.25	1				
depth (m)	0.35	0.25	0.3				
velocity (ft/s)	2.5	1	2				
CTQp =				50			
stream width (m)				12			
gradient (%)				2.5			
water temperature (C)				1			
substrate particle size (%)	boulders (>12)			35			
	rubble (3 - 12)			35			
	gravel (.125 - 3)			15			
	fines (< 0.125)			5			
deep snow, shaded, very hard to find small substrate in shallow water, tough sampling							

MACROINVERTEBRATE DATA							
LITTLE CHERRY CREEK							**STATION 1 - 4/**
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
COLEOPTERA					0%	1.0	
Heterlimnius corpulentus	0	1	2	3	0%	1.0	1.0
DIPTERA					63%	174.0	
Thienemannimyia group	2	5	11	18	2%	6.0	4.6
Paramerina sp.	1	4	10	15	2%	5.0	4.6
Pagastia sp	0	8	1	9	1%	3.0	4.4
Brillia sp.	0	1	0	1	0%	0.3	0.6
Thienemanniella sp.	0	0	3	3	0%	1.0	1.7
Chaetocladius sp.	2	5	2	9	1%	3.0	1.7
Corynoneura sp	1	1	4	6	1%	2.0	1.7
Cricotopus spp.	2	6	0	8	1%	2.7	3.1
Eukiefferiella spp.	1	4	8	13	2%	4.3	3.5
Paraphaenocladius sp.	13	42	34	89	11%	29.7	15.0
Heterotrissocladius sp	0	1	0	1	0%	0.3	0.6
Rheocricotopus sp.	4	6	16	26	3%	8.7	6.4
Psuedorthocladius sp.	0	0	1	1	0%	0.3	0.6
Tvetenia sp.	3	22	12	37	4%	12.3	9.5
Polypedilum spp.	0	0	2	2	0%	0.7	1.2
Micropsectra spp.	11	215	45	271	33%	90.3	109.3
Dicranota sp.	0	1	0	1	0%	0.3	0.6
Sphyriidae	0	1	0	1	0%	0.3	0.6
Rhabdomastix sp.	0	1	0	1	0%	0.3	0.6
Oreogeton sp.	0	2	1	3	0%	1.0	1.0
Prosimulium sp.	0	2	1	3	0%	1.0	1.0
Certatopogonidae	1	2	1	4	0%	1.3	0.6
EPHEMEROPTERA					15%	40.3	
Baetis bicaudatus	2	7	3	12	1%	4.0	2.6
Baetis tricaudatus	7	22	10	39	5%	13.0	7.9
Ephemerella infrequens	1	6	5	12	1%	4.0	2.6
Drunella coloradensis	1	1	0	2	0%	0.7	0.6
Drunella spinifera	0	0	3	3	0%	1.0	1.7
Cinygmula spp.	4	16	13	33	4%	11.0	6.2
Epeorus sp.	3	6	7	16	2%	5.3	2.1
Paraleptophlebia spp.	0	3	1	4	0%	1.3	1.5
PLECOPTERA					13%	36.7	
Doroneuria theodora	0	2	1	3	0%	1.0	1.0
Chloroperlinae	11	25	19	55	7%	18.3	7.0
Kathroperla perdita	1	0	0	1	0%	0.3	0.6
Capnia gp.	3	2	9	14	2%	4.7	3.8
Visoka sp.	1	0	2	3	0%	1.0	1.0
Zapada spp.	2	13	8	23	3%	7.7	5.5
Perlomyia sp.	3	2	6	11	1%	3.7	2.1

MACROINVERTEBRATE DATA							
LITTLE CHERRY CREEK						**STATION 1 - 4/**	
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
TRICHOPTERA					5%	12.7	
Parapsyche elsis	0	3	1	4	0%	1.3	1.5
Rhyacophila Betteni gp.	0	14	2	16	2%	5.3	7.6
Rhyacophila Brunnea gp.	0	0	2	2	0%	0.7	1.2
Rhyacophila verrula	0	2	1	3	0%	1.0	1.0
Rhyacophila velpulsa	1	1	1	3	0%	1.0	0.0
Lepidostoma spp.	1	2	2	5	1%	1.7	0.6
Ochrotrichia sp.	0	0	1	1	0%	0.3	0.6
Ecclisomyia sp.	2	0	1	3	0%	1.0	1.0
Glossosoma sp.	1	0	0	1	0%	0.3	0.6
ANNELIDA					3%	9.3	
Lumbriculidae	0	4	6	10	1%	3.3	3.1
Tubificidae	18	0	0	18	2%	6.0	10.4
OTHER							
Turbellaria	0	1	0	1	0%	0.3	0.6
TOTAL ORGANISMS	103	462	258	823		274.3	180.1
TAXA RICHNESS	28	39	39	50		35.3	6.4
SHAN. DIVERSITY	4.10	3.34	4.39	4.03		3.94	0.54
BIOTIC INDEX	4.60	4.85	4.05	4.57		4.50	0.41
EPT RICHNESS	16	17	21	28		18.0	2.6
EPT / CHIR.	1.10	0.40	0.66	0.53		0.7	0.4
BIOTIC COND. INDEX				76.7			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	2	1	1.5				
depth (m)	0.2	0.15	0.25				
velocity (ft/s)	0.5	0.25	0.5				
CTQp =				50			
stream width (m)				4			
gradient (%)				3			
water temperature (C)				2			
substrate particle size (%)	boulders (>12)			10			
	rubble (3 - 12)			30			
	gravel (.125 - 3)			40			
	fines (< 0.125)			20			

MACROINVERTEBRATE DATA							
LITTLE CHERRY CREEK			STATION 2 - 4/19/89				
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
DIPTERA					62%	130.7	
unassociated midge pupa	1	0	0	1	0%	0.3	0.6
Krenopelopia sp.	2	2	1	5	1%	1.7	0.6
Brillia sp.	4	0	1	5	1%	1.7	2.1
Chaetocladius sp.	3	0	1	4	1%	1.3	1.5
Corynoneura sp	1	0	2	3	0%	1.0	1.0
Eukiefferiella spp.	6	2	10	18	3%	6.0	4.0
Paraphaenocladius sp.	23	15	12	50	8%	16.7	5.7
Rheocricotopus sp.	5	6	3	14	2%	4.7	1.5
Tvetenia sp.	6	2	2	10	2%	3.3	2.3
Micropsectra spp.	26	17	23	66	11%	22.0	4.6
Stempellina sp.	39	13	12	64	10%	21.3	15.3
Limnophora sp.	1	0	0	1	0%	0.3	0.6
Prosimulium sp.	35	19	90	144	23%	48.0	37.2
Certatopogonidae	2	5	0	4	1%	2.3	2.5
EPHEMEROPTERA					9%	18.3	
Baetis bicaudatus	6	5	5	16	3%	5.3	0.6
Cinygmula spp.	8	5	12	25	4%	8.3	3.5
Epeorus sp.	0	0	1	1	0%	0.3	0.6
Rhithrogena spp.	0	0	3	3	0%	1.0	1.7
Paraleptophlebia spp.	8	1	1	10	2%	3.3	4.0
PLECOPTERA					21%	44.7	
Setvenia bradleyi	1	0	0	1	0%	0.3	0.6
Perlodidae	0	0	1	1	0%	0.3	0.6
Isoperla sp.	0	0	1	1	0%	0.3	0.6
Chloroperlinae	27	8	20	55	9%	18.3	9.6
Capnia gp.	0	2	2	4	1%	1.3	1.2
Visoka sp.	19	5	6	30	5%	10.0	7.8
Zapada sp. 1	13	0	2	15	2%	5.0	7.0
Perlomyia sp.	0	0	3	3	0%	1.0	1.7
Yoraperla brevis	19	1	4	24	4%	8.0	9.6
TRICHOPTERA					5%	10.7	
Parapsyche elsis	3	0	1	4	1%	1.3	1.5
Rhyacophila Betteni gp.	1	0	0	1	0%	0.3	0.6
Rhyacophila verrula	2	0	1	3	0%	1.0	1.0
Lepidostoma spp.	0	4	3	7	1%	2.3	2.1
Anagapetus sp.	7	1	8	16	3%	5.3	3.8
Micrasema sp.	0	1	0	1	0%	0.3	0.6
Lumbriculidae	0	13	0	13	2%	4.3	7.5
OTHER							
Turbellaria	0	1	1	2	0%	0.7	0.6

MACROINVERTEBRATE DATA							
LITTLE CHERRY CREEK			STATION 2 - 4/19/89				
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
TOTAL ORGANISMS	268	128	232	625		209.3	72.7
TAXA RICHNESS	26	21	29	36		25.3	4.0
SHAN. DIVERSITY	3.96	3.82	3.45	3.98		3.74	0.27
BIOTIC INDEX	2.91	3.84	3.80	3.41		3.51	0.53
EPT RICHNESS	12	9	17	24		12.7	4.0
EPT / CHIR.	0.98	0.56	1.10	0.92		0.9	0.3
BIOTIC COND. INDEX				82.6			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	1	1.5	1.5				
depth (m)	0.15	0.1	0.2				
velocity (ft/s)	0.5	0.5	0.5				
CTQp =				50			
stream width (m)				2			
gradient (%)				6			
water temperature (C)				1			
substrate particle size (%)	boulders (>12)			25			
	rubble (3 - 12)			35			
	gravel (.125 - 3)			20			
	fines (< 0.125)			20			
snow app. 4ft deep, channel open in most places, much moss.							

MACROINVERTEBRATE DATA							
POORMAN CREEK						**STATION 1 - 4/18/89**	
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					0%	0.3	
Heterlimnius corpulentus	0	1	0	1	0%	0.3	0.6
DIPTERA					28%	56.3	
Zavrelimyia sp.	0	3	1	4	1%	1.3	1.5
Pagastia sp	0	0	2	2	0%	0.7	1.2
Boreochlus sp.	1	0	0	1	0%	0.3	0.6
Brillia sp.	1	10	7	18	3%	6.0	4.6
Chaetocladius sp.	1	0	0	1	0%	0.3	0.6
Corynoneura sp	0	0	1	1	0%	0.3	0.6
Eukiefferiella spp.	0	1	2	3	1%	1.0	1.0
Hydrobaenus sp.	0	7	0	7	1%	2.3	4.0
Paraphaenocladius sp.	6	13	26	45	8%	15.0	10.1
Rheocricotopus sp.	3	2	3	8	1%	2.7	0.6
Psuedoorthocladius sp.	1	0	5	6	1%	2.0	2.6
Tvetenia sp.	1	1	8	10	2%	3.3	4.0
Micropsectra spp.	4	3	25	32	5%	10.7	12.4
Stempellina sp.	1	7	2	10	2%	3.3	3.2
Agathon sp(p).?	0	0	2	2	0%	0.7	1.2
Dicranota sp.	0	1	0	1	0%	0.3	0.6
Empididae pupa	1	0	0	1	0%	0.3	0.6
Chelifera sp.	0	1	0	1	0%	0.3	0.6
Oreogeton sp.	1	0	0	1	0%	0.3	0.6
Prosimulium sp.	1	4	2	7	1%	2.3	1.5
Certatopogonidae	0	4	4	4	1%	2.7	2.3
EPHEMEROPTERA					38%	73.3	
Ameletus spp.	0	0	1	1	0%	0.3	0.6
Baetis bicaudatus	3	4	7	14	2%	4.7	2.1
Ephemerella infrequens	0	0	2	2	0%	0.7	1.2
Drunella coloradensis	0	5	7	12	2%	4.0	3.6
Drunella doddsi	0	0	1	1	0%	0.3	0.6
Cinygmula spp.	6	40	39	85	15%	28.3	19.3
Epeorus sp.	9	54	25	88	15%	29.3	22.8
Rhithrogena spp.	2	4	11	17	3%	5.7	4.7
PLECOPTERA					27%	53.3	
Perlodidae	0	1	0	1	0%	0.3	0.6
Doroneuria theodora	1	3	2	6	1%	2.0	1.0
Chloroperlinae	15	25	35	75	13%	25.0	10.0
Capnia gp.	2	5	14	21	4%	7.0	6.2
Visoka sp.	1	0	1	2	0%	0.7	0.6
Zapada sp. 1	3	1	18	22	4%	7.3	9.3
Nemouridae	1	5	1	7	1%	2.3	2.3
Doddsia sp.	0	0	2	2	0%	0.7	1.2
Perlomyia sp.	1	13	10	24	4%	8.0	6.2

MACROINVERTEBRATE DATA							
POORMAN CREEK						**STATION 1 - 4/18/89**	
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
TRICHOPTERA					6%	12.3	
Parapsyche elsis	1	0	3	4	1%	1.3	1.5
Rhyacophila sp.	0	0	3	3	1%	1.0	1.7
Rhyacophila Betteni gp.	2	4	2	8	1%	2.7	1.2
Rhyacophila Brunnea gp.	0	0	2	2	0%	0.7	1.2
Lepidostoma spp.	0	1	3	4	1%	1.3	1.5
Chryandra sp.	0	1	0	1	0%	0.3	0.6
Neophylax sp.	5	0	0	5	1%	1.7	2.9
Oligophlebodes sp.	0	0	3	3	1%	1.0	1.7
Anagapetus sp.	0	0	1	1	0%	0.3	0.6
Glossosoma sp.	1	4	1	6	1%	2.0	1.7
ANNELIDA					0%	0.7	
Lumbricidae	1	0	0	1	0%	0.3	0.6
Lumbriculidae	1	0	0	1	0%	0.3	0.6
TOTAL ORGANISMS	77	228	284	585		196.3	107.1
TAXA RICHNESS	29	30	38	51		32.3	4.9
SHAN. DIVERSITY	4.21	3.85	4.33	4.37		4.13	0.25
BIOTIC INDEX	2.14	2.12	2.17	2.12		2.14	0.03
EPT RICHNESS	15	16	24	31		18.3	4.9
EPT / CHIR.	2.79	3.62	2.37	2.82		2.9	0.6
BIOTIC COND. INDEX				84.9			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	0.5	0.75	1.5				
depth (m)	0.3	0.3	0.3				
velocity (ft/s)	2	2	2				
CTQp =				50			
stream width (m)				3	braided		
gradient (%)				3			
water temperature (C)				1			
substrate particle size (%)	boulders (>12)			15			
	rubble (3 - 12)			40			
	gravel (.125 - 3)			30			
	fines (< 0.125)			10			
high flow, all channels full, sampled usual channel along L bank							

MACROINVERTEBRATE DATA							
POORMAN CREEK						**STATION 2 - 4/18/89**	
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					0%	0.3	
Staphylinidae	0	1	0	1	0%	0.3	0.6
DIPTERA					58%	167.3	
Zavrelimyia sp.	0	1	9	10	1%	3.3	4.9
Pagastia sp	0	0	1	1	0%	0.3	0.6
Boreochlus sp.	0	10	1	11	1%	3.7	5.5
Brillia sp.	8	7	11	26	3%	8.7	2.1
Chaetocladius sp.?	12	20	5	37	4%	12.3	7.5
Corynoneura sp	1	2	1	4	0%	1.3	0.6
Eukiefferiella spp.	2	2	3	7	1%	2.3	0.6
Paraphaenocladius spp.	45	37	43	125	14%	41.7	4.2
Rheocricotopus sp.	39	31	29	99	11%	33.0	5.3
Orthocladius spp.	1	0	0	1	0%	0.3	0.6
Tvetenia sp.	19	10	26	55	6%	18.3	8.0
Micropsectra spp.	17	3	14	34	4%	11.3	7.4
Stempellina sp.	28	4	11	43	5%	14.3	12.3
Dicranota sp.	2	1	2	5	1%	1.7	0.6
Oreogeton sp.	1	0	2	3	0%	1.0	1.0
Prosimulium sp.	21	1	16	38	4%	12.7	10.4
Certatopogonidae	0	0	3	4	0%	1.0	1.7
EPHEMEROPTERA					22%	64.7	
Ameletus spp.	3	10	0	13	2%	4.3	5.1
Baetis bicaudatus	4	8	11	23	3%	7.7	3.5
Ephemerella infrequens	0	1	1	2	0%	0.7	0.6
Drunella coloradensis	1	4	3	8	1%	2.7	1.5
Drunella spinifera	1	0	0	1	0%	0.3	0.6
Cinygmula spp.	16	20	30	66	8%	22.0	7.2
Epeorus sp.	15	45	18	78	9%	26.0	16.5
Rhithrogena spp.	1	0	2	3	0%	1.0	1.0
PLECOPTERA					16%	46.3	
Chloroperlinae	20	17	18	55	6%	18.3	1.5
Capnia gp.	2	2	8	12	1%	4.0	3.5
Visoka sp.	4	6	10	20	2%	6.7	3.1
Zapada sp. 1	1	14	2	17	2%	5.7	7.2
Nemouridae	5	0	9	14	2%	4.7	4.5
Perlomyia sp.	4	5	11	20	2%	6.7	3.8
Yoraperla brevis	0	0	1	1	0%	0.3	0.6

MACROINVERTEBRATE DATA							
POORMAN CREEK						**STATION 2 - 4/18/89**	
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
TRICHOPTERA					3%	8.3	
Rhyacophila velpulsa	1	0	0	1	0%	0.3	0.6
Rhyacophila Betteni gp.	0	0	2	2	0%	0.7	1.2
Rhyacophila Verrula	2	0	1	3	0%	1.0	1.0
Lepidostoma spp.	1	1	3	5	1%	1.7	1.2
Limnephilidae	0	2	0	2	0%	0.7	1.2
Chryandra sp.	1	2	0	3	0%	1.0	1.0
Ecclisomyia sp.	0	0	1	1	0%	0.3	0.6
Oligophlebodes sp.	4	1	1	6	1%	2.0	1.7
Anagapetus sp.	0	2	0	2	0%	0.7	1.2
COLLEMBOLA	0	1	0	1	0%	0.3	0.6
TOTAL ORGANISMS	282	271	309	863		287.3	19.6
TAXA RICHNESS	31	31	34	43		32.0	1.7
SHAN. DIVERSITY	4.02	4.05	4.33	4.35		4.13	0.17
BIOTICINDEX	3.62	2.82	3.46	3.31		3.30	0.42
EPT RICHNESS	18	16	18	28		17.3	1.2
EPT / CHIR.	0.50	1.10	0.86	0.79		0.8	0.3
BIOTIC COND. INDEX				81.4			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	1	2	1.5				
depth (m)	0.3	0.28	0.3				
velocity (ft/s)	2	2.5	2				
CTQp =				50			
stream width (m)				14			
gradient (%)				8			
water temperature (C)				2			
substrate particle size (%)	boulders (>12)			25			
	rubble (3 - 12)			45			
	gravel (.125 - 3)			30			
	fines (< 0.125)			10			
high flow, discharge app. 40 cfs, usual site whitewater cascade, moved downstream app. 100m.							

MACROINVERTEBRATE DATA							
RAMSEY CREEK					**STATION 2 4/19/89**		
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
COLEOPTERA					0%	0.3	
Hydrophilidae	0	1	0	1	0%	0.3	0.6
DIPTERA					47%	178.0	
unassociated midge pupa	2	0	0	2	0%	0.7	1.2
Brillia sp.	5	2	6	13	1%	4.3	2.1
Cheatocladius sp.	10	2	15	27	2%	9.0	6.6
Corynoneura sp	13	0	5	18	2%	6.0	6.6
Cricotopus spp.	0	1	0	1	0%	0.3	0.6
Eukiefferiella spp.	7	2	9	18	2%	6.0	3.6
Paraphaenocladius sp.	17	11	11	39	3%	13.0	3.5
Heterotrissocladius sp	0	0	1	1	0%	0.3	0.6
Rheocricotopus sp.	68	11	82	161	14%	53.7	37.6
Tvetenia sp.	23	10	41	74	7%	24.7	15.6
Stempellina sp.	106	1	7	114	10%	38.0	59.0
Polypedilum spp.	1	0	0	1	0%	0.3	0.6
Micropsectra spp.	23	3	14	40	4%	13.3	10.0
Tipulidae	0	1	0	1	0%	0.3	0.6
Dicranota sp.	1	2	0	3	0%	1.0	1.0
Prosimulium	0	0	13	13	1%	4.3	7.5
Certatopogonidae	1	7	0	8	1%	2.7	3.8
EPHEMEROPTERA					33%	124.7	
Ameletus spp.	13	0	5	18	2%	6.0	6.6
Baetis bicaudatus	11	15	54	80	7%	26.7	23.8
Drunella coloradensis	6	1	8	15	1%	5.0	3.6
Drunella doddsi	1	2	2	5	0%	1.7	0.6
Drunella spinifera	2	0	0	2	0%	0.7	1.2
Cinygmula spp.	52	38	42	132	12%	44.0	7.2
Epeorus deceptivus	46	5	59	110	10%	36.7	28.2
Rhithrogena spp.	5	6	1	12	1%	4.0	2.6
PLECOPTERA					15%	57.0	
Megarcys sp.	0	1	0	1	0%	0.3	0.6
Perlodidae	0	1	0	1	0%	0.3	0.6
Doroneuria theodora	1	4	1	6	1%	2.0	1.7
Chloroperlinae	31	9	6	46	4%	15.3	13.7
Capnia gp.	14	1	0	15	1%	5.0	7.8
Visoka sp.	7	1	1	9	1%	3.0	3.5
Zapada sp. 1	39	9	22	70	6%	23.3	15.0
Zapada cinctipes	1	3	1	5	0%	1.7	1.2
Doddsia sp.	0	0	2	2	0%	0.7	1.2
Perlomyia sp.	3	11	2	16	1%	5.3	4.9

MACROINVERTEBRATE DATA							
RAMSEY CREEK					**STATION 2**	**4/19/89**	
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
TRICHOPTERA					4%	15.7	
Parapsyche elsis	1	3	1	5	0%	1.7	1.2
Rhyacophila Betteni gp.	3	0	1	4	0%	1.3	1.5
Rhyacophila Brunnea gp.	2	0	0	2	0%	0.7	1.2
Rhyacophila Sibrica gp	0	1	0	1	0%	0.3	0.6
Lepidostoma spp.	0	0	3	3	0%	1.0	1.7
Limnephilidae	3	0	0	3	0%	1.0	1.7
Chyranda sp.	1	1	0	2	0%	0.7	0.6
Anagapetus sp.	0	1	0	1	0%	0.3	0.6
Glossosoma sp.	10	1	15	26	2%	8.7	7.1
ANNELIDA					0%	0.3	
Lumbriculidae	0	0	1	1	0%	0.3	0.6
TOTAL ORGANISMS	529	168	431	1128		376.0	186.7
TAXA RICHNESS	34	33	30	46		32.3	2.1
SHAN. DIVERSITY	4.01	4.17	3.84	4.26		4.00	0.16
BIOTICINDEX	2.72	2.57	3.31	2.92		2.86	0.39
EPT RICHNESS	21	20	18	30		19.7	1.5
EPT / CHIR.	0.92	2.65	1.18	1.16		1.6	0.9
BIOTIC COND. INDEX				93.3			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	1	3	5				
depth (m)	0.15	0.3	0.3				
velocity (ft/s)	0.5	0.75	0.75				
CTQp =				50			
stream width (m)				8			
gradient (%)				3.4			
water temperature (C)				1			
substrate particle size (%)	boulders (>12)			10			
	rubble (3 - 12)			60			
	gravel (.125 - 3)			20			
	fines (< 0.125)			10			
nice stream flow for sampling, approx. 25 cfs							

MACROINVERTEBRATE DATA							
RAMSEY CREEK					**STATION 3 4/20/89**		
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
DIPTERA					46%	342.7	
unassociated midge pupa	3	0	1	4	0%	1.3	1.5
Macropelopia sp.	3	0	0	3	0%	1.0	1.7
Zavrelimyia sp.	18	8	0	26	1%	8.7	9.0
Pagastia sp	3	0	0	3	0%	1.0	1.7
Brillia sp.	44	7	1	52	2%	17.3	23.3
Corynoneura sp	9	14	5	28	1%	9.3	4.5
Cricotopus spp.	6	2	0	8	0%	2.7	3.1
Eukiefferiella spp.	15	10	3	28	1%	9.3	6.0
Paraphaenocladius sp.	225	64	26	315	14%	105.0	105.6
Chaetocladius sp.	2	0	0	2	0%	0.7	1.2
Rheocricotopus sp.	42	17	13	72	3%	24.0	15.7
Heterotrissocladuis sp.	0	1	0	1	0%	0.3	0.6
Synorthocladius sp.	2	0	0	2	0%	0.7	1.2
Tvetenia sp.	8	5	0	13	1%	4.3	4.0
Stempellina sp.	112	30	36	178	8%	59.3	45.7
Polypedilum spp.	1	0	0	1	0%	0.3	0.6
Micropsectra spp.	149	59	48	256	11%	85.3	55.4
Agathon sp.	1	0	0	1	0%	0.3	0.6
Dicranota sp.	8	8	1	17	1%	5.7	4.0
Hemerodromia sp.	1	0	0	1	0%	0.3	0.6
Oreogeton sp.	6	3	0	9	0%	3.0	3.0
Prosimulium	2	1	0	3	0%	1.0	1.0
Certatopogonidae	3	2	0	5	0%	1.7	1.5
EPHEMEROPTERA					10%	77.3	
Ameletus spp.	1	0	2	3	0%	1.0	1.0
Baetis bicaudatus	18	23	26	67	3%	22.3	4.0
Ephemerella infrequens	0	1	0	1	0%	0.3	0.6
Drunella coloradensis	2	2	0	4	0%	1.3	1.2
Drunella spinifera	2	2	0	4	0%	1.3	1.2
Cinygmula spp.	25	40	24	89	4%	29.7	9.0
Epeorus deceptivus	14	19	14	47	2%	15.7	2.9
Paraleptophlebia spp.	4	6	7	17	1%	5.7	1.5
PLECOPTERA					39%	292.3	
Isoperla sobria	1	0	1	2	0%	0.7	0.6
Doroneuria theodora	2	4	1	7	0%	2.3	1.5
Chloroperlinae	37	48	27	112	5%	37.3	10.5
Kathroperla perdita	6	0	0	6	0%	2.0	3.5
Capnia gp.	18	2	0	20	1%	6.7	9.9
Visoka sp.	130	58	3	191	9%	63.7	63.7
Zapada sp. 1	232	201	31	464	21%	154.7	108.2
Doddsia sp.	1	0	0	1	0%	0.3	0.6
Leuctridae	15	4	11	30	1%	10.0	5.6
Yoraperla brevis	23	17	4	44	2%	14.7	9.7

.	MACROINVERTEBRATE DATA						
RAMSEY CREEK				**STATION 3 4/20/89**			
.							
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
TRICHOPTERA					4%	27.7	
Parapsyche elsis	6	5	0	11	0%	3.7	3.2
Rhyacophila Betteni gp.	11	13	2	26	1%	8.7	5.9
Rhyacophila verrula	4	5	1	10	0%	3.3	2.1
Rhyacophila velpulsa	5	1	0	6	0%	2.0	2.6
Rhyacophila Sibrica gp	1	0	0	1	0%	0.3	0.6
Lepidostoma spp.	5	2	1	8	0%	2.7	2.1
Ochrotrichia sp.	3	2	0	5	0%	1.7	1.5
Dicosmoecus sp.	0	0	1	1	0%	0.3	0.6
Neothremma sp.	1	1	0	2	0%	0.7	0.6
Anagapetus sp.	2	11	0	13	1%	4.3	5.9
ANNELIDA					0%	3.3	
Lumbriculidae	1	0	8	9	0%	3.0	4.4
Tubificidae	1	0	0	1	0%	0.3	0.6
OTHER							
Turbellaria	0	1	0	1	0%	0.3	0.6
Osrtacoda	1	0	0	1	0%	0.3	0.6
TOTAL ORGANISMS	1234	699	298	2231		743.7	469.6
TAXA RICHNESS	50	38	26	54		38.0	12.0
SHAN. DIVERSITY	3.90	3.89	3.83	4.03		3.87	0.04
BIOTIC INDEX	2.95	2.18	2.92	2.70		2.68	0.44
EPT RICHNESS	26	22	16	32		21.3	5.0
EPT / CHIR.	0.89	2.15	1.17	1.20		1.4	0.7
BIOTIC COND. INDEX				80.4			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	0.5	1	2				
depth (m)	0.2	0.3	0.3				
velocity (ft/s)	0.25	0.33	0.75				
CTQp =				50			
stream width (m)				12			
gradient (%)				5			
water temperature (C)				1			
substrate particle size (%)	boulders (>12)			35			
	rubble (3 - 12)			40			
	gravel (.125 - 3)			15			
	fines (< 0.125)			15			
samples 1 and 2 in plume from spring seep							

MACROINVERTEBRATE DATA							
RAMSEY CREEK					**STATION 4 - 4/20/89**		
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEMBOLA	2	0	0	2	0%	0.7	1.2
DIPTERA					28%	91.3	
unassociated midge pupa	0	1	0	1	0%	0.3	0.6
Macropelopia sp.	0	0	1	1	0%	0.3	0.6
Zavrelimyia sp.	0	3	3	6	1%	2.0	1.7
Brillia sp.	0	1	1	2	0%	0.7	0.6
Chaetocladius sp.	0	0	1	1	0%	0.3	0.6
Corynoneura sp	2	22	5	29	3%	9.7	10.8
Cricotopus spp.	0	16	5	21	2%	7.0	8.2
Eukiefferiella spp.	2	6	17	25	3%	8.3	7.8
Paraphaenocladius sp.	2	5	28	35	4%	11.7	14.2
Heterotrissocladius sp	2	16	21	39	4%	13.0	9.8
Rheocricotopus sp.	3	3	9	15	2%	5.0	3.5
Tvetenia sp.	0	3	16	19	2%	6.3	8.5
Stempellina sp.	0	0	1	1	0%	0.3	0.6
Polypedilum spp.	0	1	0	1	0%	0.3	0.6
Micropsectra spp.	3	10	45	58	6%	19.3	22.5
Dicranota sp.	2	5	4	11	1%	3.7	1.5
Certatopogonidae	1	6	2	9	1%	3.0	2.6
EPHEMEROPTERA					38%	121.7	
Ameletus spp.	0	2	0	2	0%	0.7	1.2
Baetis bicaudatus	4	4	3	11	1%	3.7	0.6
Drunella coloradensis	25	66	26	117	12%	39.0	23.4
Cinygmula spp.	101	37	91	229	24%	76.3	34.4
Epeorus deceptivus	0	2	0	2	0%	0.7	1.2
Rhithrogena spp.	0	0	3	3	0%	1.0	1.7
Paraleptophlebia spp.	0	1	0	1	0%	0.3	0.6
PLECOPTERA					25%	81.0	
Megarcys sp.	0	0	1	1	0%	0.3	0.6
Doroneuria theodora	1	0	0	1	0%	0.3	0.6
Chloroperlinae	21	37	9	67	7%	22.3	14.0
Kathroperla perdita	2	0	0	2	0%	0.7	1.2
Capnia gp.	3	2	0	5	1%	1.7	1.5
Visoka sp.	7	5	2	14	1%	4.7	2.5
Zapada sp. 1	27	21	63	111	11%	37.0	22.7
Podmosta sp.	2	0	0	2	0%	0.7	1.2
Despaxia sp.	0	0	1	1	0%	0.3	0.6
Yoraperla brevis	19	16	4	39	4%	13.0	7.9

MACROINVERTEBRATE DATA							
RAMSEY CREEK						**STATION 4 - 4/20/89**	
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
TRICHOPTERA					1%	4.3	
Parapsyche elsis	0	0	1	1	0%	0.3	0.6
Rhyacophila sp.	0	1	0	1	0%	0.3	0.6
Rhyacophila Betteni gp.	0	1	4	5	1%	1.7	2.1
Ecclisomyia sp.	0	1	1	2	0%	0.7	0.6
Neothremma sp.	1	0	1	2	0%	0.7	0.6
Cryptochia sp.	1	0	0	1	0%	0.3	0.6
Anagapetus sp.	1	0	0	1	0%	0.3	0.6
ANNELIDA					3%	10.3	
Enchytraeidae	0	1	2	3	0%	1.0	1.0
Lumbriculidae	0	0	21	21	2%	7.0	12.1
Tubificidae	2	4	1	7	1%	2.3	1.5
OTHER							
Turbellaria	1	42	0	43	4%	14.3	24.0
TOTAL ORGANISMS	237	341	393	971		323.7	79.4
TAXA RICHNESS	25	31	32	46		29.3	3.8
SHAN. DIVERSITY	3.04	3.93	3.75	4.00		3.57	0.47
BIOTIC INDEX	1.50	2.48	2.89	2.41		2.29	0.71
EPT RICHNESS	14	14	14	28		14.0	0.0
EPT / CHIR.	15.36	2.25	1.37	2.44		6.3	7.8
BIOTIC COND. INDEX				100.4			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	3.5	4	2				
depth (m)	0.3	0.25	0.35				
velocity (ft/s)	0.5	0.5	0.5				
CTQp =				60			
stream width (m)				8			
gradient (%)				1			
water temperature (C)				1			
substrate particle size (%)	boulders (>12)			5			
	rubble (3 - 12)			20			
	gravel (.125 - 3)			60			
	fines (< 0.125)			15			
lots of snow, canopy open, riffle open							

.	MACROINVERTEBRATE DATA						
LIBBY CREEK				**STATION 1 - 4/18/89**			
.							
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					1%	2.0	
Heterlimnius corpulentus	1	0	0	1	0%	0.3	0.6
Narpus concolor	1	0	0	1	0%	0.3	0.6
Hydrophilidae	4	0	0	4	1%	1.3	2.3
DIPTERA					17%	36.0	
Thienemannimyia group	4	0	1	5	1%	1.7	2.1
Zavrelimyia sp.	4	1	0	5	1%	1.7	2.1
Brillia sp.	0	2	1	3	0%	1.0	1.0
Corynoneura sp	0	2	0	2	0%	0.7	1.2
Eukiefferiella spp.	0	1	0	1	0%	0.3	0.6
Paraphaenocladius sp.	1	4	1	6	1%	2.0	1.7
Rheocricotopus sp.	12	1	2	15	2%	5.0	6.1
Psuedoorthocladius spp.	4	2	6	12	2%	4.0	2.0
Tvetenia sp.	6	3	0	9	1%	3.0	3.0
Stempellina sp.	1	0	0	1	0%	0.3	0.6
Polypedilum spp.	0	1	1	2	0%	0.7	0.6
Micropsectra spp.	8	4	3	15	2%	5.0	2.6
Antocha sp.	1	0	0	1	0%	0.3	0.6
Dicranota sp.	3	1	0	4	1%	1.3	1.5
Hexatoma sp.	1	0	0	1	0%	0.3	0.6
Rhabdomastix sp.	2	0	1	3	0%	1.0	1.0
Chelifera sp.	2	0	0	2	0%	0.7	1.2
Prosimulium sp.	8	4	5	17	3%	5.7	2.1
Certatopogonidae	2	0	2	4	1%	1.3	1.2
EPHEMEROPTERA					61%	131.7	
Ameletus spp.	1	0	0	1	0%	0.3	0.6
Baetis bicaudatus	5	2	1	8	1%	2.7	2.1
Baetis tricaudatus	14	4	6	24	4%	8.0	5.3
Ephemerella infrequens	21	4	1	26	4%	8.7	10.8
Drunella coloradensis	2	1	5	8	1%	2.7	2.1
Drunella doddsi	5	2	1	8	1%	2.7	2.1
Cinygmula spp.	105	23	60	188	29%	62.7	41.1
Epeorus deceptivus	47	20	39	106	16%	35.3	13.9
Rhithrogena spp.	10	7	9	26	4%	8.7	1.5
PLECOPTERA					11%	24	
Kogotus sp.	1	0	0	1	0%	0.3	0.6
Skwala sp.	1	0	0	1	0%	0.3	0.6
Chloroperlinae	21	4	5	30	5%	10.0	9.5
Kathroperla perdita	1	0	0	1	0%	0.3	0.6
Capnia gp.	7	6	1	14	2%	4.7	3.2
Nemouridae	7	1	0	8	1%	2.7	3.8
Zapada sp. 1	0	0	2	2	0%	0.7	1.2
Doddsia sp.	1	0	0	1	0%	0.3	0.6
Taenionema sp.	0	0	2	2	0%	0.7	1.2
Perlomyia sp.	7	4	0	11	2%	3.7	3.5

MACROINVERTEBRATE DATA							
LIBBY CREEK					**STATION 1 - 4/18/89**		
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
TRICHOPTERA					9%	20.0	
Arctopsyche grandis	4	1	0	5	1%	1.7	2.1
Hydropsyche (Ceratopsyche	5	3	1	9	1%	3.0	2.0
Rhyacophila Betteni gp.	0	1	0	1	0%	0.3	0.6
Lepidostoma spp.	7	1	0	8	1%	2.7	3.8
Ochrotrichia sp.	1	0	0	1	0%	0.3	0.6
Limnephilidae	0	3	5	8	1%	2.7	2.5
Oligophlebodes sp.	13	8	6	27	4%	9.0	3.6
Glossosoma sp.	0	1	0	1	0%	0.3	0.6
ANNELIDA					1%	1.7	
Lumbricidae	2	0	0	2	0%	0.7	1.2
Lumbriculidae	2	0	1	3	0%	1.0	1.0
TOTAL ORGANISMS	355	122	168	645		215.0	123.4
TAXA RICHNESS	42	31	26	51		33.0	8.2
SHAN. DIVERSITY	4.07	4.23	3.26	4.08		3.85	0.52
BIOTIC INDEX	2.32	2.25	1.92	2.20		2.16	0.22
EPT RICHNESS	22	19	15	29		18.7	3.5
EPT / CHIR.	7.15	4.57	9.60	6.92		7.1	2.5
BIOTIC COND. INDEX				83.3			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	2	4	1				
depth (m)	0.3	0.28	0.3				
velocity (ft/s) est.	1	1.25	0.75				
CTQp =				50			
stream width (m)				25			
gradient (%)				1.3			
water temperature (C)				1			
substrate particle size (%)	boulders (>12)			10			
	rubble (3 - 12)			30			
	gravel (.125 - 3)			40			
	fines (< 0.125)			20			
stage= 0.97 ft, channel full , water slightly colored, sampling confined to L bank.							

MACROINVERTEBRATE DATA							
LIBBY CREEK				**STATION 3 - 4/21/89**			
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Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
COLEOPTERA					0%	0.7	
Heterlimnius corpulentus	1	1	0	2	0%	0.7	0.6
DIPTERA					14%	26.0	
Thienemannimyia group	1	0	1	2	0%	0.7	0.6
Brillia sp.	1	1	0	2	0%	0.7	0.6
Corynoneura sp	0	1	0	1	0%	0.3	0.6
Eukiefferiella spp.	0	0	1	1	0%	0.3	0.6
Paraphaenocladius sp.	0	0	3	3	1%	1.0	1.7
Rheocricotopus sp.	4	18	3	25	4%	8.3	8.4
Hydrobaenus sp.	1	0	0	1	0%	0.3	0.6
Psuedoorthocladius sp.	2	0	1	3	1%	1.0	1.0
Tvetenia sp.	1	0	1	2	0%	0.7	0.6
Chaetocladius sp.	0	3	0	3	1%	1.0	1.7
Micropsectra spp.	2	19	2	23	4%	7.7	9.8
Dicranota sp.	2	0	0	2	0%	0.7	1.2
Hexatoma sp.	2	2	2	6	1%	2.0	0.0
Chelifera sp.	0	0	1	1	0%	0.3	0.6
Prosimulium sp.	0	3	0	3	1%	1.0	1.7
EPHEMEROPTERA					56%	107.0	
Ameletus spp.	0	2	0	2	0%	0.7	1.2
Baetis bicaudatus	2	1	4	7	1%	2.3	1.5
Baetis tricaudatus	3	0	0	3	1%	1.0	1.7
Ephemerella infrequens	11	5	1	17	3%	5.7	5.0
Drunella coloradensis	84	35	21	140	25%	46.7	33.1
Drunella doddsi	3	6	1	10	2%	3.3	2.5
Drunella spinifera	0	0	1	1	0%	0.3	0.6
Cinygmula spp.	28	29	7	64	11%	21.3	12.4
Epeorus deceptivus	26	18	10	54	9%	18.0	8.0
Rhithrogena spp.	14	2	4	20	4%	6.7	6.4
Caudatella hystrix	3	0	0	3	1%	1.0	1.7
PLECOPTERA					14%	26	
Perlodidae	1	0	1	2	0%	0.7	0.6
Megarcys sp.	0	1	0	1	0%	0.3	0.6
Doroneuria theodora	1	0	1	2	0%	0.7	0.6
Chloroperlinae	17	11	5	33	6%	11.0	6.0
Kathroperla perdita	0	1	0	1	0%	0.3	0.6
Capnia gp.	9	5	4	18	3%	6.0	2.6
Podmosta sp.	3	1	1	5	1%	1.7	1.2
Zapada sp. 1	0	3	0	3	1%	1.0	1.7
Zapada cinctipes	0	1	0	1	0%	0.3	0.6
Doddsia sp.	0	1	0	1	0%	0.3	0.6
Perlomyia sp.	3	2	7	12	2%	4.0	2.6

MACROINVERTEBRATE DATA							
LIBBY CREEK				**STATION 3 - 4/21/89**			
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
TRICHOPTERA					16%	30.0	
Rhyacophila Betteni gp.	2	2	0	4	1%	1.3	1.2
Rhyacophila Brunnea gp.	2	0	3	5	1%	1.7	1.5
Rhyacophila verrula	0	1	0	1	0%	0.3	0.6
Rhyacophila velpulsa	5	1	1	7	1%	2.3	2.3
Rhyacophila Sibrica gp	1	0	1	2	0%	0.7	0.6
Lepidostoma spp.	20	14	8	42	7%	14.0	6.0
Apatania sp.	1	0	0	1	0%	0.3	0.6
Oligophlebodes sp.	12	4	12	28	5%	9.3	4.6
ANNELIDA					0%	0.3	
Lumbriculidae	0	0	1	1	0%	0.3	0.6
TOTAL ORGANISMS	268	194	109	571		190.3	79.6
TAXA RICHNESS	32	30	29	47		30.3	1.5
SHAN. DIVERSITY	3.70	3.92	4.15	4.10		3.92	0.22
BIOTIC INDEX	0.98	2.09	1.35	1.43		1.47	0.56
EPT RICHNESS	22	22	19	32		21.0	1.7
EPT / CHIR.	20.83	3.48	7.67	7.39		10.7	9.1
BIOTIC COND. INDEX				99.0			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	0.5	0.25	0.55				
depth (m)	0.35	0.3	0.4				
velocity (ft/s) est.	1	0.75	1				
CTQp =				50			
stream width (m)				25			
gradient (%)				1.2			
water temperature (C)				1			
substrate particle size (%)	boulders (>12)			10			
	rubble (3 - 12)			55			
	gravel (.125 - 3)			20			
	fines (< 0.125)			15			
rain last night= discharge up, sampling limited to L bank behind log jam.							

MACROINVERTEBRATE DATA							
LIBBY CREEK				STATION 4 - 4/18/89			
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					1%	0.7	
Heterlimnius corpulentus	0	0	2	2	1%	0.7	1.2
DIPTERA					30%	35.0	
Brillia sp.	1	0	0	1	0%	0.3	0.6
Corynoneura sp	0	0	1	1	0%	0.3	0.6
Eukiefferiella spp.	0	0	5	5	1%	1.7	2.9
Lopscladius sp.	14	0	0	14	4%	4.7	8.1
Paraphaenocladius sp.	3	0	10	13	4%	4.3	5.1
Rheocricotopus sp.	6	5	12	23	7%	7.7	3.8
Orthocladius spp.	0	0	1	1	0%	0.3	0.6
Symposiocladius sp.	1	0	0	1	0%	0.3	0.6
Psuedoorthocladius sp.	1	1	5	7	2%	2.3	2.3
Tretenia sp.	3	0	2	5	1%	1.7	1.5
Stempellina sp.	1	1	1	3	1%	1.0	0.0
Micropsectra spp.	7	5	9	21	6%	7.0	2.0
Dicranota sp.	0	0	1	0	0%	0.3	0.6
Hexatoma sp.	0	1	1	2	1%	0.7	0.6
Prosimulium sp.	0	1	3	4	1%	1.3	1.5
Certatopogonidae	1	1	1	3	1%	1.0	0.0
EPHEMEROPTERA					51%	59.0	
Ameletus spp.	1	0	0	1	0%	0.3	0.6
Baetis bicaudatus	1	0	13	14	4%	4.7	7.2
Ephemerella infrequens	0	0	2	2	1%	0.7	1.2
Drunella coloradensis	3	0	6	9	3%	3.0	3.0
Drunella doddsi	0	0	4	4	1%	1.3	2.3
Cinygmula spp.	19	4	43	66	19%	22.0	19.7
Epeorus deceptivus	28	5	43	76	22%	25.3	19.1
Rhithrogena spp.	1	2	2	5	1%	1.7	0.6
PLECOPTERA					17%	17.0	
Doroneuria theodora	0	0	2	2	1%	0.7	1.2
Chloroperlinae	9	5	14	28	8%	9.3	4.5
Capnia gp.	0	2	1	10	3%	1.0	1.0
Zapada sp. 1	0	0	9	9	3%	3.0	5.2
Taenionema sp.	2	0	4	6	2%	2.0	2.0
Perlomyia sp.	0	1	2	3	1%	1.0	1.0
TRICHOPTERA					2%	2.3	
Arctopsyche grandis	1	0	1	2	1%	0.7	0.6
Rhyacophila Betteni gp.	1	0	0	1	0%	0.3	0.6
Rhyacophila Brunnea gp.	1	0	0	1	0%	0.3	0.6
Rhyacophila Sibrica gp	1	0	0	1	0%	0.3	0.6
Ecclisomyia sp.	0	1	0	1	0%	0.3	0.6
Oligophlebodes sp.	0	1	0	1	0%	0.3	0.6

MACROINVERTEBRATE DATA							
LIBBY CREEK				**STATION 4 - 4/18/89**			
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Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
TOTAL ORGANISMS	106	36	200	348		114.0	82.3
TAXA RICHNESS	22	15	28	37		21.7	6.5
SHAN. DIVERSITY	3.44	3.55	3.78	3.96		3.59	0.17
BIOTIC INDEX	2.46	2.75	2.36	2.40		2.52	0.20
EPT RICHNESS	12	8	14	24		11.3	3.1
EPT / CHIR.	1.84	1.75	3.17	2.55		2.3	0.8
BIOTIC COND. INDEX				85.9			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	5	7	1				
depth (m)	0.3	0.3	0.3				
velocity (ft/s) est.	1	1	0.75				
CTQp =				50			
stream width (m)				35			
gradient (%)				1.2			
water temperature (C)				1			
substrate particle size (%)	boulders (>12)			10			
	rubble (3 - 12)			35			
	gravel (.125 - 3)			45			
	fines (< 0.125)			10			

MACROINVERTEBRATE DATA							
LIBBY CREEK				**STATION 5 - 4/18/89**			
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
COLEOPTERA					0%	0.3	
Heterlimnius corpulentus	1	0	0	1	0%	0.3	0.6
DIPTERA					37%	41.7	
Thienemannimyia group	0	1	0	1	0%	0.3	0.6
Brillia sp.	0	9	0	9	3%	3.0	5.2
Cheatocladius sp. ?	0	1	0	1	0%	0.3	0.6
Eukiefferiella spp.	1	1	0	2	1%	0.7	0.6
Paraphaenocladius spp.	18	20	1	39	12%	13.0	10.4
Rheocricotopus sp.	1	21	1	23	7%	7.7	11.5
Orthocladius spp.	0	1	0	1	0%	0.3	0.6
Psuedoorthocladius sp.	6	0	0	6	2%	2.0	3.5
Tvetenia sp.	2	8	0	10	3%	3.3	4.2
Stempellina sp.	0	2	0	2	1%	0.7	1.2
Polypedilum spp.	0	1	0	1	0%	0.3	0.6
Micropsectra spp.	7	11	1	19	6%	6.3	5.0
Dicranota sp.	1	0	0	1	0%	0.3	0.6
Oreogeton sp.	0	2	0	2	1%	0.7	1.2
Prosimulium sp.	0	4	2	6	2%	2.0	2.0
Certatopogonidae	1	1	0	2	1%	0.7	0.6
EPHEMEROPTERA					39%	43.3	
Ameletus spp.	0	0	1	1	0%	0.3	0.6
Baetis bicaudatus	4	8	4	16	5%	5.3	2.3
Ephemerella infrequens	0	0	1	1	0%	0.3	0.6
Drunella coloradensis	4	8	2	14	4%	4.7	3.1
Drunella doddsi	0	0	1	1	0%	0.3	0.6
Drunella spinifera	0	1	0	1	0%	0.3	0.6
Cinygmula spp.	9	35	10	54	16%	18.0	14.7
Epeorus deceptivus	4	19	16	39	12%	13.0	7.9
Rhithrogena spp.	1	0	2	3	1%	1.0	1.0
PLECOPTERA					19%	21.3	
Isoperla sobria	0	0	1	1	0%	0.3	0.6
Chloroperlinae	4	29	4	37	11%	12.3	14.4
Capnia gp.	0	2	0	2	1%	0.7	1.2
Podmosta sp.	0	0	1	1	0%	0.3	0.6
Visoka sp.	0	11	0	11	3%	3.7	6.4
Zapada sp. 1	0	5	1	6	2%	2.0	2.6
Doddsia sp.	0	1	0	1	0%	0.3	0.6
Taenionema sp.	0	0	3	3	1%	1.0	1.7
Perlomyia sp.	0	2	0	2	1%	0.7	1.2

.	MACROINVERTEBRATE DATA						
LIBBY CREEK				**STATION 5 - 4/18/89**			
.							
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
TRICHOPTERA					4%	4.3	
Arctopsyche grandis	1	0	2	3	1%	1.0	1.0
Parapsyche elsis	0	1	0	1	0%	0.3	0.6
Rhyacophila Brunnea gp.	0	3	1	4	1%	1.3	1.5
Rhyacophila verrula	0	1	0	1	0%	0.3	0.6
Lepidostoma spp.	0	1	0	1	0%	0.3	0.6
Oligophlebodes sp.	1	1	1	3	1%	1.0	0.0
ANNELIDA					0%	0.3	
Lumbriculidae	0	0	1	1	0%	0.3	0.6
TOTAL ORGANISMS	66	211	57	334		111.3	86.4
TAXA RICHNESS	17	30	21	42		22.7	6.7
SHAN. DIVERSITY	3.43	3.98	3.62	4.18		3.68	0.28
BIOTIC INDEX	2.95	2.77	1.75	2.63		2.49	0.65
EPT RICHNESS	8	16	16	28		13.3	4.6
EPT / CHIR.	0.80	1.68	17.00	1.82		6.5	9.1
BIOTIC COND. INDEX				87.1			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	3	1	0.5				
depth (m)	0.35	0.25	0.15				
velocity (ft/s)	1	0.75	0.5				
CTQp =				50			
stream width (m)				15			
gradient (%)				3			
water temperature (C)				1			
substrate particle size (%)	boulders (>12)			30			
	rubble (3 - 12)			25			
	gravel (.125 - 3)			25			
	fines (< 0.125)			20			

-	MACROINVERTEBRATE DATA						
LIBBY CREEK				**STATION 8 - 4-18-89**			
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Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
DIPTERA					22%	23.0	
Diamesa spp.	1	0	0	1	0%	0.3	0.6
Brillia sp.	0	0	5	5	2%	1.7	2.9
Eukiefferiella spp.	0	2	4	6	2%	2.0	2.0
Paraphaenocladius sp.	3	3	9	15	5%	5.0	3.5
Heterotrissocladius sp	0	0	0	0	0%	0.0	0.0
Rheocricotopus sp.	2	2	4	8	3%	2.7	1.2
Tvetenia sp.	2	1	0	3	1%	1.0	1.0
Polypedilum spp.	0	1	0	1	0%	0.3	0.6
Stempellina sp.	1	1	3	5	2%	1.7	1.2
Lopescladius sp.	1	0	0	1	0%	0.3	0.6
Micropsectra spp.	3	5	8	16	5%	5.3	2.5
Chelifera sp.	0	0	1	1	0%	0.3	0.6
Oreogeton sp.	0	0	1	1	0%	0.3	0.6
Prosimulium	0	0	1	1	0%	0.3	0.6
Agathon sp.	0	0	1	1	0%	0.3	0.6
Certatopogonidae	2	0	2	4	1%	1.3	1.2
EPHEMEROPTERA					55%	56.0	
Ameletus spp.	0	1	0	1	0%	0.3	0.6
Baetis bicaudatus	2	0	5	7	2%	2.3	2.5
Drunella coloradensis	0	3	2	5	2%	1.7	1.5
Drunella doddsi	0	1	2	3	1%	1.0	1.0
Cinygmula spp.	18	24	38	80	26%	26.7	10.3
Epeorus deceptivus	8	16	15	39	13%	13.0	4.4
Rhithrogena spp.	13	7	13	33	11%	11.0	3.5
PLECOPTERA					20%	20.3	
Doroneuria theodora	0	1	2	3	1%	1.0	1.0
Chloroperlinae	16	11	19	46	15%	15.3	4.0
Visoka sp.	1	0	0	1	0%	0.3	0.6
Zapada sp. 1	0	0	5	5	2%	1.7	2.9
Taenionema sp.	1	0	0	1	0%	0.3	0.6
Perlomyia sp.	1	1	3	5	2%	1.7	1.2
TRICHOPTERA					2%	2.3	
Parapsyche elsis	0	1	2	3	1%	1.0	1.0
Rhyacophila Betteni gp.	0	1	0	1	0%	0.3	0.6
Rhyacophila velpulsa	0	0	1	1	0%	0.3	0.6
Glossosoma sp.	0	0	2	2	1%	0.7	1.2
ANNELIDA					1%	0.7	
Lumbriculidae	1	1	0	2	1%	0.7	0.6

MACROINVERTEBRATE DATA							
LIBBY CREEK					**STATION 8 - 4-18-89**		
Hess sampler, 0.1 meter dia:, 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
TOTAL ORGANISMS	76	83	148	307		102.3	39.7
TAXA RICHNESS	17	19	24	34		20.0	3.6
SHAN. DIVERSITY	3.24	3.28	3.75	3.69		3.42	0.28
BIOTIC INDEX	1.79	1.93	2.16	2.01		1.96	0.19
EPT RICHNESS	8	11	13	21		10.7	2.5
EPT / CHIR.	4.62	4.47	3.30	3.87		4.1	0.7
BIOTIC COND. INDEX				82.4			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	8	2	4				
depth (m)	0.3	0.22	0.3				
velocity (ft/s)	0.5	0.5	0.5				
CTQp =				50			
stream width (m)				14			
gradient (%)				3			
water temperature (C)				2			
substrate particle size (%)	boulders (>12)			10			
	rubble (3 - 12)			45			
	gravel (.125 - 3)			35			
	fines (< 0.125)			10			

MACROINVERTEBRATE DATA							
LIBBY CREEK				**STATION 10 4/18/89**			
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
DIPTERA					36%	69.7	
Zavrelimyia sp.	1	0	0	1	0%	0.3	0.6
Brillia sp.	4	0	0	4	1%	1.3	2.3
Chaetocladius sp.	6	3	0	9	2%	3.0	3.0
Corynoneura sp.	0	1	0	1	0%	0.3	0.6
Eukiefferiella spp.	3	1	1	5	1%	1.7	1.2
Paraphaenocladius sp.	34	5	20	59	10%	19.7	14.5
Rheocricotopus sp.	8	2	3	13	2%	4.3	3.2
Symposiocladius sp.	0	1	0	1	0%	0.3	0.6
Tvetenia sp.	3	14	10	27	5%	9.0	5.6
Hydrobaenus sp.	2	5	0	7	1%	2.3	2.5
Stempellina sp.	27	2	5	34	6%	11.3	13.7
Micropsectra spp.	10	18	9	37	6%	12.3	4.9
Dicranota sp.	2	0	0	2	0%	0.7	1.2
Oreogeton sp.	5	0	0	5	1%	1.7	2.9
Prosimulium	0	3	0	3	1%	1.0	1.7
Certatopogonidae	1	0	0	1	0%	0.3	0.6
EPHEMEROPTERA					36%	69.3	
Ameletus spp.	2	0	1	3	1%	1.0	1.0
Baetis bicaudatus	7	16	14	37	6%	12.3	4.7
Drunella coloradensis	6	2	5	13	2%	4.3	2.1
Cinygmula spp.	29	43	42	114	20%	38.0	7.8
Epeorus deceptivus	9	9	13	31	5%	10.3	2.3
Rhithrogena spp.	0	5	4	9	2%	3.0	2.6
Paraleptophlebia spp.	0	1	0	1	0%	0.3	0.6
PLECOPTERA					25%	47.7	
Megarcys sp.	2	0	1	3	1%	1.0	1.0
Chloroperlinae	24	16	44	84	15%	28.0	14.4
Visoka sp.	0	0	8	8	1%	2.7	4.6
Zapada sp. 1	7	11	8	26	5%	8.7	2.1
Doddsia sp.	0	0	2	2	0%	0.7	1.2
Perlomyia sp.	9	2	1	12	2%	4.0	4.4
Yoraperla brevis	4	0	4	8	1%	2.7	2.3
TRICHOPTERA					2%	4.3	
Parapsyche elsis	0	3	1	4	1%	1.3	1.5
Rhyacophila Brunnea gp.	0	1	0	1	0%	0.3	0.6
Rhyacophila verrula	0	0	1	1	0%	0.3	0.6
Rhyacophila Hylinata gp	1	0	0	1	0%	0.3	0.6
Ecclisomyia sp.	0	1	0	1	0%	0.3	0.6
Neothremma sp.	0	1	0	1	0%	0.3	0.6
Chyranda centralis	2	1	0	3	1%	1.0	1.0
Anagapetus sp.	1	0	0	1	0%	0.3	0.6
ANNELIDA					0%	0.7	
Lumbriculidae	0	0	2	2	0%	0.7	1.2

MACROINVERTEBRATE DATA							
LIBBY CREEK				**STATION 10 4/18/89**			
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
TOTAL ORGANISMS	209	167	199	575		191.7	21.9
TAXA RICHNESS	26	25	22	39		24.3	2.1
SHAN. DIVERSITY	3.96	3.71	3.55	4.03		3.74	0.20
BIOTICINDEX	2.63	2.77	2.02	2.46		2.47	0.40
EPT RICHNESS	13	14	15	26		14.0	1.0
EPT / CHIR.	1.05	2.15	3.10	1.84		2.1	1.0
BIOTIC COND. INDEX				89.9			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	1	1.5	1				
depth (m)	0.25	0.3	0.25				
velocity (ft/s)	0.5	0.75	0.75				
CTQp =				50			
stream width (m)				8			
gradient (%)				3.5			
water temperature (C)				1			
substrate particle size (%)	boulders (>12)			30			
	rubble (3 - 12)			50			
	gravel (.125 - 3)			15			
	fines (< 0.125)			5			

MACROINVERTEBRATE DATA							
LIBBY CREEK				**STATION 11 4/20/89**			
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
DIPTERA					33%	37.7	
unassociated midge pupa	2	0	0	2	1%	0.7	1.2
Zavrelimyia sp.	0	1	0	1	0%	0.3	0.6
Diamesa spp.	1	0	0	1	0%	0.3	0.6
Odontomesa sp.	0	1	0	1	0%	0.3	0.6
Brillia sp.	1	0	7	8	2%	2.7	3.8
Chaetocladius sp.	1	2	0	3	1%	1.0	1.0
Corynoneura sp	1	0	1	2	1%	0.7	0.6
Cricotopus spp.	0	1	0	1	0%	0.3	0.6
Paraphaenocladius spp.	3	5	11	19	6%	6.3	4.2
Rheocricotopus sp.	0	0	5	5	1%	1.7	2.9
Symposiocladius sp.	0	3	0	3	1%	1.0	1.7
Stempellina sp.	6	8	2	16	5%	5.3	3.1
Tvetenia sp.	1	1	2	4	1%	1.3	0.6
Micropsectra spp.	12	8	19	39	12%	13.0	5.6
Dicranota sp.	0	0	2	2	1%	0.7	1.2
Hexatoma sp.	0	0	1	1	0%	0.3	0.6
Prosimulium	0	0	1	1	0%	0.3	0.6
Certatopogonidae	0	1	3	4	1%	1.3	1.5
EPHEMEROPTERA					30%	34.0	
Ameletus spp.	0	0	2	2	1%	0.7	1.2
Baetis bicaudatus	1	9	1	11	3%	3.7	4.6
Drunella coloradensis	1	0	1	2	1%	0.7	0.6
Drunella doddsi	0	1	0	1	0%	0.3	0.6
Cinygmula spp.	3	29	24	56	17%	18.7	13.8
Epeorus deceptivus	2	13	4	19	6%	6.3	5.9
Rhithrogena spp.	0	5	6	11	3%	3.7	3.2
PLECOPTERA					30%	33.3	
Perlodidae	1	0	1	2	1%	0.7	0.6
Chloroperlinae	14	5	36	55	16%	18.3	15.9
Visoka sp.	0	4	2	6	2%	2.0	2.0
Zapada sp. 1	6	2	4	12	4%	4.0	2.0
Perlomyia sp.	0	0	2	2	1%	0.7	1.2
Yoraperla brevis	2	2	19	23	7%	7.7	9.8
TRICHOPTERA					5%	5.3	
Parapsyche elsis	0	1	0	1	0%	0.3	0.6
Rhyacophila verrula	0	0	6	6	2%	2.0	3.5
Rhyacophila velpulsa	1	0	0	1	0%	0.3	0.6
Lepidostoma spp.	1	0	1	2	1%	0.7	0.6
Neothremma sp.	0	3	0	3	1%	1.0	1.7
Anagapetus sp.	1	2	0	3	1%	1.0	1.0
OTHER							
Turbellaria	5	2	0	7	2%	2.3	2.5

MACROINVERTEBRATE DATA							
LIBBY CREEK					**STATION 11 4/20/89**		
-							
Hess sampler, 0.1 meter dia., 171 micron aperture netting							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
TOTAL ORGANISMS	66	109	163	338		112.7	48.6
TAXA RICHNESS	21	23	25	38		23.0	2.0
SHAN. DIVERSITY	3.70	3.76	3.73	4.15		3.73	0.03
BIOTICINDEX	2.71	2.28	2.20	2.33		2.40	0.27
EPT RICHNESS	11	12	14	23		12.3	1.5
EPT / CHIR.	1.18	2.53	2.32	2.08		2.0	0.7
BIOTIC COND. INDEX				78.9			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	0.5	0.5	2				
depth (m)	0.3	0.25	0.35				
velocity (ft/s)	0.25	0.5	0.1				
CTQp =				50			
stream width (m)				5			
gradient (%)				4			
water temperature (C)				1			
substrate particle size (%)	boulders (>12)			20			
	rubble (3 - 12)			30			
	gravel (.125 - 3)			30			
	fines (< 0.125)			20			

MACROINVERTEBRATE DATA							
ROCK CREEK					**STATION 1 - 4/16/89**		
kick samples, 1 meter for 45 sec.							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
COLEOPTERA					1%	1.0	
Heterlimnius corpulentus	0	1	0	1	0%	0.3	0.6
Narpus sp.	1	0	1	2	0%	0.7	0.6
DIPTERA					8%	12.0	
Diamesa spp.	0	1	0	1	0%	0.3	0.6
Brillia sp.	1	2	5	8	2%	2.7	2.1
Corynoneura sp	0	0	1	1	0%	0.3	0.6
Eukiefferiella spp.	0	2	5	7	2%	2.3	2.5
Tvetenia sp.	1	2	3	6	1%	2.0	1.0
Micropsectra spp.	2	1	4	7	2%	2.3	1.5
Hexatoma sp.	1	0	0	1	0%	0.3	0.6
Oreogeton sp.	1	0	0	1	0%	0.3	0.6
Prosimulium sp.	0	1	3	4	1%	1.3	1.5
EPHEMEROPTERA					73%	106.7	
Ameletus spp.	0	0	2	2	0%	0.7	1.2
Baetis bicaudatus	2	0	1	3	1%	1.0	1.0
Baetis tricaudatus	1	1	1	3	1%	1.0	0.0
Caudatella edmundsi	0	0	1	1	0%	0.3	0.6
Drunella coloradensis	0	0	3	3	1%	1.0	1.7
Drunella doddsi	0	0	2	2	0%	0.7	1.2
Cinygmula spp.	15	16	51	82	19%	27.3	20.5
Epeorus sp.	3	48	141	192	44%	64.0	70.4
Rhithrogena spp.	17	6	9	32	7%	10.7	5.7
PLECOPTERA					10%	14.0	
Megarcys sp.	0	0	1	1	0%	0.3	0.6
Perlodidae	0	0	1	1	0%	0.3	0.6
Chloroperlinae	11	9	3	23	5%	7.7	4.2
Capnia gp.	0	1	2	3	1%	1.0	1.0
Visoka sp.	0	1	1	2	0%	0.7	0.6
Zapada sp. 1	0	0	2	2	0%	0.7	1.2
Doddsia sp.	4	6	0	10	2%	3.3	3.1
TRICHOPTERA					8%	12.0	
Arctopsyche grandis	0	0	1	1	0%	0.3	0.6
Parapsyche elsis	0	1	1	2	0%	0.7	0.6
Rhyacophila Betteni gp.	0	1	0	1	0%	0.3	0.6
Lepidostoma spp.	1	3	18	22	5%	7.3	9.3
Limnephilidae	0	1	0	1	0%	0.3	0.6
Oligophlebodes sp.	0	0	8	8	2%	2.7	4.6
Glossosoma sp.	0	0	1	1	0%	0.3	0.6

MACROINVERTEBRATE DATA							
ROCK CREEK						**STATION 1 - 4/16/89**	
kick samples, 1 meter for 45 sec.							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
ANNELIDA					0%	0.7	
Lumbricidae	0	1	0	1	0%	0.3	0.6
Lumbriculidae	0	0	1	1	0%	0.3	0.6
OTHER							
Turbellaria	0	0	1	1	0%	0.3	0.6
TOTAL ORGANISMS	61	105	274	440		146.7	112.4
TAXA RICHNESS	14	20	29	37		21.0	7.5
SHAN. DIVERSITY	2.93	2.88	2.69	3.07		2.83	0.13
BIOTICINDEX	1.43	1.62	1.50	1.52		1.52	0.10
EPT RICHNESS	8	12	20	27		13.3	6.1
EPT / CHIR.	13.50	11.75	13.89	13.27		13.0	1.1
BIOTIC COND. INDEX				88.6			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	4	2	5				
depth (m)	0.5	0.3	0.5				
velocity (ft/s)	3	2	4				
CTQp =				50			
stream width (m)				20			
gradient (%)				2			
water temperature (C)				1			
substrate particle size (%)	boulders (>12)			35			
	rubble (3 - 12)			50			
	gravel (.125 - 3)			15			
	fines (< 0.125)			5			
runoff started, stage gauge at 2.0, few bugs at depths less than .3m, sampled below stage gauge							

MACROINVERTEBRATE DATA							
ROCK CREEK				**STATION 3 - 4/16/89**			
kick samples, 1 meter, 45 seconds.							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
COLEOPTERA					1%	5.3	
Heterlimnius corpulentus	6	0	0	6	0%	2.0	3.5
Narpus sp.	0	2	0	2	0%	0.7	1.2
Cleptelmis ornata	0	6	0	6	0%	2.0	3.5
Lara sp.	0	0	1	1	0%	0.3	0.6
Zaitzevia parvula	0	1	0	1	0%	0.3	0.6
DIPTERA					48%	231.3	
Thienemannimyia group	23	2	2	27	2%	9.0	12.1
Procladius sp.	0	1	0	1	0%	0.3	0.6
Diamesa spp.	4	3	11	18	1%	6.0	4.4
Pagastia sp	1	0	0	1	0%	0.3	0.6
Brillia sp.	0	1	0	1	0%	0.3	0.6
Cardiocladius spp.	0	1	7	8	1%	2.7	3.8
Cricotopus spp.	64	40	82	186	13%	62.0	21.1
Eukiefferiella spp.	0	1	8	9	1%	3.0	4.4
Diplocladius sp.	1	1	0	2	0%	0.7	0.6
Psectrocladius sp.	4	0	0	4	0%	1.3	2.3
Heterotrissocladius sp	1	0	0	1	0%	0.3	0.6
Rheocricotopus sp.	2	0	0	2	0%	0.7	1.2
Symposiocladius sp.	1	0	0	1	0%	0.3	0.6
Tvetenia sp.	1	1	1	3	0%	1.0	0.0
Polypedilum spp.	2	0	0	2	0%	0.7	1.2
Micropsectra spp.	137	87	29	253	17%	84.3	54.0
Pericoma sp.	0	1	0	1	0%	0.3	0.6
Chelifera sp.	0	1	1	2	0%	0.7	0.6
Oreogeton sp.	1	0	1	2	0%	0.7	0.6
Prosimulium sp.	20	61	87	168	12%	56.0	33.8
Certatopogonidae	2	0	0	4	0%	0.7	1.2
EPHEMEROPTERA					31%	150.0	
Baetis bicaudatus	4	4	5	13	1%	4.3	0.6
Caudatella edmundsi	0	2	7	9	1%	3.0	3.6
Ephemerella infrequens	52	53	82	187	13%	62.3	17.0
Epeorus sp.	1	0	8	9	1%	3.0	4.4
Paraleptophlebia spp.	168	43	19	230	16%	76.7	80.0
MEGALOPTERA							
Sialis sp.	2	0	0	2	0%	0.7	1.2
PLECOPTERA					2%	8.7	
Rickera sp.?	0	0	9	9	1%	3.0	5.2
Isoperla sobria	2	2	0	4	0%	1.3	1.2
Chloroperlinae	1	7	5	13	1%	4.3	3.1

MACROINVERTEBRATE DATA							
ROCK CREEK				**STATION 3 - 4/16/89**			
kick samples, 1 meter, 45 seconds.							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV
TRICHOPTERA					6%	31.3	
Arctopsyche grandis	1	1	1	3	0%	1.0	0.0
Rhyacophila Betteni gp.	1	0	0	1	0%	0.3	0.6
Rhyacophila Brunnea gp.	4	12	11	27	2%	9.0	4.4
Rhyacophila verrula	0	0	1	1	0%	0.3	0.6
Lepidostoma spp.	18	2	0	20	1%	6.7	9.9
Hydroptila sp.	11	7	1	19	1%	6.3	5.0
Ochrotrichia sp.	0	1	0	1	0%	0.3	0.6
Ecclisomyia sp.	2	0	0	2	0%	0.7	1.2
Polycentropus sp.	10	1	0	11	1%	3.7	5.5
Micrasema sp.	3	2	4	9	1%	3.0	1.0
MOLLUSCA							
Sphaeriidae	71	47	29	147	10%	49.0	21.1
ANNELIDA					0%	2.0	
Lumbricidae	0	1	0	1	0%	0.3	0.6
Lumbriculidae	2	0	1	3	0%	1.0	1.0
Tubificidae	0	2	0	2	0%	0.7	1.2
OTHER							
Turbellaria	4	10	0	14	1%	4.7	5.0
TOTAL ORGANISMS	627	407	413	1449		482.3	125.3
TAXA RICHNESS	34	33	25	50		30.7	4.9
SHAN. DIVERSITY	3.32	3.53	3.39	3.68		3.41	0.11
BIOTIC INDEX	4.70	5.10	4.99	4.90		4.93	0.20
EPT RICHNESS	14	12	11	23		12.3	1.5
EPT / CHIR.	1.15	0.98	1.06	1.08		1.1	0.1
BIOTIC COND. INDEX				66.4			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	3	1	6				
depth (m)	0.4	0.4	0.5				
velocity (ft/s)	2	1.5	4				
CTQp =				53			
stream width (m)				10			
gradient (%)				1			
water temperature (C)				2			
substrate particle size (%)	boulders (>12)			25			
	rubble (3 - 12)			35			
	gravel (.125 - 3)			25			
	fines (< 0.125)			15			

MACROINVERTEBRATE DATA							
ROCK CREEK				**STATION 4 - 4/16/89**			
kick sample, 1 meter for15 sec.							
Taxon	sample1	sample2	sample3	SUM	%RA	MEAN	ST. DEV.
EPHEMEROPTERA		SAMPLING			100%	5.0	
Cinygmula spp.	3			3	60%	3.0	#DIV/0!
Epeorus sp.	1	ABORTED		1	20%	1.0	#DIV/0!
Rhithrogena spp.	1			1	20%	1.0	#DIV/0!
TOTAL ORGANISMS	5			5		5.0	#DIV/0!
TAXA RICHNESS	3			3		3.0	#DIV/0!
SHAN. DIVERSITY	1.37			1.37		1.37	#DIV/0!
BIOTIC INDEX	1.40			1.40		1.40	#DIV/0!
EPT RICHNESS	3			2		3.0	#DIV/0!
EPT / CHIR.							
BIOTIC COND. INDEX				227.3			
ID's by D. McGuire & P. Wilkinson							
PHYSICAL DATA							
distance from shore (m)	0.5						
depth (m)	0.5						
velocity (ft/s)	3						
CTQp =				50			
stream width (m)				5			
gradient (%)				15			
water temperature (C)				1			
substrate particle size (%)	boulders (>12)			70			
	rubble (3 - 12)			20			
	gravel (.125 - 3)			5			
	fines (< 0.125)			5			
sampling aborted,conditions unsafe! no site suitable for sampling at this flow.							

APPENDIX 6.6 QA/QC review of nine aquatic macroinvertebrate samples.

June 6, 1989

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Dan McGuire
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Dear Dan,

Thanks for the oppurtunity to review some of your samples, and for dropping my name to others. I like the small jobs. They provide variety, so I don't get too bored picking samples from any one location. The data and determinations that I came up with for the samples are attached.

1. Misc. Rhyacophilidae- determinations are on labels in vials. I think we went over most of this on the phone. I'm enclosing an unpublished key of Smith's, plus some material I put together.

R. vepulsa is a junior synonym of R. narvae. The color pattern on larval headcapsules can vary.

R. ?verrula was R. Iranda Group. Head round in dorsal aspect, but appears flattened when viewed laterally. Minute spines cover dorsum of head. Short, single filament gills on abdomen. These gills are most apparent in the final 2 instars, and may not be readily visible in early instar larvae.

There were R. angelita pupae present in the R. Angelita Group larvae from the Blackfoot River.

R. Betteni Gr. (you also called R. vaccua). Safer to leave as R. Betteni Group. Other species could be present. Need pupae.

2. Misc. Limnephilidae: Determinations are on labels in the vials.

Apatania sp.: Apatania albertae male pupae found in the samples. It is probably safe enough to call the larvae this, though more pupae to further confirm the I.D. would be better.

Psychoglypha sp.: You have at least 2 taxa present. P. subborealis can be separated out. The scleotized body parts are yellow, with black dots. The legs are banded (see the illustration in Wiggins 1977). There was another Psychoglypha sp. mixed in with the Homophylax.

Dicosmoecus sp.= Dicosmoecus atripes. At least the one you sent. See Wiggins and Richardson 1982. Revision and synopsis of the caddisfly genus Dicosmoecus (Trichoptera: Limnephilidae; Dicosmoecinae). Aquatic Insects 4: 181-217.

Chyranda sp. = Chyranda centralis. The genus is monotypic.

Neophylax = Neophylax rickeri.

There was one Neothremma alicia pupae in the Neothremma vial. All larvae/pupae should be this species in that area, but it would be better to confirm that with more pupae.

3. Misc. comments on taxa list and samples:

Baetis spp. I don't put species names on any more, or at least I note them as e.g. bicaudatus or tricaudatus type larvae. There are just too many unresolved taxonomic problems.

Cinygmula: May have gotten some mixed with Rhithrogena, since they were often in poor shape. The larvae in Ra 4-2 were unusual. Their heads were unusually broad, and the frontal notch was not pronounced. However, other characters indicated that they were Cinygmula. I would be interested to find out what you called these larvae.

Epeorus: Most larvae appeared to be Epeorus (Iron) longimanus (early to mid-instar larvae). They were in poor condition and not really large enough to be positive. It has been my experience that the macula (dark spot on femora) is not present in early instar larvae. Also, the keys talk about whether the gills on the 1st abdominal segement meet in the middle or not (e.g. not for E. deceptivus). This is not a reliable character.

There are many who feel that D. coloradensis and D. flavilinea should be synonomized. Same for E. infrequens and E. inermis.

Yoraperla ?brevis. Your specimens present a problem. I have encountered this from other sites in the northern Rocky Mtns. They would key out to Y. mariana, based on the fact that the posterior edge of the metasternum is straight, and not curved. Y. mariana has not been positively confirmed as occurring in the northern Rocky Mtns. Please send these to Dick Baumann for his opinion. I know he would be interested.

Dr. Richard Baumann
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I would leave at Yoraperla sp. for now.

Chloroperlidae: Alloperla vs. Sweltsa. Sweltsa is usually the dominant taxa in NW streams. It is so much so, that I tend to call everything Sweltsa.

Visoka = Visoka cataractae (monotypic genus).

Capniidae/Leuctridae larvae. Don't trust my I.D.'s. I usually toss a coin. There was a mature Paraleuctra occidentalis nymph in one of the samples.

Doddsia =D. occidentalis.

There were a few Nemourids (Nemourinae) that I couldn't identify. Need larger specimens in better condition (larvae have no gills).

Anagapetus vs. Glossosoma. It is very difficult to separate early instar larvae out. Most are probably Glossosoma. Anagapetus is found in very small, forested streams.

Zapada: I would expect that columbiana, oregonensis and frigida would be present. You really need fairly mature larve to be positive, but I'm pretty sure there were some frigida in the samples.

Zaitzevia: Harley Brown has turned up another species in the Northwest (unpublished as of yet), so the genus is no longer monotypic in the Northwest.

Cheumatopsyche: usually a riverine taxa.

Hydropsyche-Ceratopsyche: I haven't accepted the generic divisions that Schuster has proposed. I still call them all Hydropsyche.

Chironomidae: The larvae were in pretty poor shape. We would need some specimens in better condition (and larger) to be certain on some of the I.D.'s (e.g. Tanypodinae). Mary Jo Wevers (my wife) does the midges for me. She uses Wiederholm's keys. Her comments are:

1. Material poorly preserved.
2. Many specimens are early instars. It would be better to select some later instar larvae for verification.
3. Taxa list looks too long, based on the samples she has seen. She suspects that there are actually fewer genera involved.
4. For QA/QC checks, it may be better (and take less time) to just look at your slide mounts of the more obscure taxa.

This is the first time I've been involved with an official QA/QC check. I think it is a good idea, and this exercise has caused me to give the process some thought. I'll pass on some general recommendations and thoughts.

1. Better preservation is needed. I used to use Kahle's fluid (ethanol + acetic acid + formaldehyde + water) to fix my samples. The recipe is in Wiggins caddis book. It is a superlative fixative. I've recently become very concerned about formaldehyde, however, and no longer use it (I get a severe allergic reaction, plus the stuff is carcinogenic). I would recommend using copious amounts of 95% ethanol spiked with a little acetic acid to fix and preserve the samples. Change the fluid once you return from the field, if the samples have a lot of organic matter and will be stored for some time. Isopropyl makes invertebrates brittle.

2. Don't feel embarrased about leaving some I.D.'s at the e.g. family level (I used to feel this way sometimes). Early instar material often cannot be pushed any further. I think it's better to go only as far as you are sure.

Call me if you have any questions. Again, thanks for the opportunity to work on your samples.

Sincerely,

Bob Wisseman

MT: Cabinet Mountains. Benthos samples for Dan McGuire
Collected in April 1989. Determined by Bob Wisseman

TAXA	Ro1	Ro3	Li1	Li4	Li8	Be1	Lc2	Po1	Ra4
Turbellaria	0	10	0	0	0	0	0	0	42
Nematoda	0	0	0	0	1	0	0	0	0
Oligochaeta	1	2	2	1	1	2	1	0	3
Ostracoda	0	0	0	0	0	1	0	0	0
TOTAL: MISC. TAXA	1	12	2	1	2	3	1	0	45
Baetis (?bicaudatus)	0	4	0	0	0	2	5	3	4
Baetis (?tricaudatus)	1	0	8	1	0	0	0	0	0
Ameletus	0	0	1	1	1	0	0	0	2
Paraleptophlebia	0	44	0	0	0	0	7	0	1
Cinygmula	17	0	68	18	26	28	10	39	37
Epeorus (I.) longimanus	51	0	38	31	15	15	0	53	0
E. (Ironopsis) grandis	0	0	0	0	0	1	0	0	2
Rhithrogena	6	0	8	1	6	17	0	6	0
Caudatella edmundsi	0	2	0	0	0	0	0	0	0
Drunella coloradensis	5	0	3	3	3	11	0	6	64
Drunella doddsi	0	0	1	0	1	4	0	0	0
Ephemerella inermis	0	54	1	0	0	1	0	0	0
TOTAL: EPHEMEROPTERA	80	104	128	55	52	79	22	107	110
Yoraperla ??	0	0	0	0	0	0	18	0	16
Nemourinae	0	0	0	0	0	1	0	2	0
Visoka cataractae	0	0	0	1	1	0	20	1	7
Zapada-small	0	0	0	2	0	1	12	0	22
Z. frigida	0	0	1	0	0	1	0	1	0
Z. Oregonensis Gr.	1	0	0	0	0	0	0	0	0
Doddsia occidentalis	5	0	1	2	0	0	0	0	0
Capniidae	1	0	1	0	0	?7	4	5	1
Leuctridae	0	0	0	2	1	0	0	13	0
Paraleuctra occidentalis	0	0	0	0	0	1	0	0	0
Pteronarcidae-small	0	0	0	0	0	1	0	0	0
Perlidae-small	0	0	0	0	1	0	0	0	0
Doroneuria	0	0	0	0	0	0	0	3	0
Perlodidae-small	0	0	0	1	0	0	0	1	0
Setvena bradleyi	0	0	0	0	0	0	1	0	0
Isoperla sobria	0	2	0	0	0	0	0	0	0
Sweltsa (most)	4	7	7	10	11	35	26	24	38
TOTAL: PLECOPTERA	11	9	10	18	14	40	81	50	84
Rhyacophila-small	0	0	0	1	0	0	0	0	1
R. Betteni Gr.	1	0	0	0	0	0	1	1	1
R. Brunnea Gr.	0	12	0	1	0	0	0	0	0
R. Iranda Gr.	0	0	0	0	0	0	3	0	0
R. Sibirica Gr.	0	0	0	1	1	0	0	0	0
Agraylea	0	1	0	0	0	0	0	0	0
Hydroptila	0	7	0	0	0	0	0	0	0
Anagapetus	0	0	0	0	0	1	0	0	0
Glossosoma	0	0	0	0	0	0	6	3	0
Polycentropus	0	1	0	0	0	0	0	0	0
Wormaldia occidea-Pu	0	0	0	0	0	0	1	0	0

Arctopsyche grandis	0	1	0	1	0	0	0	0	0
Parapsyche elsis	1	0	1	0	1	0	3	0	0
Ecclisomyia	0	0	0	0	0	0	0	0	1
Chyranda centralis	0	0	0	0	0	0	0	1	0
Apatania albertae-Pu	1	0	0	0	0	0	0	0	0
Neophylax-small	0	0	3	0	0	0	0	0	0
Oligophlebodes	0	0	5	0	0	4	0	0	0
Lepidostoma	4	1	0	0	0	2	0	0	0
Micrasema	0	2	0	0	0	0	0	0	0
TOTAL: TRICHOPTERA	7	25	9	4	2	7	14	5	3
Cleptelmis ornata-larvae	0	4	0	0	0	0	0	0	0
C. ornata-adult	0	2	0	0	0	0	0	0	0
Heterlimnius-larvae	1	2	0	0	0	0	0	1	0
Zaitzevia-adult	0	1	0	0	0	0	0	0	0
Hydrophilidae-larvae	3	0	0	0	0	0	0	0	0
TOTAL-COLEOPTERA	4	9	0	0	0	0	0	1	0
Dicranota	0	0	0	0	0	1	0	1	6
Hexatoma	0	0	0	0	0	0	1	0	0
Pericoma	0	1	0	0	0	0	0	0	0
Ceratopogonidae	0	0	2	2	0	1	2	4	6
Prosimulium	1	60	5	0	0	1	34	3	0
Simulium	0	0	1	0	0	0	0	0	0
Twinnia	0	0	0	0	0	1	0	0	0
Chelifera	0	1	0	0	0	0	0	1	0
TOTAL: MISC. DIPTERA	1	62	8	2	0	4	37	9	12
Brillia	0	2	0	0	0	1	0	11	0
Constempellina ?	0	0	0	0	0	0	37	7	0
Corynoneura	0	0	0	0	0	0	0	0	18
Micropsectra	0	71	0	1	0	0	6	0	9
Orthocladius Complex	2	54	4	9	4	2	53	9	49
Parametriocnemus ?	0	0	1	1	0	0	0	10	5
Tanypodinae	0	2	1	0	0	0	1	1	1
Tvetenia	3	1	0	0	0	0	0	0	0
Chironomidae-pupae	0	0	0	0	0	0	0	0	1
TOTAL: CHIRONOMIDAE	5	130	6	11	4	3	97	38	83
GRAND TOTAL	109	351	163	91	74	136	252	210	337

Diatom Count
Rock Creek Station 1 Slide 2
Collected October 17,1988

Taxon		Cell Count
Achnanthes minutissima		731
Tabellaria flocculosa		2
Gomphonema intricatum		47
angustatum		T
Fragilaria vaucheria		7
Diatoma hiemale var. mesodon		3
hiemale		T
Melosira italica ?		1
Cymbella minuta		5
sp.		3
Hannaea arcus		1
Cyclotella Meneghiniana		T
Navicula Pseudoscutiformis		T
Cocconeis Placentula		T
Eunotia Pectinalis		T
Frustulia rhomboides		T
	TOTAL	790

Diatom Count
Rock Creek Station 3 Slide 4
Collected October 17,1988

Taxon	Cell Count
Achmanthes minutissima	29
lanceolata	1
Anomoeneis vitrea	1
serians var. brachysira	T
Amphora ovalis var. Pediculus	1
Tabellaria flocculosa	92
fennestrata	1
Gomphonema turris	T
angustatum var. intermedia	19
var. obtusatum	1
truncatum	T
Fragilaria vaucheria	30
virescens	1
construens var. venter	54
constricta	1
Eunotia curvata	5
Pectinalis var. minor	6
serra var diadema	1
Diatoma anceps	2
hiemale var. mesodon	16
Melosira distans	95
granulata	11
Cymbella minuta	9
cistula	1
cesattii	1
lunata	4
heteropleura var. subrostrata	T
Hannaea arcus	17
Cyclotella sp	1
Navicula pseudoscutiformis	3
cryptocephala	4
pupula	T
pupula var elliptica	6
naviculiformis	T
mutica	T

Diatom Count
Rock Creek Station 3 Slide 4 Page 2
Collected October 17,1988

Taxon	Cell Count
Pinnularia maior	T
caudata	1
borealis	T
Frustulia rhomboides	5
Meridion circulare	1
Stauroneis Phoenicenteron f. gracilis	T
StenoPterobia intermedia	T
Neidium bisulcatum	T
TOTAL	420

Diatom Count
Libby Creek Station 3 Slide 1
Collected October 20,1988

Taxon	Cell Count
Achnanthes minutissima ?	7
lanceolata var omissa	1
Gomphonema clevei	6
Fragilaria leptostauron	3
Diatoma hiemale var. mesodon	2
Melosira varians	T
Cymbella minuta	2
mexicana	1
Hannaea arcus	1
Didymosphenia geminata	T
Cocconeis placentula	T
Nitzschia palea	1
frustulum var perpusilla	3
TOTAL	27

Diatom Count
Rock Creek Station 3-Macrophyte- Slide 1
Collected October 17,1988

Taxon	Cell Count
Achnanthes minutissima	178
lanceolata var dubia	10
Amphora perpusilla	2
Tabellaria flocculosa	11
fennestrata	4
Gomphonema turris	2
angustatum	3
truncatum	T
brebissonii	T
Fragilaria vaucheria	1
leptostauron	1
var dubia	4
Eunotia perpusilla	1
pectinalis	2
exigua	1
vanheurckii	T
Diatoma hiemale var. mesodon	5
Melosira distans	T
Cymbella minuta	1
lunata	2
heteropleura var. subrostrata	T
sinuata	1
naviculiformis	2
mexicana	T
Hannaea arcus	2
Navicula pseudoscutiformis	1
mutica	T
Pinnularia borealis	1
gentilis	T
Meridion circulare var constrictum	1
Stauroneis phoenicenteron	T
Didymosphenia geminata	T
Hantzschia amphioxys	T
Cocconeis placentula	T
Nitzschia linearis	1
amphibia	T
sigmoidea	T
tryblionella	T
frustulum	T

Diatom Count
Rock Creek Station 4 Slide 1
Collected October 17,1988

Taxon		Cell Count
Achnanthes	minutissima	70
	lanceolata	5
	sp	1
Anomoeonis	vitrea	T
Tabellaria	flocculosa	2
Gomphonema	subclavatum	9
	angustatum	4
Fragilaria	vaucheria	40
Eunotia	curvata	T
	Pectinalis	2
Diatoma	hiemale var. mesodon	101
	ancePs	1
Frustulia	rhomboides	1
Cymbella	minuta	11
Hannaea	arcus	34
Pinnularia	borealis var rectangularis	T
Meridion	circulare	5
Nitzschia	sp	2
Cyclotella	sp	2
Stephanodiscus	astraea	T
Neidium	sp	T
	TOTAL	290