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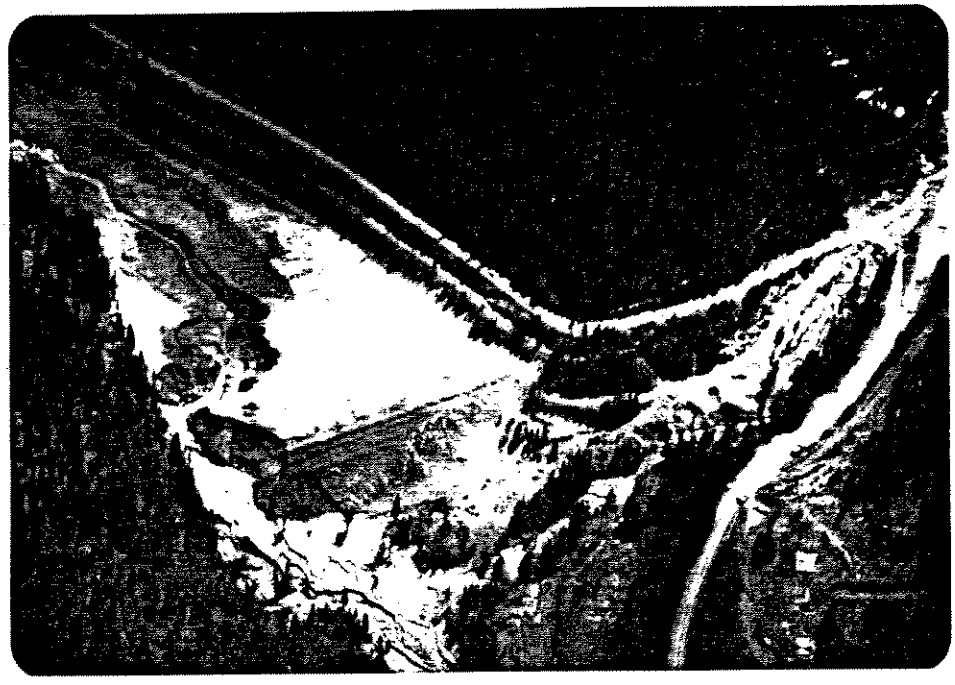
REGION 2

Effects of the June, 1975 Mike Horse Mine Tailings Dam Failure on Water Quality and Aquatic Resources of the Upper Blackfoot River, Montana



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Effects of the 1975 Mike Horse Mine Tailings Dam Failure on Water Quality and Aquatic Resources of the Upper Blackfoot River, Montana[1]

INTRODUCTION

On June 19, 1975, the Mike Horse Tailings Dam, located on Beartrap Creek and controlled by the Anaconda Company, in the headwaters of the Blackfoot River near Lincoln, failed due to heavy precipitation and runoff from winter snowpack. Failure of a bypass structure and canal that normally diverted Beartrap Creek flows around the dam caused runoff to fill the pond, overtop the dam and wash out the east abutment. Runoff water carried heavy loads of gray-colored, pyritic tailings out of the pond area and into the Blackfoot River. Temporary repairs made by the company allowed most of the runoff water to be diverted around the tailings pond, reducing the amount of tailings material entering the river below. However, seepage water from within the pond site continued to carry smaller amounts of material into the river for approximately three weeks. The gray-colored water was evident 15 miles downstream before it became obscured by high, muddy waters of Landers Fork, a major tributary stream (See photos at end of report).

This report summarizes water quality and biological changes which occurred following dam failure.

Water quality, streambed sediment samples, bottom fauna and fisheries data were collected during the problem period. These data were compared with similar data collected during a baseline study from 1970-1973 in anticipation of a proposed open pit mining venture by the Anaconda Company in the Mike Horse Mine area (Spence 1975).

A description of the upper Blackfoot River drainage is found in Spence (1975). The Mike Horse Mill was constructed on Mike Horse Creek in 1919 to process lead and silver. Mining and milling occurred intermittently through the period until about 1954 when the venture was abandoned. During the time the mine was active, a tailings pond was gradually built on Beartrap Creek from mill wastes (See photos). When the dam failed, approximately 100,000 tons of pyritic tailings washed into Beartrap Creek and the upper Blackfoot River (Laird 1975). Metallic constituents of the tails included Cadmium (Cd), Copper (Cu), Iron (Fe), Nickel (Ni), Lead (Pb), Zinc (Zn), Gold (Au), and Silver (Ag). Fe, Pb and Zn were present in the highest concentrations.

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[1] A draft of this report was begun by the Montana Fish and Game Department in 1976 but never completed due to personnel changes, decreased interest in mining in the Heddleston Mining District in the upper Blackfoot River and priorities of other programs. Renewed interest in mining in the upper Blackfoot River has generated requests to Fish, Wildlife & Parks (FWP) for historic information and FWP decided to complete the draft report (in 1982, the Fish and Game Department was renamed the Department of Fish, Wildlife & Parks). This is the report referenced in paragraph 5 of the "Report Supplement" in Spence (1975).

Repairs by the Anaconda Company consisted of rebuilding the break in the dam, placement of additional spillway capacity and refacing the dam with new gravel material. The original 24" outlet pipe under the dam was cleared out at both ends and will continue in use. No further repairs were made to the bypass canal since it is intended the canal will not be used in the future due to its poor condition. A new 54" concrete overflow pipe was installed through the dam to replace the bypass canal. Changes were made to the diversion structure at the head of the pond so that runoff water would more readily be transported into the pond instead of entering the old bypass canal.

During dam repair, four ponds of various sizes were constructed in the Blackfoot River floodplain downstream from the dam. The pond locations were borrow sites for material used to repair the dam. They were designed to help improve fish habitat in this reach of the river.

METHODS

Water Quality

Water quality samples were collected at the sites listed in Table 1 and shown on Map No. 1 (Page A-71 at the end of this report. Several agencies collected samples during the period. Some of the same sites sampled by Spence (1975) were resampled during this study.

Samples collected by all agencies except the US Geological Survey (USGS) were analyzed at the chemistry laboratory, Department of Health and Environmental Sciences (DHES) in Helena. Samples collected by the USGS were analyzed at their Salt Lake City, Utah laboratory.

Bottom Fauna

Bottom fauna samples were collected at two sites on October 2, 1975: (1) Blackfoot River at Pops Place and (2) Blackfoot River at the Flesher Pass road crossing on Highway 279. These two sites were previously sampled by Spence (1975). Three 1-square-foot samples were collected with a modified Waters round square foot stream bottom sampler (Waters 1961). Samples were preserved in 70% alcohol and sorted in the Department of Fish and Game's pollution control laboratory in Helena. Samples were identified to genera by Robert Newell, Department of Fish and Game, Glendive, MT.

Table 1. Water quality sample stations

Location	Date Sampled	Sampled By
Beartrap Creek below Mike Horse Tailings Dam *	6/23/75 6/25/75	US Forest Service Water Quality Bureau, DHES
Blackfoot River above Shoue Gulch	6/23/75 7/1/75 12/23/75 5/13/76	Fish and Game Department Water Quality Bureau, DHES Water Quality Bureau, DHES Fish and Game Department
Shoue Gulch	7/10/75[2]	Fish and Game Department
Blackfoot River Ponds below Pass Creek	7/10/75	Fish and Game Department
Blackfoot River at Pops Place *	6/23/75 6/27/75 7/10/75 12/23/75 5/13/76	Fish and Game Department US Geological Survey Fish and Game Department Water Quality Bureau, DHES Fish and Game Department
Blackfoot River at Flesher Road *	6/23/75 6/25/75 7/10/75 12/23/75 5/13/76	Fish and Game Department Water Quality Bureau, DHES Fish and Game Department Water Quality Bureau, DHES Fish and Game Department
Blackfoot River at Hogum Creek Road *	6/23/75 6/27/75	Fish and Game Department US Geological Survey
Blackfoot River below 7-Up Pete Creek *	6/24/75 6/27/75	US Forest Service US Geological Survey
Blackfoot River at Lincoln	6/25/75	Water Quality Bureau, DHES
Blackfoot River at Dalton Mountain Road Bridge*	6/24/75	US Forest Service
Blackfoot River at Blackfoot Canyon Camp *	6/24/75	US Forest Service

* Indicates same sites sampled by Spence (1975).

[2]All 7/10/75 samples were taken at caged fish sites

Species diversity of the bottom fauna populations before and after dam failure was determined using Shannon-Weaver diversity indices (Shannon and Weaver 1964). Formulae for the indices are given in **Appendix A**. Appendix A also shows Brillouin diversity indices, which are modifications of Shannon-Weaver (Peilou 1969, quoted in Newell 1976a).

Live Caged Fish

Four live cages containing wild cutthroat trout were placed at four locations to measure survival. Cages were placed at the locations listed in Table 2 and shown on Map No. 2 (Page A-72 at the end of this report). Cage No. 4 was a control placed in Shoue Gulch (also known as Shave Gulch), an unaffected tributary entering the Blackfoot River about one mile below the tailings dam.

Table 2. Live cage data

Cage No.	Location	Date Installed	Source of Fish	No. of Fish	Size of Fish
1	Blackfoot River at Flesher Road	7/9/75	Alice Creek	11	4-7"
2	Blackfoot River at Pop's Place	7/9/75	Alice Creek	10	4-7"
3	Blackfoot River Ponds below Pass Creek	7/9/75	½ Alice Creek ½ Pass Creek	10	3-6"
4	Shoue Gulch (control)	7/9/75	Pass Creek	10	4-7"

Cages were checked daily from July 9-13 and the status of fish noted (re. alive and healthy, alive but stressed, dead). Cages were removed after checking them on July 13.

Fish Populations

Electrofishing with a Fisher-Shocker, Model FS-101, powered by a 1500 watt alternator, was conducted on July 11, 1975 to determine if a complete kill of fish had occurred due to the tailings pollution. Sampling was done in the Blackfoot River at Flesher Pass road crossing at a site previously sampled by Spence (1975). Approximately 900 feet of stream were sampled. Prior to this date, water was too high for adequate sampling efficiency and safety. Sampling was also done on a 600-foot section of the Blackfoot River at Pop's Place on July 18, 1975.

A second fish sampling program was done in late September at the Flesher road site. This time a fish population estimate was made using the method of Vincent (1974) and was compared with a

previous estimate made in early September 1973 (Spence 1975). A 2,455-foot section was electrofished with a Smith-Root Type VI backpack shocker. The marking run was made on September 25 and the recapture run on October 2, 1975.

Stream Sediment and Tailings Analyses

One sample of sediment that had washed downstream from the tailings dam was collected and sent to the Montana Bureau of Mines and Geology, Butte, for metals analysis. This sample was arbitrarily collected at a deposition zone in the Blackfoot River upstream from Shoue Gulch on June 23, 1975. Approximately two liters of a sediment/water mixture were collected from the upper 2-3 inches of deposited material. Laboratory results are compared with a sediment sample collected at Pop's Place in 1973.

Two samples of the mine tailings behind the dam were collected by the Anaconda Company on July 10, 1975 and analyzed in their laboratory in Tucson, Arizona. Results of those analyses are given later in this report.

RESULTS

Water Quality

Analytical results of individual water quality samples taken at the sites shown in Table 1 are given in **Appendix B**.

Bottom Fauna

Results of the bottom fauna collected at two stations (Pop's Place and Flesher) in October 1971 and November 1972 (before dam failure) and in October 1975 (after dam failure) are tabulated in Table 3.

The most noticeable differences were at the Flesher station, particularly within genera which contained large numbers of individuals before dam failure and much fewer after failure. For example, in the order Plecoptera, the genus *Alloperla* contained only 67 individuals in 1975 compared to 243 in 1971 and 336 in 1972. Similarly, the genus *Baetis*, in the order Ephemeroptera, contained six individuals in 1975 compared to 157 in 1971 and 81 in 1972. On the other hand, some genera occurred in 1975 which had not been found in 1971 or 1972. Overall, there was a marked reduction in numbers within individual genera in 1975 compared to those present in 1971 and 1972. The number of genera decreased by 65.3% at Pop's Place and 65.2% at Flesher. Total numbers were 86.2% less at Pop's Place and 92.4% less at Flesher. Numbers per square foot decreased 92.5% at Pop's Place and 86.7% at Flesher. The above percentages were calculated using the average of 1971 and 1972 data.

Table 3. Kinds (genera) and numbers of bottom fauna collected in October 1971, November 1972 and October 1975 at Pop's Place and Flesher.

Station No. Sq. Ft. Sampled	Pop's Place 3			Flesher 3			Station No. Sq. Ft. Sampled	Pop's Place 3			Flesher 3		
PLECOPTERA	1971	1972	1975	1971	1972	1975	**TRICOPTERA**	1971	1972	1975	1971	1972	1975
Pteronarcys	-	-	-	-	-	-	Glossosoma	-	-	-	2	2	-
Pteronarcella	-	-	-	-	-	-	Brachycentrus	-	-	-	102	11	-
Nemoura	62	64	-	81	425	4	Hydropsyche	1	-	-	30	125	-
Capnia	-	-	-	28	35	3	Arctopsyche	2	-	-	2	15	2
Isoperla	-	-	-	2	-	-	Rhyacophila	-	1	-	8	20	2
Arcynopteryx	-	-	-	3	13	-	Psychoronia	-	-	-	-	-	-
Acroneuria	-	1	-	7	17	2	Lepidostoma	-	-	-	-	-	-
Claassenia	-	-	-	4	20	-	Hydroptila	-	-	-	1	-	-
Alloperla	54	158	27	243	336	67	Limnephilidae	-	-	-	3	2	-
Brachyptera	-	-	-	-	-		Parapsyche	1	2	-	-	5	-
Isogenus	24	8	-	15	26	-	Tinodes	-	-	-	-	-	-
Hastaperla	-	-	-	-	-	-	Chimarra	-	-	-	-	-	-
Paraperla	5	-	2	6	-	1	Ochrotrichia	-	-	-	-	-	-
Eucapnopsis	18	-	-	-	-	-	Psychomylidae	-	-	-	-	-	-
Chloroperlidae	-	-	-	-	-	-	Anagapetus	-	-	-	-	-	-
Perlodidae	-	-	-	-	-	-	Agraylea	-	-	-	-	-	-
Leuctra	-	2	-	46	-	-	Sortosa	-	1	-	-	-	-
Unknown	-	-	-	-	-	-	Unknown	-	-	-	-	-	-
TOTAL	163	233	29	435	872	77	TOTAL	4	4	0	148	180	4
EPHEMEROPTERA							**DIPTERA**						
Baetis	-	-	-	157	81	6	Ephidiidae	-	2	-	-	-	-
Paraleptophlebia	-	-	-	-	-	-	Simuliidae	-	-	-	-	18	-
Ephemerella	-	-	-	3	-	1	Atherix	-	-	1	-	-	-
Rhithrogena	-	-	-	-	-	1	Hexatoma	-	-	-	5	2	-
Cinygmula	-	-	-	57	8	-	Empididae	-	-	-	1	-	-
Epeorus	-	-	-	-	-	-	Brillia	-	-	-	-	-	-
Ameletus	-	-	-	-	-	-	Rhabdomastix	-	-	-	-	-	-
Heptagenia	-	-	-	-	-	-	Orthocladius	-	-	-	32	-	-
Unknown	-	-	-	-	-	-	Dicranota	-	-	-	4	-	-
							Metriocnemus	1	-	-	-	-	-

Station No. Sq. Ft. Sampled	Pop's Place 3			Flesher 3			Station No. Sq. Ft. Sampled	Pop's Place 3			Flesher 3		
TOTAL	0	0	0	217	89	8	Antocha	1	-	-	351	34	1
	1971	1972	1975	1971	1972	1975		1971	1972	1975	1971	1972	1975
							DIPTERA cont.						
COLEOPTERA							Cardiocladius	-	-	-	-	-	-
Optioservus	-	-	-	-	-	-	Pericoma	-	-	-	208	69	-
Heterlimnius	-	-	-	-	-	4	Tanytarsus	-	-	-	-	-	-
Zaitsevia	1	-	-	-	5	-	Pentaneura	-	-	-	-	-	-
Cleptelmis	-	-	-	-	-	-	Diamesa	-	-	-	-	-	-
Brychius	-	-	-	-	-	-	Heleinae	-	-	-	-	-	2
Lara	-	-	-	-	-	-	Chironomidae	25	15	1	-	21	5
Narpus	-	-	-	-	-	-	Dolichopodidae	-	-	-	-	-	-
TOTAL	1	0	0	0	5	4	Tanypodinae	-	-	-	8	-	-
OLIGOCHAETA & NEMATODA	-	1	-	4	2	2	Tanytarsini	-	-	-	1	-	-
							Pentaneurini	-	-	-	-	-	-
TOTAL	0	1	0	4	2	0	TOTAL	27	17	2	610	144	8
GRAND TOTAL	195	255	31	1414	1292	103							
AVE NO/SQ FT	65	85	10	471	431	34							

Note: For reference purposes, Table 3 shows the families or genera of bottom fauna collected during the study by Spence (1975) whether or not they were found at the stations sampled during the current study.

Figure 1 illustrates the total numbers of bottom fauna, Figure 2 the number of bottom fauna per square foot and Figure 3 the number of bottom fauna genera before and after failure of the tailings dam.

A newly constructed beaver dam had flooded out the Pop's Place station sampled in 1971 and 1972. Therefore, the 1975 sample site was moved about 100 feet upstream from the previous site and on a similar substrate type.

Species Diversity

Species diversity indices are used to analyze the structure of a biological community through the use of information theory (Newell 1976a). In analyzing community structure, information theorists ask how much new knowledge or "information" about species composition can be obtained by drawing individuals at random (Newell 1976a). As sample size increases, the diversity of the pooled samples increases rapidly at first, then levels off. Since diversity of individual samples is highly variable, it is preferable to report the diversity of the pooled samples (Newell 1977).

Figure 1. Total number of bottom fauna found at Pop's Place and Flesher before and after Mike Horse Dam failure.

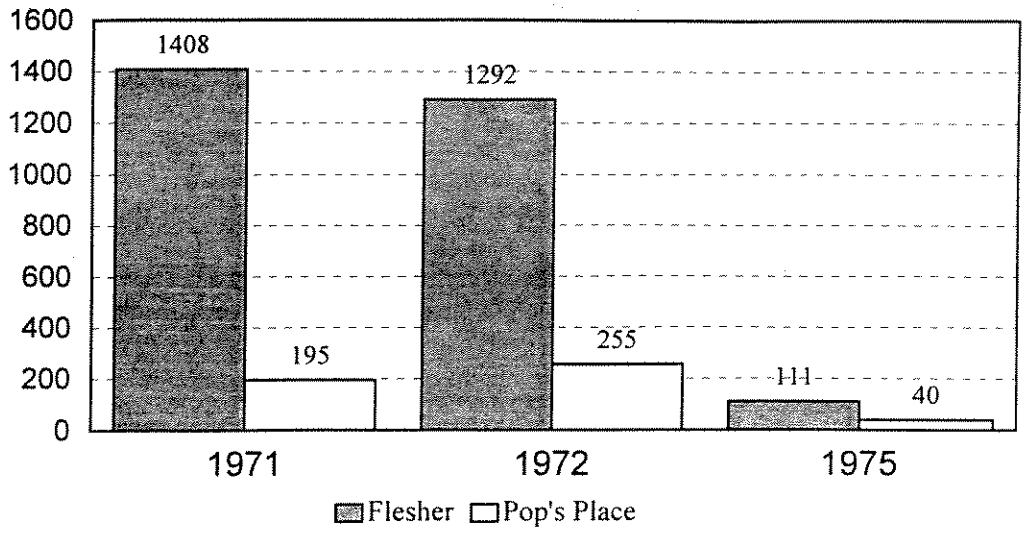


Figure 2. Average number of bottom fauna per square foot at Pop's place and Flesher before and after Mike Horse Dam failure.

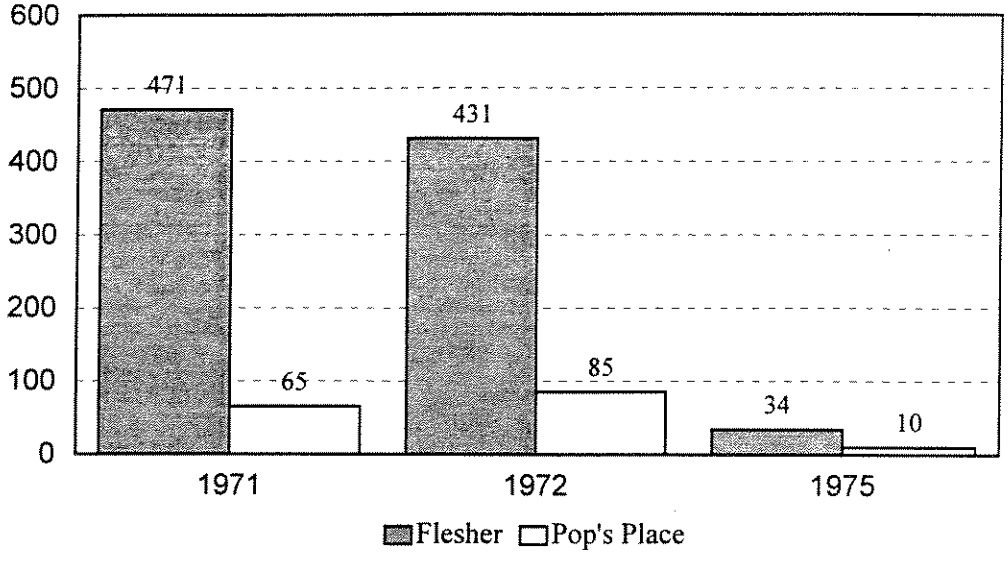
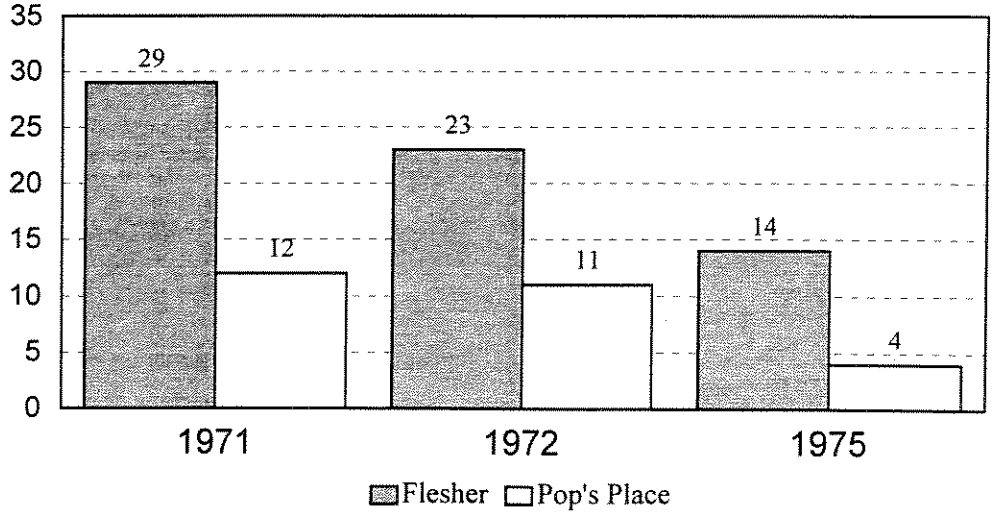


Figure 3. Number of bottom fauna genera found at Pop's Place and Flesher before and after Mike Horse Dam failure.



With the Shannon-Weaver index, an index above 3.0 generally reflects a healthy, unstressed community while an index below 1.0 indicates a monospecific community under stress. An index range of 1.0-3.0 seems to indicate a community under some stress (Newell 1976a). A low diversity index indicates a largely monotypic community dominated by a few abundant organisms. Often the total number of species is low, suggesting that degraded environmental conditions exist which favor the proliferation of a few tolerant species and the removal of less tolerant ones. A high diversity index indicates a heterogeneous community in which abundance is distributed more evenly among a number of species and the total number of species is generally high (Newell 1977).

Theoretical maximum diversity (Dmax) exists if each individual belongs to a different species and theoretical minimum diversity (Dmin) exists if all individuals belong to the same species. The distribution of individuals among species lies between these extremes in most communities and diversity is intermediate. Redundancy (R) is an expression of the dominance of one or more species and is inversely proportional to the wealth of species (Wilhm and Dorris 1968). Redundancy is always between 0 and 1. The numerical value for diversity (D) lies between Dmax and Dmin and shows the actual diversity of the aquatic community as compared to the maximum and minimum diversities which could have occurred in the given sample. When diversity is high, redundancy is low and vice verse (Spence 1975).

Comparisons of bottom fauna diversity before and after dam failure using the Shannon-Weaver diversity indices are shown in Table 4. The indices are based on pooling three one-square-foot samples at Pop's Place in 1971 and 1972, four one-square-foot samples at Pop's Place in 1975 and three one-square-foot samples at Flesher in 1975. The 1971 data for Pop's Place are taken from Spence (1975), page A-86, since diversity indices had already been calculated. Diversity indices had not been calculated by Spence (1975) for the October, 1971 samples at Flesher but the data (See p. A-90) were used to calculate the indices after dam failure. The 1972 Flesher samples had not been identified when the Spence (1975) report was completed. These samples, as well as the 1975 samples, were identified by Robert Newell after dam failure. Pooled data for all the samples (except for 1971 at Pop's Place) are shown in **Appendix C-1.**

Diversity indices for each one-square-foot sample collected before and after dam failure are shown in Table 5 and **Appendix C-2**)

Table 4. Shannon-Weaver species diversity indices for bottom fauna collected in 1971, 1972 and 1975 at Pop's Place and Flesher stations.

	Pop's Place			Flesher		
	October 1971	November 1972	October 1975	October 1971	November 1972	October 1975
Diversity	2.51	1.62	0.95	3.33	3.04	2.41
D. Max	3.58	3.46	2.58	4.81	4.52	4.09
D. Min	0.51	0.37	0.83	0.23	0.20	1.17
Redundancy	0.35	0.60	0.94	0.32	0.34	0.57

In analyzing whether significant differences in diversity indices occur between samples, Cairns (1967) states that ....."For biologically oriented readers, my own operational definition of optimal is the ability to support an aquatic community in a pattern which does not vary more than 20 percent from the empirically estimated maximum steady-state diversity possible in each particular locale." Newell (1976b and **Appendix D**) interprets this to mean that variations of up to 20% of maximum observed diversity can be called normal and healthy but deviations over 20% are called unhealthy.

The highest diversity indices found for the pooled data at Pop's Place and Flesher for 1971 and 1972 were compared with the diversity indices at the two stations for 1975 (See Table 4). These comparisons show a 62.2% deviation at Pop's Place and 27.6% deviation at Flesher, indicating a signficant difference in bottom fauna populations, particularly at Pop's Place, as a result of dam failure.

Table 5. Diversity indices for each one-square-foot sample collected at Pop's Place and Flesher during 1971, 1972 and 1975.

	Treatments (Years)			
	1971	**1972**	**1975**	**Total**
Pop's Place	2.11	1.26	0.44	
	2.17	1.41	0.50	
	2.47	1.60	0.68	
Sub-Total	**6.75**	**4.27**	**1.62**	**12.64**
Flesher	3.01	2.75	2.10	
	3.31	2.84	2.12	
	3.34	2.97	2.14	
Sub-Total	**9.66**	**8.56**	**6.36**	**24.58**
Total	**16.41**	**12.83**	**7.98**	**37.22**

Live Caged Fish

Results of this test are shown in Table 6. More detailed data are given in **Appendix E**.

The data show that the tailings pollution caused mortality in caged fish. Excluding those trout which escaped, the percent mortality which occurred in each cage was as follows:

Cage #1 (Flesher road)	7/9	=	78%
Cage #2 (Pop's Place)	10/10	=	100%
Cage #3 (Below Pass Cr.)	7/10	=	70%
Cage #4 (Shoue Gulch)	0/6	=	0%

The specific cause of mortality (suspended sediment, metals, etc.) was not determined.

Fish Populations

The electrofishing done on July 11, 1975 at the Flesher station produced 27 cutthroat trout averaging 4.9 inches long and 22 brook trout averaging 5.0 inches long. Thirty-eight (38) slimy sculpin between 1.5-4.6 inches in length were also captured in the 900-foot section. The data show that the dam failure did not completely eliminate the existing fish populations.

The Pop's Place station was similarly sampled on July 18, 1975. Seven cutthroat trout averaging 6.3 inches long and 54 brook trout averaging 4.8 inches long were captured in a 400-foot section, again showing there was not a complete kill of trout. No sculpin were observed in the section. However, very few sculpin were found at this location in sampling prior to dam failure (Spence 1975, p. A-130).

The trout population estimate made in September, 1975 at the Flesher station showed that, compared to 1973, there was a total reduction of 83% for all sizes of cutthroat trout and 77% for brook trout after dam failure (Table 7). Most of the reduction in cutthroat occurred in the smaller size groups (1.5-4.9 inches). There was also a reduction in larger sizes of cutthroat. Confidence limits are at the 80% probability level for both the 1973 and 1975 estimates. The data indicate that cutthroat were either unsuccessful in spawning during the spring of 1975 or there was a large mortality of eggs and/or fry in gravels after spawning took place. There were insufficient recaptures of marked brook trout in 1975 to estimate their numbers by separate age groups. The reduction in total numbers was statistically significant at the 80% probability level for both cutthroat and brook trout.

Stream Sediment and Tailings Analyses

The data presented show what metals were present in the mine tailings behind the dam and the principal metals found in sediments in the Blackfoot River before and after dam failure.

Results of analyses of the sediment sample collected above Shoue Gulch in 1975 are given in **Appendix F**. The analyses show that only small amounts of each metal were carried in dissolved form (Table I) but high concentrations were carried in suspended form (Table IV). Some of the water quality analyses that reported dissolved fractions showed the same results, i.e., only small amounts of metals were dissolved in runoff waters (See Appendix B).

Table 6. Test Results of Live-caged Fish.

Date Checked	Time	Alive	Dead	Comments
Cage Number 1 - Blackfoot River at Flesher Road, 11 cutthroat				
7/9/75	1515	11	-	Cage installed
7/10/75	1115	9	1	1 fish escaped through hole
7/11/75	1300	3	6	Dead fish decomposing
7/12/75	1200	3	0	Alive fish active
7/13/75	1530	2	0	1 fish escaped. Cage Removed
Cage Number 2 - Blackfoot River at Pop's Place, 10 cutthroat				
7/9/75	1700	10	-	Cage installed
7/10/75	1330	10	-	All fish very active
7/11/75	1330	5	5	Dead fish decomposing, 1 live fish stressed
7/12/75	1215	1	4	Very little decomposition yet
7/13/75	1550	0	1	Cage removed
Cage Number 3 - Blackfoot River Ponds below Pass Creek, 10 cutthroat				
7/9/75	1750	10	-	Cage installed
7/10/75	1410	9	1	3 live fish distressed
7/11/75	1345	5	4	Dead fish badly decomposed
7/12/75	1230	3	2	3 live fish distressed
7/13/75	1610	3	0	Cage removed
Cage Number 4 - Shoue Gulch (Control) 10 cutthroat				
7/9/75	1900	10	-	Cage installed
7/10/75	1530	6	0	4 fish escaped through hole
7/11/75	1400	6	0	All fish very active
7/12/75	1340	6	0	All fish very active
7/13/75	1635	6	0	All fish very active. Cage removed

Table 7. Trout population estimates at Flesher station before and after tailings dam failure. Confidence limits are at the 80% probability level.

Cutthroat Trout

Before failure (1973) - Section length = 2,455 Feet

	Length (inches)	Number Estimate	Weight Estimate, lbs
	1.5-4.9	380 ± 98	6
	5.0-10.9	58 ± 16	6
Total		438 ± 99 (23%) (399-537)	12 ± 2 (17%)
Total/1000 ft.		178	4.89

After failure (1975) - Section length = 2,455 Feet

	Length (inches)	Number Estimate	Weight Estimate, lbs
	1.5 - 4.9	44 ± 15	1 ± 0
	5.0 - 8.9	31 ± 8	3 ± 1
Total		75 ± 17 (23%) (58-92)	4 ± 1 (25%)
Total/1000 ft.		31	1.6

Percent Reduction - Numbers

1.5 - 4.9	=	88%	(100- 44/380 x 100)
5.0 - 10.9	=	47%	(100 - 31/58 x 100)
Total	=	83%	(100 - 75/438 x 100)

- Weight

1.5 - 4.9	=	83%	(100 - 1/6 x 100)
5.0 - 10.9	=	50%	(100 - 3/6 x 100)
Total	=	67%	(100 - 1.6/4.9 x 100)

Brook Trout

Before failure (1973) - Section length = 2,455 Feet

	Length (inches)	Number Estimate	Weight Estimate, lbs
	2.0 - 4.9	231 ± 83	3 ± 1
	5.0 - 9.1	35 ± 9	3 ± 1
Total		266 ± 84 (32%) (182-350)	6 ± 2 (33%)
Total/1000 feet		108	2.44

After failure (1975) - Section length = 2,455 Feet

	Length (inches)	Number Estimated	Weight Estimate, lbs
	2.0 - 10.9*	60 ± 19 (32%)	6 ± 2 (33%)
Total/1000 feet		24	2.44

*Length groups combined due to insufficient recaptures in lower age group for separate estimate.

Percent Reduction - Numbers

2.0 - 10.9	=	77%	(100 - 60/266 x 100)

- Weight

None

Table 8 compares the metal content of sediment samples collected in the Blackfoot River before (1973) and after (1975) dam failure. Except for Cd, higher concentrations of metals occurred in the 1975 sediment sample than occurred in the 1973 sample. The 1975 sample was not collected at the same site as the 1973 sample and this may account for some of the variation. For purposes of comparing the two samples, only the Tyler Sieve (mesh) U.S. Standard No. (-100) fraction is shown in Table 8.

Table 8. Concentration of metals in sediment collected at Pop's Place in 1973 and below Shoue Gulch in 1975 (-100 fraction).

	Metal and Concentration (ug/gram)					
	Cd	Cu	Ni	Pb	Zn	Fe
1973[3]	282.5	700	50	400	4,080	36,600
1975[4]	29.0	952	75	976	4,836	64,800

Analyses of the two tailings samples collected by the Anaconda Company gave the results shown in **Appendix G**.

DISCUSSION

Water quality and biological sampling showed that the Mike Horse Dam failure adversely effected fish and bottom fauna populations in the upper Blackfoot River, although it was not specifically determined how these effects occurred.

A possible cause for mortality of smaller cutthroat trout is sediment deposition during the cutthroat spawning and rearing period which prevented egg and fry development and, consequently, resulted in reduced numbers of young-of-the-year trout. Some other mechanism, such as high concentrations of suspended sediment, may have been responsible for reduction in larger trout of both species as well as for young-of-the-year brook trout from the 1974 fall spawning season. Suspended sediment can cause physical damage to the fish, but some literature indicates that large quantities of sediment are needed to cause direct fish mortalities (Cordone and Kelly 1961). Suspended sediment samples were not collected in 1975 but turbidity readings were made. The highest turbidity recorded during the period was 5200 JTU on June 25 in

[3]See Spence (1975), Appendix D, p. A75, Field No. 8 and Lab No. 8.

[4]See Appendix E, Table IV (-100 fraction) in this report.

Beartrap Creek immediately below the dam. On the same day, the turbidity at the Flesher station, 7.5 miles downstream was 82 JTU. No turbidity was determined at Pop's Place on that date. The beaver ponds below Pass Creek apparently settled out much of the suspended material and clear water from tributary streams diluted the sediment concentration between the two stations. On June 23, turbidity at Pop's Place was 290 JTU. The maximum turbidity recorded at Flesher prior to dam failure was 5.2 JTU (Spence 1975).

Most of the caged trout died in a short time period while some uncaged trout remained alive in the same sections (as shown by electrofishing). Live cage mortality could have been partly due to stress caused by handling in addition to the poor water quality conditions present. However, this is not likely since the control fish in Shoue Gulch underwent the same handling procedure and none of them suffered mortality.

Bottom fauna were noticeably decreased after dam failure at the two stations sampled. There were marked differences in numbers of individuals, numbers per square foot and numbers of genera after dam failure. Diversity indices also showed significant reductions in fauna as a result of dam failure.

Continued impacts to the aquatic biota are possible because of the metals which were deposited along the floodplain. As these fine sediment particles are exposed to oxygen, they may oxidize into a more available form. If substantial amounts of sulfides are present, sulfide oxidation to sulfate will make the SO_4 ion more soluble in water. Sulfate and water will produce sulfuric acid which will lower the pH, which will allow previously undissolved metals to go into solution, causing stress to the more sensitive aquatic biota. Thus, even though the released tailings were more or less neutral in pH, their presence in the system could alter the future chemical/biological condition of the river.

Some newspaper articles about the dam failure are presented in **Appendix H**.

Appendix I contains some photographs taken before and after dam failure.

Appendix J contains maps showing water quality sampling sites and locations of fish live cages.

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APPENDICES

Page

SHANNON DIVERSITY INDEXES

$$D = -\sum_{i}^{s} (N_i/N)\log(N_i/N) = \log(N) - \sum_{i}^{s} (N_i/N)\log(N_i)$$

$$DMAX = \log(S)$$

$$DMIN = \log(N) - \left(\frac{N-S+1}{N}\right)\log(N-S+1)$$

$$RD = \frac{DMAX - D}{DMAX - DMIN}$$

$$EV = D/DMAX = D/\log S$$

$$EQ = D/\log(N)$$

$$SR = D - EQ$$

From: Newell, R. L. 1976. Yellowstone River Study. Final Report. Mont. Dept. Fish and Game and Intake Water Co. 97 pp. + appendices.

BRILLOUIN DIVERSITY INDEXES

$$D = \frac{1}{N}\log\left\{N!/\prod_i^S N_i!\right\} = \frac{1}{N}\left\{\log(N!) - \sum_i^S \log(N_i!)\right\}$$

$$DMAX = \frac{1}{N}\log\left\{\frac{N!}{(X!)^{S-R}(Y!)^R}\right\} = \frac{1}{N}\left\{\log(N!) - (S-R)\log(X!) - R\log(Y!)\right\}$$

$$DMIN = \frac{1}{N}\log\left\{\frac{N!}{(N-S+1)!}\right\} = \frac{1}{N}\left\{\log(N!) - \log[(N-S+1)!]\right\}$$

$$RD = \frac{DMAX - D}{DMAX - DMIN}$$

$$EV = D/DMAX$$

$$EQ = D/\left\{\frac{1}{N}\log(N!)\right\}$$

$$SR = D - EQ$$

NOTATION

D = DIVERSITY

DMAX = MAXIMUM DIVERSITY

DMIN = MINIMUM DIVERSITY

RD = REDUNDANCY

EV = EVENNESS

EQ = EQUITABILITY

SR = SPECIES RICHNESS

S = NUMBER OF TAXA IN SAMPLE

N_i = NUMBER OF INDIVIDUALS IN TAXON i

$N = \sum_{i}^{S} N_i$

X = LARGEST INTEGER $\leq N/S$

Y = X + 1

R = N - S*X

STATE HEALTH DEPT. WATER QUALITY BUREAU HELENA, MONTANA 59601

STATE	MONTANA	COUNTY	LEWIS+CLARK
LAT.-LONG.	47 143N 1122115W	SAMPLE LOCATION	15N 6W 27BCD
STATION CODE		ANALYSIS NUMBER	75W1002
DATE SAMPLED	06-23-75	DRAINAGE BASIN	76F
TIME SAMPLED	1030	WATER FLOW RATE	
METHOD SAMPLED	GRAB	FLOW MEASUREMENT METHOD	
SAMPLE SOURCE	STREAM	ALTITUDE OF LAND SURFACE	
WATER USE	UNUSED	TOTAL WELL DEPTH BELOW LS	
AQUIFER(S)		SWL ABOVE(+) OR BELOW LS	
SAMPLED BY	USFS	SAMPLE DEPTH BELOW SURFACE	

SAMPLING SITE: BEARTRAP CREEK BELOW MIKE HORSE DAM

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)			BICARBONATE(HCO3)		
MAGNESIUM (MG)			CARBONATE (CO3)		
SODIUM (NA)			CHLORIDE (CL)		
POTASSIUM (K)			SULFATE (SO4)		
IRON (FE)			FLUORIDE (F)		
MANGANESE (MN)			NITRATE (NO3 AS N)		
ALUMINUM (AL)			NO3+NO2 (TOT AS N)		
HYDROGEN (H+)			PHOSPHATE(PO4 AS P)		
TOTAL CATIONS	0.0		TOTAL ANIONS	0.000	

LABORATORY PH		TOTAL HARDNESS AS CACO3	
FIELD WATER TEMPERATURE (C)		TOTAL ALKALINITY AS CACO3	
DISSOLVED SOLIDS CALCULATED		LAB TURBIDITY (JTU)	
LAB CONDUCTIVITY-UMHOS-25C		SODIUM ADSORPTION RATIO	

ADDITIONAL PARAMETERS

ARSENIC,TR (MG/L AS AS)	.066	IRON,TR (MG/L AS FE)	110.
COPPER,TR (MG/L AS CU)	1.1	ZINC,TR (MG/L AS ZN)	9.0
LEAD,TR (MG/L AS PB)	16.	CADMIUM, TR (MG/L AS CD)	.05
MANGANESE,TR(MG/L AS MN)	83.	ARSENIC,TOT (MG/L AS AS)	.087
LEAD, TOTAL (MG/L AS PB)	18.	IRON, TOTAL (MG/L AS FE)	120.
COPPER,TOTAL(MG/L AS CU)	1.1	CADMIUM,TOT (MG/L AS CD)	.05
ZINC, TOTAL (MG/L AS ZN)	9.0	MANGANESE, TOT (MG/L-MN)	92.

REMARKS: MIKE HORSE DAM FAILURE EXTREMELY TURBID,GRAY COLOR, THICK APPEARANCE, HIGH FLOW

EXPLANATION: MG/L=MILLIGRAMS PER LITER MEQ/L=MILLIEQUIVILENTS PER LITER ALL CONSTITUENTS DISSOLVED (DISS) EXCEPT AS NOTED. TOT=TOTAL SUSP=SUSPENDED (M)= MEASURED(R)=REPORTED (E)=ESTIMATED M=METERS TR=TOTAL RECOVERABLE

SAMPLE NO SAMPLER JRT HANDLING 1100 ANALYST ME LAB WQBH
COMPLETED 07-09-75 COMPUTER RUN 07/15/75 PROGRAM SYS 75 FUND 0650

STND DEV. ION BALANCE 0.00	CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
SEGMENT MPDES	0.0	0.0	0.0	0.0	33.3	33.3	0.0	33.3	0.0

STATE HEALTH DEPT. WATER QUALITY BUREAU HELENA, MONTANA 59601

STATE	MONTANA	COUNTY	LEWIS+CLARK
LAT.-LONG.	47 140N 11222 7W	SAMPLE LOCATION	15N 6W 28
STATION CODE		ANALYSIS NUMBER	75W1034
DATE SAMPLED	06-25-75	DRAINAGE BASIN	76F
TIME SAMPLED	1300	WATER FLOW RATE	15.00CFS(E)
METHOD SAMPLED	GRAB	FLOW MEASUREMENT METHOD	NOT MEASURED
SAMPLE SOURCE	STREAM	ALTITUDE OF LAND SURFACE	
WATER USE	UNUSED	TOTAL WELL DEPTH BELOW LS	
AQUIFER(S)		SWL ABOVE(+) OR BELOW LS	
SAMPLED BY	WQBH	SAMPLE DEPTH BELOW SURFACE	

SAMPLING SITE: JUST BELOW MIKE-HORSE TAILINGS POND (BEARTRAP CREEK)

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)			BICARBONATE(HCO3)		
MAGNESIUM (MG)			CARBONATE (CO3)		
SODIUM (NA)			CHLORIDE (CL)		
POTASSIUM (K)			SULFATE (SO4)		
IRON (FE)	.10	0.005	FLUORIDE (F)		
MANGANESE (MN)	.08	0.003	NITRATE (NO3 AS N)		
ALUMINUM (AL)			NO3+NO2 (TOT AS N)		
HYDROGEN (H+)			PHOSPHATE(PO4 AS P)		
TOTAL CATIONS		0.008	TOTAL ANIONS		0.000

LABORATORY PH		TOTAL HARDNESS AS CACO3	
FIELD WATER TEMPERATURE (C)	5.5	TOTAL ALKALINITY AS CACO3	
DISSOLVED SOLIDS CALCULATED		LAB TURBIDITY (JTU)	5200.
LAB CONDUCTIVITY-UMHOS-25C	171.	SODIUM ADSORPTION RATIO	

ADDITIONAL PARAMETERS

SEDIMENT,TOT,SUSP (MG/L)	10480.	ARSENIC,DISS(MG/L AS AS)	< .001
CADMIUM,DISS(MG/L AS CD)	.003	COPPER,DISS(MG/L AS CU)	< .01
LEAD DISS(MG/L AS PB)	< .05	ZINC,DISS(MG/L AS ZN)	.01
COPPER,TR (MG/L AS CU)	2.8	COPPER,TOTAL(MG/L AS CU)	6.6
MANGANESE,TR(MG/L AS MN)	120.	MANGANESE, TOT (MG/L-MN)	120.
IRON,TR (MG/L AS FE)	150.	IRON, TOTAL (MG/L AS FE)	720.
CADMIUM, TR (MG/L AS CD)	.17	CADMIUM,TOT (MG/L AS CD)	.27
ZINC,TR (MG/L AS ZN)	54.	ZINC, TOTAL (MG/L AS ZN)	70.
LEAD,TR (MG/L AS PB)	35.	LEAD, TOTAL (MG/L AS PB)	35.
ARSENIC,TR (MG/L AS AS)	.17	ARSENIC,TOT (MG/L AS AS)	1.9

REMARKS: MIKE-HORSE MINE SURVEILL. VERY TURBID-METALLIC GRAY COLOR

EXPLANATION: MG/L=MILLIGRAMS PER LITER MEQ/L=MILLIEQUIVILENTS PER LITER
ALL CONSTITUENTS DISSOLVED (DISS) EXCEPT AS NOTED. TOT=TOTAL SUSP=SUSPENDED
(M)= MEASURED(R)=REPORTED (E)=ESTIMATED M=METERS TR=TOTAL RECOVERABLE

SAMPLE NO 1 SAMPLER MJP HANDLING 3210 ANALYST KEV LAB WQBH
COMPLETED 08-04-75 COMPUTER RUN 08/06/75 PROGRAM SYS 75 FUND 0650

	CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
STND DEV. ION BALANCE -0.08									
SEGMENT MPDES	0.0	0.0	0.0	0.0	33.3	33.3	0.0	33.3	0.0

STATE HEALTH DEPT. WATER QUALITY BUREAU HELENA, MONTANA 59601

STATE	MONTANA	COUNTY	LEWIS+CLARK
LAT.-LONG.	47 229N 1122453W	SAMPLE LOCATION	15N 6W 19CAB
STATION CODE		ANALYSIS NUMBER	75W1001
DATE SAMPLED	06-23-75	DRAINAGE BASIN	76F
TIME SAMPLED	1320	WATER FLOW RATE	
METHOD SAMPLED	GRAB	FLOW MEASUREMENT METHOD	NOT MEASURED
SAMPLE SOURCE	STREAM	ALTITUDE OF LAND SURFACE	
WATER USE	UNUSED	TOTAL WELL DEPTH BELOW LS	
AQUIFER(S)		SWL ABOVE(+) OR BELOW LS	
SAMPLED BY	MF+G	SAMPLE DEPTH BELOW SURFACE	

SAMPLING SITE: BLACKFOOT RIVER ABOVE SHOUE GULCH

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)			BICARBONATE(HCO3)	73.	1.20
MAGNESIUM (MG)			CARBONATE (CO3)	0.	0.0
SODIUM (NA)			CHLORIDE (CL)		
POTASSIUM (K)			SULFATE (SO4)	85.	1.77
IRON (FE)	< .01		FLUORIDE (F)		
MANGANESE (MN)	.42	0.015	NITRATE (NO3 AS N)		
ALUMINUM (AL)			NO3+NO2 (TOT AS N)		
HYDROGEN (H+)	0.00	0.000	PHOSPHATE(PO4 AS P)		
TOTAL CATIONS		0.015	TOTAL ANIONS		2.96

LABORATORY PH	7.58	TOTAL HARDNESS AS CACO3	
FIELD WATER TEMPERATURE (C)		TOTAL ALKALINITY AS CACO3	60
DISSOLVED SOLIDS CALCULATED		LAB TURBIDITY (JTU)	190.
LAB CONDUCTIVITY-UMHOS-25C	250.	SODIUM ADSORPTION RATIO	

ADDITIONAL PARAMETERS

SEDIMENT,TOT,SUSP (MG/L)	2348.	ARSENIC,DISS(MG/L AS AS)	.005
CADMIUM,DISS(MG/L AS CD)	.005	COPPER,DISS(MG/L AS CU)	< .01
LEAD DISS(MG/L AS PB)	< .5	ZINC,DISS(MG/L AS ZN)	.78
ARSENIC,TR (MG/L AS AS)	.025	IRON,TR (MG/L AS FE)	25.
COPPER,TR (MG/L AS CU)	.42	ZINC,TR (MG/L AS ZN)	3.8
LEAD,TR (MG/L AS PB)	4.2	CADMIUM, TR (MG/L AS CD)	.02
MANGANESE,TR(MG/L AS MN)	19.	ARSENIC,TOT (MG/L AS AS)	.028
LEAD, TOTAL (MG/L AS PB)	4.2	IRON, TOTAL (MG/L AS FE)	25.
COPPER,TOTAL(MG/L AS CU)	.42	CADMIUM,TOT (MG/L AS CD)	.02
ZINC, TOTAL (MG/L AS ZN)	3.8	MANGANESE, TOT (MG/L-MN)	22.

REMARKS: MIKE HORSE DAM FAILURE EXTREMELY TURBID,GRAY COLOR, THICK APPEARANCE, HIGH FLOW

EXPLANATION: MG/L=MILLIGRAMS PER LITER MEQ/L=MILLIEQUIVILENTS PER LITER ALL CONSTITUENTS DISSOLVED (DISS) EXCEPT AS NOTED. TOT=TOTAL SUSP=SUSPENDED (M)= MEASURED(R)=REPORTED (E)=ESTIMATED M=METERS TR=TOTAL RECOVERABLE

SAMPLE NO SAMPLER LES HANDLING 3210 ANALYST LAB LAB WQBH
COMPLETED 07-14-75 COMPUTER RUN 07/15/75 PROGRAM SYS 75 FUND 0650

STND DEV. ION BALANCE 9.99	CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
SEGMENT MPDES	0.0	0.0	0.0	0.0	0.0	59.6	40.4	0.0	0.0

STATE HEALTH DEPT. WATER QUALITY BUREAU HELENA, MONTANA 59601

STATE	MONTANA	COUNTY	LEWIS+CLARK
LAT.-LONG.		SAMPLE LOCATION	14N 8W
STATION CODE		ANALYSIS NUMBER	75W1089
DATE SAMPLED	07-01-75	DRAINAGE BASIN	76F
TIME SAMPLED	1615	WATER FLOW RATE	5. CFS(E)
METHOD SAMPLED	GRAB	FLOW MEASUREMENT METHOD	NOT MEASURED
SAMPLE SOURCE	STREAM	ALTITUDE OF LAND SURFACE	
WATER USE	UNUSED	TOTAL WELL DEPTH BELOW LS	
AQUIFER(S)		SWL ABOVE(+) OR BELOW LS	
SAMPLED BY	WQBH	SAMPLE DEPTH BELOW SURFACE	

SAMPLING SITE: BLACKFOOT R ABOVE SHAVE (SHOUE) GULCH

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)			BICARBONATE(HCO3)		
MAGNESIUM (MG)			CARBONATE (CO3)		
SODIUM (NA)			CHLORIDE (CL)		
POTASSIUM (K)			SULFATE (SO4)		
IRON (FE)	3.5	0.168	FLUORIDE (F)		
MANGANESE (MN)	1.4	0.051	NITRATE (NO3 AS N)		
ALUMINUM (AL)			NO3+NO2 (TOT AS N)		
HYDROGEN (H+)	0.00	0.000	PHOSPHATE(PO4 AS P)		
TOTAL CATIONS		0.239	TOTAL ANIONS		0.000

LABORATORY PH	7.82	TOTAL HARDNESS AS CACO3	
FIELD WATER TEMPERATURE (C)		TOTAL ALKALINITY AS CACO3	
DISSOLVED SOLIDS CALCULATED		LAB TURBIDITY (JTU)	150.
LAB CONDUCTIVITY-UMHOS-25C	255.	SODIUM ADSORPTION RATIO	

ADDITIONAL PARAMETERS

ARSENIC,DISS(MG/L AS AS)	.013	CADMIUM,DISS(MG/L AS CD)	.008
COPPER,DISS(MG/L AS CU)	.05	LEAD DISS(MG/L AS PB)	.23
ZINC,DISS(MG/L AS ZN)	1.9	COPPER,TR (MG/L AS CU)	3.1
COPPER,TOTAL(MG/L AS CU)	4.7	MANGANESE,TR(MG/L AS MN)	13.
MANGANESE, TOT (MG/L-MN)	13.	IRON,TR (MG/L AS FE)	27.
IRON, TOTAL (MG/L AS FE)	58.	ZINC,TR (MG/L AS ZN)	4.9
ZINC, TOTAL (MG/L AS ZN)	5.8	CADMIUM, TR (MG/L AS CD)	.019
CADMIUM,TOT (MG/L AS CD)	.021	LEAD,TR (MG/L AS PB)	.25
LEAD, TOTAL (MG/L AS PB)	.27	ARSENIC,TR (MG/L AS AS)	.16
ARSENIC,TOT (MG/L AS AS)	.29		

REMARKS: MIKE HORSE DAM FAILURE WATER GREY & TURBID

EXPLANATION: MG/L=MILLIGRAMS PER LITER MEQ/L=MILLIEQUIVILENTS PER LITER ALL CONSTITUENTS DISSOLVED (DISS) EXCEPT AS NOTED. TOT=TOTAL SUSP=SUSPENDED (M)= MEASURED(R)=REPORTED (E)=ESTIMATED M=METERS TR=TOTAL RECOVERABLE

SAMPLE NO 100 SAMPLER MKB HANDLING 3210 ANALYST KEV LAB WQBH
COMPLETED 08-04-75 COMPUTER RUN 08/06/75 PROGRAM SYS 75 FUND 0650

STND DEV. ION BALANCE -2.21	CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
SEGMENT MPDES	0.0	0.0	0.0	0.0	33.3	33.3	0.0	33.3	0.0

STATE HEALTH DEPT. WATER QUALITY BUREAU HELENA, MONTANA 59601

STATE	MONTANA	COUNTY	LEWIS+CLARK
LAT.-LONG.	47 222N 1122212W	SAMPLE LOCATION	15N 6W 21CAC
STATION CODE		ANALYSIS NUMBER	75W2452
DATE SAMPLED	12-23-75	DRAINAGE BASIN	76F
TIME SAMPLED		WATER FLOW RATE	1. CFS(E
METHOD SAMPLED	GRAB	FLOW MEASUREMENT METHOD	NOT MEASURED
SAMPLE SOURCE	STREAM	ALTITUDE OF LAND SURFACE	
WATER USE	RECREATIONAL	TOTAL WELL DEPTH BELOW LS	
AQUIFER(S)		SWL ABOVE(+) OR BELOW LS	
SAMPLED BY	WQBH	SAMPLE DEPTH BELOW SURFACE	

SAMPLING SITE: BLACKFOOT R. ABOVE (shoue) SHAVE GULCH

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)			BICARBONATE(HCO3)	73.	1.200
MAGNESIUM (MG)			CARBONATE (CO3)	0.	0.0
SODIUM (NA)			CHLORIDE (CL)		
POTASSIUM (K)			SULFATE (SO4)	105.	2.186
IRON (FE)	< .01		FLUORIDE (F)		
MANGANESE (MN)	.24	0.009	NITRATE (NO3 AS N)		
ALUMINUM (AL)			NO3+NO2 (TOT AS N)		
			PHOSPHATE(PO4 AS P)		
TOTAL CATIONS		0.009	TOTAL ANIONS		3.386

LABORATORY PH	7.70	TOTAL HARDNESS AS CACO3	
FIELD WATER TEMPERATURE (C)	0.5	TOTAL ALKALINITY AS CACO3	60
DISSOLVED SOLIDS CALCULATED		LAB TURBIDITY (JTU)	.6
LAB CONDUCTIVITY-UMHOS-25C	343.	SODIUM ADSORPTION RATIO	

ADDITIONAL PARAMETERS

ARSENIC,DISS(MG/L AS AS)	< .001	CADMIUM,DISS(MG/L AS CD)	.003
COPPER,DISS(MG/L AS CU)	< .01	LEAD DISS(MG/L AS PB)	< .05
ZINC,DISS(MG/L AS ZN)	1.8	COPPER,TR (MG/L AS CU)	< 0.01
COPPER,TOTAL(MG/L AS CU)	.01	ZINC,TR (MG/L AS ZN)	1.9
ZINC, TOTAL (MG/L AS ZN)	1.9	LEAD,TR (MG/L AS PB)	< 0.05
LEAD, TOTAL (MG/L AS PB)	< 0.05	IRON,TR (MG/L AS FE)	.08
IRON, TOTAL (MG/L AS FE)	.12	MANGANESE,TR(MG/L AS MN)	.24
MANGANESE, TOT (MG/L-MN)	.24	CADMIUM, TR (MG/L AS CD)	.005
CADMIUM,TOT (MG/L AS CD)	.005	ARSENIC,TR (MG/L AS AS)	.001
ARSENIC,TOT (MG/L AS AS)	< 0.001		

REMARKS: MIKE-HORSE MONITORING

EXPLANATION: MG/L=MILLIGRAMS PER LITER MEQ/L=MILLIEQUIVILENTS PER LITER
ALL CONSTITUENTS DISSOLVED (DISS) EXCEPT AS NOTED. TOT=TOTAL SUSP=SUSPENDED
(M)= MEASURED(R)=REPORTED (E)=ESTIMATED M=METERS TR=TOTAL RECOVERABLE

SAMPLE NO 1 SAMPLER MJP HANDLING 3210 ANALYST KEV LAB WQBH
COMPLETED 04-22-76 COMPUTER RUN 05/06/76 PROGRAM SYS 75 FUND 0650

STND DEV. ION BALANCE 9.99	CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
SEGMENT MPOES	0.0	0.0	0.0	0.0	0.0	64.6	35.4	0.0	0.0

75W2452

STATE HEALTH DEPT. WATER QUALITY BUREAU HELENA, MONTANA 59601

STATE	MONTANA	COUNTY	JUDITH BASIN
LAT.-LONG.	47 229N 1122221W	SAMPLE LOCATION	15N 6W 21CAB
STATION CODE		ANALYSIS NUMBER	76W0776
DATE SAMPLED	05-13-76	DRAINAGE BASIN	076F
TIME SAMPLED	1330	WATER FLOW RATE	14.0 CFS(E)
METHOD SAMPLED	DEPTH COMPOSITE	FLOW MEASUREMENT METHOD	FLOAT + TIME
SAMPLE SOURCE	STREAM	ALTITUDE OF LAND SURFACE	
WATER USE	UNUSED	TOTAL WELL DEPTH BELOW LS	
AQUIFER(S)		SWL ABOVE(+) OR BELOW LS	
SAMPLED BY	MF&G	SAMPLE DEPTH BELOW SURFACE	

SAMPLING SITE: BLACKFOOT RIVER ABOVE SHAVE GULCH

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)			BICARBONATE(HCO3)	62.	1.016
MAGNESIUM (MG)			CARBONATE (CO3)	0.	0.0
SODIUM (NA)			CHLORIDE (CL)		
POTASSIUM (K)			SULFATE (SO4)	42.0	0.874
IRON (FE)	.10	0.005	FLUORIDE (F)		
MANGANESE (MN)	.44	0.016	NITRATE (NO3 AS N)		
ALUMINUM (AL)			NO3+NO2 (TOT AS N)		
			PHOSPHATE(PO4 AS P)		
TOTAL CATIONS		0.021	TOTAL ANIONS		1.891

LABORATORY PH	7.64	TOTAL HARDNESS AS CACO3	
FIELD WATER TEMPERATURE (C)	8.5	TOTAL ALKALINITY AS CACO3	
DISSOLVED SOLIDS CALCULATED		LAB TURBIDITY (JTU)	
LAB CONDUCTIVITY-UMHOS-25C	185.5	SODIUM ADSORPTION RATIO	

ADDITIONAL PARAMETERS

SEDIMENT,TOT,SUSP (MG/L)	10.5	CADMIUM,DISS(MG/L AS CD)	.004
COPPER,DISS(MG/L AS CU)	.02	LEAD DISS(MG/L AS PB)	< .05
ZINC,DISS(MG/L AS ZN)	1.1		

REMARKS: WATER RELATIVELY CLEAR HIGHER RUNOFF HAD OCCURED ABOUT 10 DAYS EARLIER

EXPLANATION: MG/L=MILLIGRAMS PER LITER MEQ/L=MILLIEQUIVILENTS PER LITER ALL CONSTITUENTS DISSOLVED (DISS) EXCEPT AS NOTED. TOT=TOTAL SUSP=SUSPENDED (M)= MEASURED(R)=REPORTED (E)=ESTIMATED M=METERS TR=TOTAL RECOVERABLE

SAMPLE NO SAMPLER KNK HANDLING 3210 ANALYST TN LAB WQEH
COMPLETED 7- 8-76 COMPUTER RUN 07/13/76 PROGRAM SYS 75 FUND 1530

STND DEV. ION BALANCE 9.99	CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
SEGMENT NPDES	0.0	0.0	0.0	0.0	0.0	46.3	53.7	0.0	0.0

76W0776

STATE HEALTH DEPT. WATER QUALITY BUREAU HELENA, MONTANA 59601

STATE	MONTANA	COUNTY	LEWIS+CLARK
LAT.-LONG.	47 24BN 11222 2W	SAMPLE LOCATION	15N 6W 21ABC
STATION CODE		ANALYSIS NUMBER	75W1154
DATE SAMPLED	07-10-75	DRAINAGE BASIN	76F
TIME SAMPLED	1525	WATER FLOW RATE	4.3 CFS(M)
METHOD SAMPLED	GRAB	FLOW MEASUREMENT METHOD	GURLEY METER
SAMPLE SOURCE	STREAM	ALTITUDE OF LAND SURFACE	
WATER USE	RECREATIONAL	TOTAL WELL DEPTH BELOW LS	
AQUIFER(S)		SWL ABOVE(+) OR BELOW LS	
SAMPLED BY	MF+G	SAMPLE DEPTH BELOW SURFACE	

SAMPLING SITE: SHOUE GULCH 0.6 MI ABOVE MIKE HORSE RD

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)			BICARBONATE(HCO3)	51.	0.840
MAGNESIUM (MG)			CARBONATE (CO3)	0.	0.0
SODIUM (NA)			CHLORIDE (CL)		
POTASSIUM (K)			SULFATE (SO4)	2.0	0.042
IRON (FE)	< .02		FLUORIDE (F)		
MANGANESE (MN)	< .01		NITRATE (NO3 AS N)		
ALUMINUM (AL)			NO3+NO2 (TOT AS N)		
			PHOSPHATE(PO4 AS P)		
TOTAL CATIONS		0.0	TOTAL ANIONS		0.881

LABORATORY PH	7.47	TOTAL HARDNESS AS CACO3	
FIELD WATER TEMPERATURE (C)	11.3	TOTAL ALKALINITY AS CACO3	42
DISSOLVED SOLIDS CALCULATED		LAB TURBIDITY (JTU)	.4
LAB CONDUCTIVITY-UMHOS-25C	93.	SODIUM ADSORPTION RATIO	

ADDITIONAL PARAMETERS

SEDIMENT,TOT,SUSP (MG/L)	0.	ARSENIC,DISS(MG/L AS AS)	< .001
CADMIUM,DISS(MG/L AS CD)	< .001	COPPER,DISS(MG/L AS CU)	.01
LEAD DISS(MG/L AS PB)	< .05	ZINC,DISS(MG/L AS ZN)	< .01
IRON,TR (MG/L AS FE)	.02	COPPER,TR (MG/L AS CU)	.01
ZINC,TR (MG/L AS ZN)	< 0.01	MANGANESE,TR(MG/L AS MN)	< 0.01
CADMIUM, TR (MG/L AS CD)	< 0.001		

REMARKS: MIKE HORSE DAM FAILURE WATER VERY CLEAR SAMPLE SITE 0.6 MI UP SHOUE GULCH RD

EXPLANATION: MG/L=MILLIGRAMS PER LITER MEQ/L=MILLIEQUIVILENTS PER LITER ALL CONSTITUENTS DISSOLVED (DISS) EXCEPT AS NOTED. TOT=TOTAL SUSP=SUSPENDED (M)= MEASURED(R)=REPORTED (E)=ESTIMATED M=METERS TR=TOTAL RECOVERABLE

SAMPLE NO SAMPLER LES HANDLING 3210 ANALYST ME LAB WQBH
COMPLETED 09-26-75 COMPUTER RUN 09/30/75 PROGRAM SYS 75 FUND 3650

STND DEV. ION BALANCE 7.78	CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
SEGMENT MPDES	0.0	0.0	0.0	0.0	0.0	4.7	95.3	0.0	0.0

STATE HEALTH DEPT. WATER QUALITY BUREAU HELENA, MONTANA 59601

STATE	MONTANA	COUNTY	LEWIS+CLARK
LAT.-LONG.	47 3 1N 1122250W	SAMPLE LOCATION	15N 6W 17DDD
STATION CODE		ANALYSIS NUMBER	75W1152
DATE SAMPLED	07-10-75	DRAINAGE BASIN	76F
TIME SAMPLED	1415	WATER FLOW RATE	.
METHOD SAMPLED	GRAB	FLOW MEASUREMENT METHOD	
SAMPLE SOURCE	STREAM	ALTITUDE OF LAND SURFACE	
WATER USE	RECREATIONAL	TOTAL WELL DEPTH BELOW LS	
AQUIFER(S)		SWL ABOVE(+) OR BELOW LS	
SAMPLED BY	MF+G	SAMPLE DEPTH BELOW SURFACE	

SAMPLING SITE: BLACKFOOT RIVER PONDS BELOW PASS CREEK

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)			BICARBONATE(HCO3)	74.	1.220
MAGNESIUM (MG)			CARBONATE (CO3)	0.	0.0
SODIUM (NA)			CHLORIDE (CL)		
POTASSIUM (K)			SULFATE (SO4)	33.0	0.687
IRON (FE)	1.80	0.097	FLUORIDE (F)		
MANGANESE (MN)	.71	0.026	NITRATE (NO3 AS N)		
ALUMINUM (AL)			NO3+NO2 (TOT AS N)		
			PHOSPHATE(PO4 AS P)		
TOTAL CATIONS		0.123	TOTAL ANIONS		1.907

LABORATORY PH	7.59	TOTAL HARDNESS AS CACO3	
FIELD WATER TEMPERATURE (C)	16.7	TOTAL ALKALINITY AS CACO3	61
DISSOLVED SOLIDS CALCULATED		LAB TURBIDITY (JTU)	45.
LAB CONDUCTIVITY-UMHOS-25C	200.	SODIUM ADSORPTION RATIO	

ADDITIONAL PARAMETERS

SEDIMENT,TOT,SUSP (MG/L)	66.	ARSENIC,DISS(MG/L AS AS)	.008
CADMIUM,DISS(MG/L AS CD)	.001	COPPER,DISS(MG/L AS CU)	.04
LEAD DISS(MG/L AS PB)	.16	ZINC,DISS(MG/L AS ZN)	.76
ZINC,TR (MG/L AS ZN)	1.05	COPPER,TR (MG/L AS CU)	.06
IRON,TR (MG/L AS FE)	2.64	MANGANESE,TR(MG/L AS MN)	.88
CADMIUM, TR (MG/L AS CD)	.001		

REMARKS: MIKE HORSE DAM FAILURE WATER VERY TURBID,BROWNISH-GRAY COLR

EXPLANATION: MG/L=MILLIGRAMS PER LITER MEQ/L=MILLIEQUIVILENTS PER LITER
ALL CONSTITUENTS DISSOLVED (DISS) EXCEPT AS NOTED. TOT=TOTAL SUSP=SUSPENDED
(M)= MEASURED(R)=REPORTED (E)=ESTIMATED M=METERS TR=TOTAL RECOVERABLE

SAMPLE NO SAMPLER LES HANDLING 3210 ANALYST JH LAB WOBH
COMPLETED 09-26-75 COMPUTER RUN 09/30/75 PROGRAM SYS 75 FUND 0650

TNO DEV. ION BALANCE 9.99	CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
SEGMENT MPDES	0.0	0.0	0.0	0.0	0.0	36.0	64.0	0.0	0.0

STATE HEALTH DEPT. WATER QUALITY BUREAU HELENA, MONTANA 59601

STATE	MONTANA	COUNTY	LEWIS+CLARK
LAT.-LONG.	47 235N 1122434W	SAMPLE LOCATION	15N 6W 19ACC
STATION CODE		ANALYSIS NUMBER	75W1000
DATE SAMPLED	06-23-75	DRAINAGE BASIN	76E
TIME SAMPLED	1300	WATER FLOW RATE	
METHOD SAMPLED	GRAB	FLOW MEASUREMENT METHOD	NOT MEASURED
SAMPLE SOURCE	STREAM	ALTITUDE OF LAND SURFACE	
WATER USE	UNUSED	TOTAL WELL DEPTH BELOW LS	
AQUIFER(S)		SWL ABOVE(+) OR BELOW LS	
SAMPLED BY	MF+G	SAMPLE DEPTH BELOW SURFACE	

SAMPLING SITE: BLACKFOOT RIVER AT POPS PLACE

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)			BICARBONATE(HCO3)	62.	1.010
MAGNESIUM (MG)			CARBONATE (CO3)	0.	0.0
SODIUM (NA)			CHLORIDE (CL)		
POTASSIUM (K)			SULFATE (SO4)	34.0	0.708
IRON (FE)	< .01		FLUORIDE (F)		
MANGANESE (MN)	.27	0.010	NITRATE (NO3 AS N)		
ALUMINUM (AL)			NO3+NO2 (TOT AS N)		
HYDROGEN (H+)	0.00	0.000	PHOSPHATE(PO4 AS P)		
TOTAL CATIONS		0.010	TOTAL ANIONS		1.718

LABORATORY PH	7.81	TOTAL HARDNESS AS CACO3	
FIELD WATER TEMPERATURE (C)		TOTAL ALKALINITY AS CACO3	51
DISSOLVED SOLIDS CALCULATED		LAB TURBIDITY (JTU)	290.
LAB CONDUCTIVITY-UMHOS-25C	190.	SODIUM ADSORPTION RATIO	

ADDITIONAL PARAMETERS

SEDIMENT,TOT,SUSP (MG/L)	716.	ARSENIC,DISS(MG/L AS AS)	.005
CADMIUM,DISS(MG/L AS CD)	.001	COPPER,DISS(MG/L AS CU)	< .01
LEAD DISS(MG/L AS PB)	< .05	ZINC,DISS(MG/L AS ZN)	.27
ARSENIC,TR (MG/L AS AS)	.021	IRON,TR (MG/L AS FE)	17.
COPPER,TR (MG/L AS CU)	.32	ZINC,TR (MG/L AS ZN)	4.1
LEAD,TR (MG/L AS PB)	3.6	CADMIUM, TR (MG/L AS CD)	.02
MANGANESE,TR(MG/L AS MN)	6.5	ARSENIC,TOT (MG/L AS AS)	.022
LEAD, TOTAL (MG/L AS PB)	3.6	IRON, TOTAL (MG/L AS FE)	17.
COPPER,TOTAL(MG/L AS CU)	.32	CADMIUM,TOT (MG/L AS CD)	.02
ZINC, TOTAL (MG/L AS ZN)	4.1	MANGANESE, TOT (MG/L-MN)	7.4

REMARKS: MIKE HORSE DAM FAILURE EXTREMELY TURBID,GRAY COLOR,THICK APPEARANCE, HIGH FLOW

EXPLANATION: MG/L=MILLIGRAMS PER LITER MEQ/L=MILLIEQUIVILENTS PER LITER ALL CONSTITUENTS DISSOLVED (DISS) EXCEPT AS NOTED. TOT=TOTAL SUSP=SUSPENDED (M)= MEASURED(R)=REPORTED (E)=ESTIMATED M=METERS TR=TOTAL RECOVERABLE

SAMPLE NO SAMPLER LES HANDLING 3210 ANALYST LAB LAB WQBH
COMPLETED 07-14-75 COMPUTER RUN 07/15/75 PROGRAM SYS 75 FUND 065C

STND DEV. ION BALANCE 9.99	CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
SEGMENT MPDES	0.0	0.0	0.0	0.0	0.0	41.2	58.8	0.0	0.0

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CENTRAL LABORATORY, SALT LAKE CITY, UTAH

WATER QUALITY ANALYSIS
LAB ID # 164506 RECORD # 26097

SAMPLE LOCATION: BLACKFOOT R NR LINCOLN MT AT Pops Place
STATION ID: 12334600 LAT.LONG.SEQ.:
DATE OF COLLECTION: BEGIN--750627 END-- TIME--1500
COUNTY CODE: PROJECT IDENTIFICATION: SPEC
DATA TYPE: 2 SOURCE: SURFACE WATER GEOLOGIC UNIT:
COMMENTS:
BREAK IN TAILINGS POND DYKE SPILL INTO RIVER

CADMIUM DISSOLVED	UG/L		2	LEAD TOTAL	UG/L		1000
CADMIUM TOTAL	UG/L	<	10	MANGANESE DISSOLVED	UG/L		380
COPPER DISSOLVED	UG/L		3	MANGANESE TOTAL	UG/L		2300
COPPER TOTAL	UG/L		200	SILVER DISSOLVED	UG/L		0
IRON DISSOLVED	UG/L		40	SILVER TOTAL	UG/L	<	10
IRON TOTAL	UG/L		9500	ZINC DISSOLVED	UG/L		450
LEAD DISSOLVED	UG/L		8	ZINC TOTAL	UG/L		1800

STATE HEALTH DEPT. WATER QUALITY BUREAU HELENA, MONTANA 59601

STATE	MONTANA	COUNTY	LEWIS+CLARK
LAT.-LONG.	47 23SN 1122434W	SAMPLE LOCATION	15N 6W 19ACC
STATION CODE		ANALYSIS NUMBER	75W1155
DATE SAMPLED	07-10-75	DRAINAGE BASIN	76F
TIME SAMPLED	1330	WATER FLOW RATE	23.32CFS(M)
METHOD SAMPLED	GRAB	FLOW MEASUREMENT METHOD	GURLEY METER
SAMPLE SOURCE	STREAM	ALTITUDE OF LAND SURFACE	
WATER USE	RECREATIONAL	TOTAL WELL DEPTH BELOW LS	
AQUIFER(S)		SWL ABOVE(+) OR BELOW LS	
SAMPLED BY	MF+G	SAMPLE DEPTH BELOW SURFACE	

SAMPLING SITE: BLACKFOOT RIVER AT POP'S PLACE

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)			BICARBONATE(HCO3)	70.	1.150
MAGNESIUM (MG)			CARBONATE (CO3)	0.	0.0
SODIUM (NA)			CHLORIDE (CL)		
POTASSIUM (K)			SULFATE (SO4)	44.0	0.916
IRON (FE)	.04	0.002	FLUORIDE (F)		
MANGANESE (MN)	.62	0.023	NITRATE (NO3 AS N)		
ALUMINUM (AL)			NO3+NO2 (TOT AS N)		
			PHOSPHATE(PO4 AS P)		
TOTAL CATIONS		0.025	TOTAL ANIONS		2.066

LABORATORY PH	7.64	TOTAL HARDNESS AS CACO3	
FIELD WATER TEMPERATURE (C)	15.0	TOTAL ALKALINITY AS CACO3	58
DISSOLVED SOLIDS CALCULATED		LAB TURBIDITY (JTU)	21.
LAB CONDUCTIVITY-UMHOS-25C	208.	SODIUM ADSORPTION RATIO	

ADDITIONAL PARAMETERS

SEDIMENT,TOT,SUSP (MG/L)	32.	ARSENIC,DISS(MG/L AS AS)	< .001
CADMIUM,DISS(MG/L AS CD)	< .001	COPPER,DISS(MG/L AS CU)	.01
LEAD DISS(MG/L AS PB)	< .05	ZINC,DISS(MG/L AS ZN)	.78
IRON,TR (MG/L AS FE)	1.34	COPPER,TR (MG/L AS CU)	.03
ZINC,TR (MG/L AS ZN)	1.21	MANGANESE,TR(MG/L AS MN)	< 0.79
CADMIUM, TR (MG/L AS CD)	.001		

REMARKS: MIKE HORSE DAM FAILURE WATER TURBID, GRAY COLOR

EXPLANATION: MG/L=MILLIGRAMS PER LITER MEQ/L=MILLIEQUIVILENTS PER LITER
ALL CONSTITUENTS DISSOLVED (DISS) EXCEPT AS NOTED. TOT=TOTAL SUSP=SUSPENDED
(M)= MEASURED(R)=REPORTED (E)=ESTIMATED M=METERS TR=TOTAL RECOVERABLE

SAMPLE NO SAMPLER LES HANDLING 3210 ANALYST JH LAB WQBH
COMPLETED 09-26-75 COMPUTER RUN 09/30/75 PROGRAM SYS 75 FUND 0650

STND DEV. ION BALANCE 9.99	CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
SEGMENT MPDES	0.0	0.0	0.0	0.0	0.0	44.3	55.7	0.0	0.0

STATE HEALTH DEPT. WATER QUALITY BUREAU HELENA, MONTANA 59601

STATE	MONTANA	COUNTY	LEWIS+CLARK
LAT.-LONG.	47 23SN 1122434W	SAMPLE LOCATION	15N 6W 19ACC
STATION CODE		ANALYSIS NUMBER	75W2453
DATE SAMPLED	12-23-75	DRAINAGE BASIN	76F
TIME SAMPLED		WATER FLOW RATE	.
METHOD SAMPLED	GRAB	FLOW MEASUREMENT METHOD	NOT MEASURED
SAMPLE SOURCE	STREAM	ALTITUDE OF LAND SURFACE	
WATER USE	RECREATIONAL	TOTAL WELL DEPTH BELOW LS	
AQUIFER(S)		SWL ABOVE(+) OR BELOW LS	
SAMPLED BY	WQBH	SAMPLE DEPTH BELOW SURFACE	

SAMPLING SITE: BLACKFOOT R AT POPS PLACE

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)			BICARBONATE(HCO3)	53.	0.870
MAGNESIUM (MG)			CARBONATE (CO3)	0.	0.0
SODIUM (NA)			CHLORIDE (CL)		
POTASSIUM (K)			SULFATE (SO4)	75.	1.561
IRON (FE)	.11	0.006	FLUORIDE (F)		
MANGANESE (MN)	.44	0.016	NITRATE (NO3 AS N)		
ALUMINUM (AL)			NO3+NO2 (TOT AS N)		
			PHOSPHATE(PO4 AS P)		
TOTAL CATIONS		0.022	TOTAL ANIONS		2.431

LABORATORY PH	7.36	TOTAL HARDNESS AS CACO3	
FIELD WATER TEMPERATURE (C)	0.5	TOTAL ALKALINITY AS CACO3	44
DISSOLVED SOLIDS CALCULATED		LAB TURBIDITY (JTU)	2.9
LAB CONDUCTIVITY-UMHOS-25C	254.5	SODIUM ADSORPTION RATIO	

ADDITIONAL PARAMETERS

ARSENIC,DISS(MG/L AS AS)	< .001	CADMIUM,DISS(MG/L AS CD)	< .001
COPPER,DISS(MG/L AS CU)	.01	LEAD DISS(MG/L AS PB)	< .05
ZINC,DISS(MG/L AS ZN)	.78	COPPER,TR (MG/L AS CU)	.02
COPPER,TOTAL(MG/L AS CU)	.03	ZINC,TR (MG/L AS ZN)	.81
ZINC, TOTAL (MG/L AS ZN)	.82	LEAD,TR (MG/L AS PB)	< 0.05
LEAD, TOTAL (MG/L AS PB)	< 0.05	IRON,TR (MG/L AS FE)	.57
IRON, TOTAL (MG/L AS FE)	.62	MANGANESE,TR(MG/L AS MN)	.47
MANGANESE, TOT (MG/L-MN)	.45	CADMIUM, TR (MG/L AS CD)	.001
CADMIUM,TOT (MG/L AS CD)	.001	ARSENIC,TR (MG/L AS AS)	< 0.001
ARSENIC,TOT (MG/L AS AS)	< 0.001		

REMARKS: MIKE-HORSE MONITORING ICE COVERED,TURB.DUE TO CUTTING ICE

EXPLANATION: MG/L=MILLIGRAMS PER LITER MEQ/L=MILLIEQUIVILENTS PER LITER
ALL CONSTITUENTS DISSOLVED (DISS) EXCEPT AS NOTED. TOT=TOTAL SUSP=SUSPENDED
(M)= MEASURED(R)=REPORTED (E)=ESTIMATED M=METERS TR=TOTAL RECOVERABLE

SAMPLE NO 2 SAMPLER MJP HANDLING 3210 ANALYST KEV LAB WQBH
COMPLETED 04-22-76 COMPUTER RUN 05/06/76 PROGRAM SYS 75 FUND 0650

STNC DEV. ION BALANCE 9.99	CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
SEGMENT NPDES	0.0	0.0	0.0	0.0	0.0	64.2	35.8	0.0	0.0

75W2453

STATE HEALTH DEPT. WATER QUALITY BUREAU HELENA, MONTANA 59601

STATE	MONTANA	COUNTY	JUDITH BASIN
LAT.-LONG.	47 235N 1122434W	SAMPLE LOCATION	15N 6W 19ACC
STATION CODE		ANALYSIS NUMBER	76W0775
DATE SAMPLED	05-13-76	DRAINAGE BASIN	076F
TIME SAMPLED	1500	WATER FLOW RATE	35.0 CFS(E)
METHOD SAMPLED	DEPTH COMPOSITE	FLOW MEASUREMENT METHOD	FLOAT + TIME
SAMPLE SOURCE	STREAM	ALTITUDE OF LAND SURFACE	
WATER USE	RECREATIONAL	TOTAL WELL DEPTH BELOW LS	
AQUIFER(S)		SWL ABOVE(+) OR BELOW LS	
SAMPLED BY	MF&G	SAMPLE DEPTH BELOW SURFACE	

SAMPLING SITE: BLACKFOOT RIVER AT POPS PLACE

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)			BICARBONATE(HCO3)	37.	0.604
MAGNESIUM (MG)			CARBONATE (CO3)	0.	0.0
SODIUN (NA)			CHLORIDE (CL)		
POTASSIUM (K)			SULFATE (SO4)		
IRON (FE)	.08	0.004	FLUORIDE (F)		
MANGANESE (MN)	.20	0.007	NITRATE (NO3 AS N)		
ALUMINUM (AL)			NO3+NO2 (TOT AS N)		
			PHOSPHATE(PO4 AS P)		
TOTAL CATIONS		0.012	TOTAL ANIONS		0.604

LABORATORY PH	7.30	TOTAL HARDNESS AS CACO3	
FIELD WATER TEMPERATURE (C)	9.8	TOTAL ALKALINITY AS CACO3	30
DISSOLVED SOLIDS CALCULATED		LAB TURBIDITY (JTU)	
LAB CONDUCTIVITY-UMHOS-25C	131.2	SODIUM ADSORPTION RATIO	

ADDITIONAL PARAMETERS

SEDIMENT,TOT,SUSP (MG/L)	12.5	CADMIUM,DISS(MG/L AS CD)	< .001
COPPER,DISS(MG/L AS CU)	.02	LEAD DISS(MG/L AS PB)	<.05
ZINC,DISS(MG/L AS ZN)	.42		

REMARKS: WATER RELATIVELY CLEAR HIGHER RUNOFF HAD OCCURED ABOUT 10 DAYS EARLIER

EXPLANATION: MG/L=MILLIGRAMS PER LITER MEQ/L=MILLIEQUIVILENTS PER LITER ALL CONSTITUENTS DISSOLVED (DISS) EXCEPT AS NOTED. TOT=TOTAL SUSP=SUSPENDED (M)=MEASURED(R)=REPORTED (E)=ESTIMATED M=METERS TR=TOTAL RECOVERABLE

SAMPLE NO SAMPLER KNK HANDLING 3210 ANALYST LAB WQBH
COMPLETED COMPUTER RUN 07/09/76 PROGRAM SYS 75 FUND 1530

STND DEV. ION BALANCE 5.32	CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
SEGMENT MPDES	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0

76W0775

STATE HEALTH DEPT. WATER QUALITY BUREAU HELENA, MONTANA 59601

STATE	MONTANA	COUNTY	LEWIS+CLARK
LAT.-LONG.	47 045N 1122716W	SAMPLE LOCATION	15N 7W 35BCA
STATION CODE		ANALYSIS NUMBER	75W0999
DATE SAMPLED	06-23-75	DRAINAGE BASIN	76F
TIME SAMPLED	1030	WATER FLOW RATE	
METHOD SAMPLED	GRAB	FLOW MEASUREMENT METHOD	NOT MEASURED
SAMPLE SOURCE	STREAM	ALTITUDE OF LAND SURFACE	
WATER USE	UNUSED	TOTAL WELL DEPTH BELOW LS	
AQUIFER(S)		SWL ABOVE(+) OR BELOW LS	
SAMPLED BY	MF+G	SAMPLE DEPTH BELOW SURFACE	

SAMPLING SITE: BLACKFOOT RIVER AT FLESHER ROAD

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)			BICARBONATE(HCO3)	73.	1.200
MAGNESIUM (MG)			CARBONATE (CO3)	0.	0.0
SODIUM (NA)			CHLORIDE (CL)		
POTASSIUM (K)			SULFATE (SO4)	17.0	0.354
IRON (FE)	< .01		FLUORIDE (F)		
MANGANESE (MN)	.10	0.004	NITRATE (NO3 AS N)		
ALUMINUM (AL)			NO3+NO2 (TOT AS N)		
HYDROGEN (H+)	0.00	0.000	PHOSPHATE(PO4 AS P)		
TOTAL CATIONS		0.004	TOTAL ANIONS		1.554

LABORATORY PH	7.70	TOTAL HARDNESS AS CACO3	
FIELD WATER TEMPERATURE (C)		TOTAL ALKALINITY AS CACO3	60
DISSOLVED SOLIDS CALCULATED		LAB TURBIDITY (JTU)	110.
LAB CONDUCTIVITY-UMHOS-25C	173.	SODIUM ADSORPTION RATIO	

ADDITIONAL PARAMETERS

SEDIMENT,TOT,SUSP (MG/L)	114.	ARSENIC,DISS(MG/L AS AS)	< .001
CADMIUM,DISS(MG/L AS CD)	.001	COPPER,DISS(MG/L AS CU)	.01
LEAD DISS(MG/L AS PB)	< .05	ZINC,DISS(MG/L AS ZN)	.21
ARSENIC,TR (MG/L AS AS)	.003	IRON,TR (MG/L AS FE)	2.8
COPPER,TR (MG/L AS CU)	.09	ZINC,TR (MG/L AS ZN)	.84
LEAD,TR (MG/L AS PB)	.61	CADMIUM, TR (MG/L AS CD)	.007
MANGANESE,TR(MG/L AS MN)	.88	ARSENIC,TOT (MG/L AS AS)	.007
LEAD, TOTAL (MG/L AS PB)	.61	IRON, TOTAL (MG/L AS FE)	2.8
COPPER,TOTAL(MG/L AS CU)	.26	CADMIUM,TOT (MG/L AS CD)	.007
ZINC, TOTAL (MG/L AS ZN)	1.3	MANGANESE, TOT (MG/L-MN)	.94

REMARKS: MIKE HORSE DAM FAILURE EXTREMELY TURBID,GRAY COLOR, THICK APPEARANCE,HIGH FLOW

EXPLANATION: MG/L=MILLIGRAMS PER LITER MEQ/L=MILLIEQUIVILENTS PER LITER ALL CONSTITUENTS DISSOLVED (DISS) EXCEPT AS NOTED. TOT=TOTAL SUSP=SUSPENDED (M)= MEASURED(R)=REPORTED (E)=ESTIMATED M=METERS TR=TOTAL RECOVERABLE

SAMPLE NO SAMPLER LES HANDLING 3210 ANALYST LAB LAB WQBH
COMPLETED 07-14-75 COMPUTER RUN 07/15/75 PROGRAM SYS 75 FUND 0650

STND DEV. ION BALANCE 9.99	CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
SEGMENT MPDES	0.0	0.0	0.0	0.0	0.0	22.8	77.2	0.0	0.0

STATE HEALTH DEPT. WATER QUALITY BUREAU HELENA, MONTANA 59601

STATE	MONTANA	COUNTY	LEWIS+CLARK
LAT.-LONG.		SAMPLE LOCATION	14N 8W
STATION CODE		ANALYSIS NUMBER	75W1035
DATE SAMPLED	06-25-75	DRAINAGE BASIN	76F
TIME SAMPLED	1450	WATER FLOW RATE	40. CFS(E)
METHOD SAMPLED	GRAB	FLOW MEASUREMENT METHOD	NOT MEASURED
SAMPLE SOURCE	STREAM	ALTITUDE OF LAND SURFACE	
WATER USE	UNUSED	TOTAL WELL DEPTH BELOW LS	
AQUIFER(S)		SWL ABOVE(+) OR BELOW LS	
SAMPLED BY	WQBH	SAMPLE DEPTH BELOW SURFACE	

SAMPLING SITE: BLACKFOOT R AT HWY-279 CULVERT (FLESHER ROAD)

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)			BICARBONATE(HCO3)		
MAGNESIUM (MG)			CARBONATE (CO3)		
SODIUM (NA)			CHLORIDE (CL)		
POTASSIUM (K)			SULFATE (SO4)		
IRON (FE)	.03	0.002	FLUORIDE (F)		
MANGANESE (MN)	.13	0.005	NITRATE (NO3 AS N)		
ALUMINUM (AL)			NO3+NO2 (TOT AS N)		
HYDROGEN (H+)			PHOSPHATE(PO4 AS P)		
TOTAL CATIONS		0.006	TOTAL ANIONS		0.000

LABORATORY PH		TOTAL HARDNESS AS CACO3	
FIELD WATER TEMPERATURE (C)	9.5	TOTAL ALKALINITY AS CACO3	
DISSOLVED SOLIDS CALCULATED		LAB TURBIDITY (JTU)	82.
LAB CONDUCTIVITY-UMHOS-25C	174.	SODIUM ADSORPTION RATIO	

ADDITIONAL PARAMETERS

SEDIMENT,TOT,SUSP (MG/L)	80.	ARSENIC,DISS(MG/L AS AS)	< .001
CADMIUM,DISS(MG/L AS CD)	.001	COPPER,DISS(MG/L AS CU)	< .01
LEAD DISS(MG/L AS PB)	< .05	ZINC,DISS(MG/L AS ZN)	.20
COPPER,TR (MG/L AS CU)	.06	COPPER,TOTAL(MG/L AS CU)	.09
MANGANESE,TR(MG/L AS MN)	.65	MANGANESE, TOT (MG/L-MN)	.68
IRON,TR (MG/L AS FE)	3.4	IRON, TOTAL (MG/L AS FE)	5.5
CADMIUM, TR (MG/L AS CD)	.005	CADMIUM,TOT (MG/L AS CD)	.005
ZINC,TR (MG/L AS ZN)	.68	ZINC, TOTAL (MG/L AS ZN)	.72
LEAD,TR (MG/L AS PB)	.40	LEAD, TOTAL (MG/L AS PB)	.40
ARSENIC,TR (MG/L AS AS)	.008	ARSENIC,TOT (MG/L AS AS)	.017

REMARKS: MIKE-HORSE MINE SURVEILL. VERY TURBID-METALLIC GRAY COLOR

EXPLANATION: MG/L=MILLIGRAMS PER LITER MEQ/L=MILLIEQUIVILENTS PER LITER
ALL CONSTITUENTS DISSOLVED (DISS) EXCEPT AS NOTED. TOT=TOTAL SUSP=SUSPENDED
(M)= MEASURED(R)=REPORTED (E)=ESTIMATED M=METERS TR=TOTAL RECOVERABLE

SAMPLE NO 2 SAMPLER MJP HANDLING 3210 ANALYST KEV LAB WQBH
COMPLETED 08-04-75 COMPUTER RUN 08/06/75 PROGRAM SYS 75 FUND 0650

STND DEV. ION BALANCE -0.06	CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
SEGMENT MPCES	0.0	0.0	0.0	0.0	33.3	33.3	0.0	33.3	0.0

STATE HEALTH DEPT. WATER QUALITY BUREAU HELENA, MONTANA 59601

STATE	MONTANA	COUNTY	LEWIS+CLARK
LAT.-LONG.	47 045N 1122716W	SAMPLE LOCATION	15N 7W 35BCA
STATION CODE		ANALYSIS NUMBER	75W1156
DATE SAMPLED	07-10-75	DRAINAGE BASIN	76F
TIME SAMPLED	1115	WATER FLOW RATE	35.51CFS(M)
METHOD SAMPLED	GRAB	FLOW MEASUREMENT METHOD	GURLEY METER
SAMPLE SOURCE	STREAM	ALTITUDE OF LAND SURFACE	
WATER USE	RECREATIONAL	TOTAL WELL DEPTH BELOW LS	
AQUIFER(S)		SWL ABOVE(+) OR BELOW LS	
SAMPLED BY	MF+S	SAMPLE DEPTH BELOW SURFACE	

SAMPLING SITE: BLACKFOOT RIVER AT FLESHER

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)			BICARBONATE(HCO3)	88.	1.450
MAGNESIUM (MG)			CARBONATE (CO3)	0.	0.0
SODIUM (NA)			CHLORIDE (CL)		
POTASSIUM (K)			SULFATE (SO4)	27.0	0.562
IRON (FE)	.02	0.001	FLUORIDE (F)		
MANGANESE (MN)	.19	0.007	NITRATE (NO3 AS N)		
ALUMINUM (AL)			NO3+NO2 (TOT AS N)		
			PHOSPHATE(PO4 AS P)		
TOTAL CATIONS		0.038	TOTAL ANIONS		2.012

LABORATORY PH	7.86	TOTAL HARDNESS AS CACO3	
FIELD WATER TEMPERATURE (C)	14.4	TOTAL ALKALINITY AS CACO3	73
DISSOLVED SOLIDS CALCULATED		LAB TURBIDITY (JTU)	2.
LAB CONDUCTIVITY-UMHOS-25C	213.	SODIUM ADSORPTION RATIO	

ADDITIONAL PARAMETERS

SEDIMENT,TOT,SUSP (MG/L)	4.	ARSENIC,DISS(MG/L AS AS)	< .001
CADMIUM,DISS(MG/L AS CD)	< .001	COPPER,DISS(MG/L AS CU)	< .01
LEAD DISS(MG/L AS PB)	< .05	ZINC,DISS(MG/L AS ZN)	.32
IRON,TR (MG/L AS FE)	.24	COPPER,TR (MG/L AS CU)	< 0.01
ZINC,TR (MG/L AS ZN)	.35	MANGANESE,TR(MG/L AS MN)	.19
CADMIUM, TR (MG/L AS CD)	< 0.001		

REMARKS: MIKE HORSE DAM FAILURE WATER CLEAR,GRAY SEDIMENT DEPOSITS ALONG STREAMBANK

EXPLANATION: MG/L=MILLIGRAMS PER LITER MEQ/L=MILLIEQUIVILENTS PER LITER ALL CONSTITUENTS DISSOLVED (DISS) EXCEPT AS NOTED. TOT=TOTAL SUSP=SUSPENDED (M)= MEASURED(R)=REPORTED (E)=ESTIMATED M=METERS TR=TOTAL RECOVERABLE

SAMPLE NO SAMPLER LES HANDLING 3210 ANALYST JH LAB WQBH
COMPLETED 09-26-75 COMPUTER RUN 09/30/75 PROGRAM SYS 75 FUND 0650

TND DEV. ION BALANCE 9.99	CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
SEGMENT MPDES	0.0	0.0	0.0	0.0	0.0	27.9	72.1	0.0	0.0

STATE HEALTH DEPT. WATER QUALITY BUREAU HELENA, MONTANA 59601

STATE	MONTANA	COUNTY	LEWIS+CLARK
LAT.-LONG.	47 045N 1122716W	SAMPLE LOCATION	15N 7W 35BCA
STATION CODE		ANALYSIS NUMBER	75W2454
DATE SAMPLED	12-23-75	DRAINAGE BASIN	76F
TIME SAMPLED		WATER FLOW RATE	4. CFS(E)
METHOD SAMPLED	GRAB	FLOW MEASUREMENT METHOD	
SAMPLE SOURCE	STREAM	ALTITUDE OF LAND SURFACE	
WATER USE	RECREATIONAL	TOTAL WELL DEPTH BELOW LS	
AQUIFER(S)		SWL ABOVE(+) OR BELOW LS	
SAMPLED BY	WQBH	SAMPLE DEPTH BELOW SURFACE	

SAMPLING SITE: BLACKFOOT R AT FLESHER HWY

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)			BICARBONATE(HCO3)	76.	1.240
MAGNESIUM (MG)			CARBONATE (CO3)	0.	0.0
SODIUM (NA)			CHLORIDE (CL)		
POTASSIUM (K)			SULFATE (SO4)	51.	1.062
IRON (FE)	.01	0.001	FLUORIDE (F)		
MANGANESE (MN)	.04	0.001	NITRATE (NO3 AS N)		
ALUMINUM (AL)			NO3+NO2 (TOT AS N)		
			PHOSPHATE(PO4 AS P)		
TOTAL CATIONS		0.002	TOTAL ANIONS		2.301

LABORATORY PH	7.65	TOTAL HARDNESS AS CACO3	
FIELD WATER TEMPERATURE (C)		TOTAL ALKALINITY AS CACO3	62
DISSOLVED SOLIDS CALCULATED		LAB TURBIDITY (JTU)	.6
LAB CONDUCTIVITY-UMHOS-25C	238.4	SODIUM ADSORPTION RATIO	

ADDITIONAL PARAMETERS

ARSENIC,DISS(MG/L AS AS)	.001	CADMIUM,DISS(MG/L AS CD)	.001
COPPER,DISS(MG/L AS CU)	.01	LEAD DISS(MG/L AS PB)	.05
ZINC,DISS(MG/L AS ZN)	.31	COPPER,TR (MG/L AS CU)	< 0.01
	< 0.01	ZINC,TR (MG/L AS ZN)	.31
ZINC, TOTAL (MG/L AS ZN)	.33	LEAD,TR (MG/L AS PB)	< 0.05
LEAD, TOTAL (MG/L AS PB)	< 0.05	IRON,TR (MG/L AS FE)	.07
IRON, TOTAL (MG/L AS FE)	.18	MANGANESE,TR(MG/L AS MN)	.04
MANGANESE, TOT (MG/L-MN)	.05	CADMIUM, TR (MG/L AS CD)	< 0.001
CADMIUM,TOT (MG/L AS CD)	< 0.001	ARSENIC,TR (MG/L AS AS)	< 0.001
ARSENIC,TOT (MG/L AS AS)	< 0.001		

REMARKS: MIKE-HORSE MONITORING

EXPLANATION: MG/L=MILLIGRAMS PER LITER MEQ/L=MILLIEQUIVILENTS PER LITER
ALL CONSTITUENTS DISSOLVED (DISS) EXCEPT AS NOTED. TOT=TOTAL SUSP=SUSPENDED
(M)= MEASURED(R)=REPORTED (E)=ESTIMATED M=METERS TR=TOTAL RECOVERABLE

SAMPLE NO 3 SAMPLER MJP HANDLING 3210 ANALYST KEV LAB
COMPLETED 04-22-76 COMPUTER RUN 05/06/76 PROGRAM SYS 15 FUND
STND DEV. ION BALANCE 9.99

SEGMENT	NPDES	CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
		0.0	0.0	0.0	0.0	0.0	46.1	53.9	0.0	0.0

75W2454

STATE HEALTH DEPT. WATER QUALITY BUREAU HELENA, MONTANA 59601

STATE	MONTANA	COUNTY	JUDITH BASIN
LAT.-LONG.	47 045N 1122716W	SAMPLE LOCATION	15N 7W 35BCA
STATION CODE		ANALYSIS NUMBER	76W0777
DATE SAMPLED	05-13-76	DRAINAGE BASIN	076F
TIME SAMPLED	1600	WATER FLOW RATE	55.0 CFS(E)
METHOD SAMPLED	DEPTH COMPOSITE	FLOW MEASUREMENT METHOD	FLOAT + TIME
SAMPLE SOURCE	STREAM	ALTITUDE OF LAND SURFACE	
WATER USE	RECREATIONAL	TOTAL WELL DEPTH BELOW LS	
AQUIFER(S)		SWL ABOVE(+) OR BELOW LS	
SAMPLED BY	MF&G	SAMPLE DEPTH BELOW SURFACE	

SAMPLING SITE: BLACKFOOT RIVER AT FLESHER ROAD

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)			BICARBONATE (HCO3)	73.	1.200
MAGNESIUM (MG)			CARBONATE (CO3)	0.	0.0
SODIUM (NA)			CHLORIDE (CL)		
POTASSIUM (K)			SULFATE (SO4)	17.3	0.360
IRON (FE)	.08	0.004	FLUORIDE (F)		
MANGANESE (MN)	.01	0.000	NITRATE (NO3 AS N)		
ALUMINUM (AL)			NO3+NO2 (TOT AS N)		
			PHOSPHATE(PO4 AS P)		
TOTAL CATIONS		0.005	TOTAL ANIONS		1.560

LABORATORY PH	7.79	TOTAL HARDNESS AS CACO3	
FIELD WATER TEMPERATURE (C)	12.1	TOTAL ALKALINITY AS CACO3	60
DISSOLVED SOLIDS CALCULATED		LAB TURBIDITY (JTU)	
LAB CONDUCTIVITY-UMHOS-25C	149.3	SODIUM ADSORPTION RATIO	

ADDITIONAL PARAMETERS

SEDIMENT,TOT,SUSP (MG/L)	2.0	CADMIUM,DISS(MG/L AS CD)	< .001
COPPER,DISS(MG/L AS CU)	.01	LEAD DISS(MG/L AS PB)	< .05
ZINC,DISS(MG/L AS ZN)	< .13		

REMARKS: WATER RELATIVELY CLEAR HIGHER RUNOFF HAD OCCURED ABOUT 10 DAYS EALIER

EXPLANATION: MG/L=MILLIGRAMS PER LITER MEQ/L=MILLIEQUIVILENTS PER LITER ALL CONSTITUENTS DISSOLVED (DISS) EXCEPT AS NOTED. TOT=TOTAL SUSP=SUSPENDED (M)= MEASURED(R)=REPORTED (E)=ESTIMATED M=METERS TR=TOTAL RECOVERABLE

SAMPLE NO SAMPLER KNK HANDLING 3210 ANALYST TN LAB WQBH
COMPLETED 7- 8-76 COMPUTER RUN 07/09/76 PROGRAM SYS 75 FUND 1530

STND DEV. ION BALANCE 9.99	CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
SEGMENT MPDES	0.0	0.0	0.0	0.0	0.0	23.1	76.9	0.0	0.0

76W0777

STATE HEALTH DEPT. WATER QUALITY BUREAU HELENA, MONTANA 59601

STATE	MONTANA	COUNTY	LEWIS+CLARK
LAT.-LONG.	465920N 1123044W	SAMPLE LOCATION	14N 7W 5CDD
STATION CODE		ANALYSIS NUMBER	75W0998
DATE SAMPLED	06-23-75	DRAINAGE BASIN	76E
TIME SAMPLED	1230	WATER FLOW RATE	
METHOD SAMPLED	GRAB	FLOW MEASUREMENT METHOD	NOT MEASURED
SAMPLE SOURCE	STREAM	ALTITUDE OF LAND SURFACE	
WATER USE	UNUSED	TOTAL WELL DEPTH BELOW LS	
AQUIFER(S)		SWL ABOVE(+) OR BELOW LS	
SAMPLED BY	MF+G	SAMPLE DEPTH BELOW SURFACE	

SAMPLING SITE: BLACKFOOT RIVER AT HOGUM CREEK ROAD

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)			BICARBONATE(HCO3)	81.	1.32
MAGNESIUM (MG)			CARBONATE (CO3)	0.	0.0
SODIUM (NA)			CHLORIDE (CL)		
POTASSIUM (K)			SULFATE (SO4)	9.5	0.19
IRON (FE)	.03	0.002	FLUORIDE (F)		
MANGANESE (MN)	.03	0.001	NITRATE (NO3 AS N)		
ALUMINUM (AL)			NO3+NO2 (TOT AS N)		
HYDROGEN (H+)	0.00	0.000	PHOSPHATE(PO4 AS P)		
TOTAL CATIONS		0.003	TOTAL ANIONS		1.51

LABORATORY PH	7.95	TOTAL HARDNESS AS CACO3	
FIELD WATER TEMPERATURE (C)		TOTAL ALKALINITY AS CACO3	66
DISSOLVED SOLIDS CALCULATED		LAB TURBIDITY (JTU)	89.
LAB CONDUCTIVITY-UMHOS-25C	155.	SODIUM ADSORPTION RATIO	

ADDITIONAL PARAMETERS

SEDIMENT,TOT,SUSP (MG/L)	162.	ARSENIC,DISS(MG/L AS AS)	< .001
CADMIUM,DISS(MG/L AS CD)	< .001	COPPER,DISS(MG/L AS CU)	.01
LEAD DISS(MG/L AS PB)	< .05	ZINC,DISS(MG/L AS ZN)	.04
ARSENIC,TR (MG/L AS AS)	.004	IRON,TR (MG/L AS FE)	1.9
COPPER,TR (MG/L AS CU)	.01	ZINC,TR (MG/L AS ZN)	.21
LEAD,TR (MG/L AS PB)	.17	CADMIUM, TR (MG/L AS CD)	< 0.001
MANGANESE,TR(MG/L AS MN)	.35	ARSENIC,TOT (MG/L AS AS)	.006
LEAD, TOTAL (MG/L AS PB)	.17	IRON, TOTAL (MG/L AS FE)	2.0
COPPER,TOTAL(MG/L AS CU)	.04	CADMIUM,TOT (MG/L AS CD)	.002
ZINC, TOTAL (MG/L AS ZN)	.26	MANGANESE, TOT (MG/L-MN)	.36

REMARKS: MIKE HORSE DAM FAILURE TURBID,BROWNISH-GRAY COLOR,HIGH FLOW

EXPLANATION: MG/L=MILLIGRAMS PER LITER MEQ/L=MILLIEQUIVILENTS PER LITER
ALL CONSTITUENTS DISSOLVED (DISS) EXCEPT AS NOTED. TOT=TOTAL SUSP=SUSPENDED
(M)= MEASURED(R)=REPORTED (E)=ESTIMATED M=METERS TR=TOTAL RECOVERABLE

SAMPLE NO SAMPLER LES HANDLING 3210 ANALYST LAB LAB WQBH
COMPLETED 07-14-75 COMPUTER RUN 07/15/75 PROGRAM SYS 75 FUND 0650

STND DEV. ION BALANCE 9.99	CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
SEGMENT MPDES	0.0	0.0	0.0	0.0	0.0	13.0	87.0	0.0	0.0

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CENTRAL LABORATORY, SALT LAKE CITY, UTAH

WATER QUALITY ANALYSIS
LAB ID # 184507 RECORD # 26099

SAMPLE LOCATION: BLACKFOOT R BL ALICE C NR LINCOLN MT At Hogum C
STATION ID: 12334650 LAT.LONG.SEQ.:
DATE OF COLLECTION: BEGIN--750627 END-- TIME--1545
COUNTY CODE: PROJECT IDENTIFICATION: SPEC
DATA TYPE: 2 SOURCE: SURFACE WATER GEOLOGIC UNIT:
COMMENTS:
BREAK IN TAILINGS POND DYKE SPILL INTO BLACKFOOT RIVER

CADMIUM DISSOLVED	UG/L		1	LEAD TOTAL	UG/L	<	100
CADMIUM TOTAL	UG/L	<	10	MANGANESE DISSOLVED	UG/L		50
COPPER DISSOLVED	UG/L		3	MANGANESE TOTAL	UG/L		170
COPPER TOTAL	UG/L		30	SILVER DISSOLVED	UG/L		0
IRON DISSOLVED	UG/L		40	SILVER TOTAL	UG/L	<	10
IRON TOTAL	UG/L		1500	ZINC DISSOLVED	UG/L		60
LEAD DISSOLVED	UG/L		4	ZINC TOTAL	UG/L		170

STATE HEALTH DEPT. WATER QUALITY BUREAU HELENA, MONTANA 59601

STATE	MONTANA	COUNTY	LEWIS+CLARK
LAT.-LONG.	465734N 1123429W	SAMPLE LOCATION	14N 8W 14CDD
STATION CODE		ANALYSIS NUMBER	75W1052
DATE SAMPLED	06-24-75	DRAINAGE BASIN	76F
TIME SAMPLED	1610	WATER FLOW RATE	
METHOD SAMPLED	GRAB	FLOW MEASUREMENT METHOD	NOT MEASURED
SAMPLE SOURCE	STREAM	ALTITUDE OF LAND SURFACE	
WATER USE	UNUSED	TOTAL WELL DEPTH BELOW LS	
AQUIFER(S)		SWL ABOVE(+) OR BELOW LS	
SAMPLED BY	USFS	SAMPLE DEPTH BELOW SURFACE	

SAMPLING SITE: BLACKFOOT RIVER BELOW 7-UP PETE CREEK

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)			BICARBONATE(HCO3)	124.	2.029
MAGNESIUM (MG)			CARBONATE (CO3)	0.	0.0
SODIUM (NA)			CHLORIDE (CL)		
POTASSIUM (K)			SULFATE (SO4)	4.4	0.092
IRON (FE)			FLUORIDE (F)		
MANGANESE (MN)			NITRATE (NO3 AS N)		
ALUMINUM (AL)			NO3+NO2 (TOT AS N)		
HYDROGEN (H+)	0.00	0.000	PHOSPHATE(PO4 AS P)		
TOTAL CATIONS		0.000	TOTAL ANIONS		2.121

LABORATORY PH	8.15	TOTAL HARDNESS AS CACO3	
FIELD WATER TEMPERATURE (C)		TOTAL ALKALINITY AS CACO3	102
DISSOLVED SOLIDS CALCULATED		LAB TURBIDITY (JTU)	225.
LAB CONDUCTIVITY-UMHOS-25C	191.	SODIUM ADSORPTION RATIO	

ADDITIONAL PARAMETERS

SEDIMENT,TOT,SUSP (MG/L)	496.	COPPER,TR (MG/L AS CU)	.01
COPPER,TOTAL(MG/L AS CU)	.04	MANGANESE,TR(MG/L AS MN)	.19
MANGANESE, TOT (MG/L-MN)	.38	IRON,TR (MG/L AS FE)	.97
IRON, TOTAL (MG/L AS FE)	10.	CADMIUM, TR (MG/L AS CD)	< 0.001
CADMIUM,TOT (MG/L AS CD)	< 0.001	ZINC,TR (MG/L AS ZN)	.01
ZINC, TOTAL (MG/L AS ZN)	.11	LEAD,TR (MG/L AS PB)	< 0.05
LEAD, TOTAL (MG/L AS PB)	< 0.05	ARSENIC,TR (MG/L AS AS)	.003
ARSENIC,TOT (MG/L AS AS)	.006		

REMARKS: MIKE HORSE CAM FAILURE WATER TURBID, BROWN COLOR

EXPLANATION: MG/L=MILLIGRAMS PER LITER MEQ/L=MILLIEQUIVILENTS PER LITER ALL CONSTITUENTS DISSOLVED (DISS) EXCEPT AS NOTED. TOT=TOTAL SUSP=SUSPENDED (M)= MEASURED(R)=REPORTED (E)=ESTIMATED M=METERS TR=TOTAL RECOVERABLE

SAMPLE NO SAMPLER DR HANDLING 2000 ANALYST KEV LAB WQBH
COMPLETED 08-04-75 COMPUTER RUN 08/06/75 PROGRAM SYS 75 FUND 0650
STND DEV. ION BALANCE 9.99

	MPDES	CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
SEGMENT		0.0	0.0	0.0	0.0	0.0	4.3	95.7	0.0	0.0

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CENTRAL LABORATORY, SALT LAKE CITY, UTAH

WATER QUALITY ANALYSIS
LAB ID # 184508 RECORD # 26101

SAMPLE LOCATION: BLACKFOOT R BL 7-UP PETE C, NR LINCOLN, MT. Bl Landers 7-up Pete
STATION ID: 12334700 LAT.LONG.SEQ.: 465721 1123502 00
DATE OF COLLECTION: BEGIN--750627 END-- TIME--1620
COUNTY CODE: 049 PROJECT IDENTIFICATION: SPEC
DATA TYPE: 2 SOURCE: SURFACE WATER GEOLOGIC UNIT:
COMMENTS:
BREAK IN TAILINGS POND DYKE SPILL INTO BLACKFOOT RIVER

CADMIUM DISSOLVED	UG/L	0	LEAD TOTAL	UG/L <	100
CADMIUM TOTAL	UG/L <	10	MANGANESE DISSOLVED	UG/L	0
COPPER DISSOLVED	UG/L	1	MANGANESE TOTAL	UG/L	230
COPPER TOTAL	UG/L	10	SILVER DISSOLVED	UG/L	0
IRON DISSOLVED	UG/L	10	SILVER TOTAL	UG/L <	10
IRON TOTAL	UG/L	4800	ZINC DISSOLVED	UG/L	10
LEAD DISSOLVED	UG/L	2	ZINC TOTAL	UG/L	70

STATE HEALTH DEPT. WATER QUALITY BUREAU HELENA, MONTANA 59601

STATE	MONTANA	COUNTY	LEWIS+CLARK
LAT.-LONG.	4657 5N 1123927W	SAMPLE LOCATION	14N 8W 19
STATION CODE		ANALYSIS NUMBER	75W1036
DATE SAMPLED	06-25-75	DRAINAGE BASIN	76F
TIME SAMPLED	1500	WATER FLOW RATE	
METHOD SAMPLED	GRAB	FLOW MEASUREMENT METHOD	
SAMPLE SOURCE	STREAM	ALTITUDE OF LAND SURFACE	
WATER USE	UNUSED	TOTAL WELL DEPTH BELOW LS	
AQUIFER(S)		SWL ABOVE(+) OR BELOW LS	
SAMPLED BY	WQBH	SAMPLE DEPTH BELOW SURFACE	

SAMPLING SITE: BLACKFOOT R AT LINCOLN

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)			BICARBONATE(HCO3)		
MAGNESIUM (MG)			CARBONATE (CO3)		
SODIUM (NA)			CHLORIDE (CL)		
POTASSIUM (K)			SULFATE (SO4)		
IRON (FE)	.03	0.002	FLUORIDE (F)		
MANGANESE (MN)	< .01		NITRATE (NO3 AS N)		
ALUMINUM (AL)			NO3+NO2 (TOT AS N)		
HYDROGEN (H+)			PHOSPHATE(PO4 AS P)		
TOTAL CATIONS		0.002	TOTAL ANIONS		0.000

LABORATORY PH		TOTAL HARDNESS AS CACO3	
FIELD WATER TEMPERATURE (C)	9.0	TOTAL ALKALINITY AS CACO3	
DISSOLVED SOLIDS CALCULATED		LAB TURBIDITY (JTU)	240.
LAB CONDUCTIVITY-UMHOS-25C	192.	SODIUM ADSORPTION RATIO	

ADDITIONAL PARAMETERS

SEDIMENT,TOT,SUSP (MG/L)	548.	ARSENIC,DISS(MG/L AS AS)	< .001
CADMIUM,DISS(MG/L AS CD)	< .001	COPPER,DISS(MG/L AS CU)	< .01
LEAD DISS(MG/L AS PB)	< .005	ZINC,DISS(MG/L AS ZN)	< .01
COPPER,TR (MG/L AS CU)	.01	COPPER,TOTAL(MG/L AS CU)	.03
MANGANESE,TR(MG/L AS MN)	.38	MANGANESE, TOT (MG/L-MN)	.43
IRON,TR (MG/L AS FE)	4.9	IRON, TOTAL (MG/L AS FE)	11.
CADMIUM, TR (MG/L AS CD)	.001	CADMIUM,TOT (MG/L AS CD)	.001
ZINC,TR (MG/L AS ZN)	.05	ZINC, TOTAL (MG/L AS ZN)	.09
LEAD,TR (MG/L AS PB)	< 0.05	LEAD, TOTAL (MG/L AS PB)	< 0.05
ARSENIC,TR (MG/L AS AS)	.003	ARSENIC,TOT (MG/L AS AS)	.009

REMARKS: MIKE-HORSE MINE SURVEILL. VERY TURBID-LIGHT TAN COLOR

EXPLANATION: MG/L=MILLIGRAMS PER LITER MEQ/L=MILLIEQUIVILENTS PER LITER
ALL CONSTITUENTS DISSOLVED (DISS) EXCEPT AS NOTED. TOT=TOTAL SUSP=SUSPENDED
(M)= MEASURED(R)=REPORTED (E)=ESTIMATED M=METERS TR=TOTAL RECOVERABLE

SAMPLE NO 3 SAMPLER MJP HANDLING 3210 ANALYST KEV LAB WQBH
COMPLETED 08-04-75 COMPUTER RUN 08/06/75 PROGRAM SYS 75 FUND 0650

STND DEV. ION BALANCE -0.01		CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
SEGMENT	NPDES	0.0	0.0	0.0	0.0	33.3	33.3	0.0	33.3	0.0

STATE HEALTH DEPT. WATER QUALITY BUREAU HELENA, MONTANA 59601

STATE	MONTANA	COUNTY	LEWIS+CLARK
LAT.-LONG.	465636N 1124416W	SAMPLE LOCATION	14N SW 28ABA
STATION CODE		ANALYSIS NUMBER	75W1053
DATE SAMPLED	06-24-75	DRAINAGE BASIN	76F
TIME SAMPLED	1630	WATER FLOW RATE	
METHOD SAMPLED	GRAB	FLOW MEASUREMENT METHOD	
SAMPLE SOURCE	STREAM	ALTITUDE OF LAND SURFACE	
WATER USE	UNUSED	TOTAL WELL DEPTH BELOW LS	
AQUIFER(S)		SWL ABOVE(+) OR BELOW LS	
SAMPLED BY	USFS	SAMPLE DEPTH BELOW SURFACE	

SAMPLING SITE: BLACKFOOT RIVER AT DALTON MTN ROAD BRIDGE

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)			BICARBONATE(HCO3)	135.	2.219
MAGNESIUM (MG)			CARBONATE (CO3)	0.	0.0
SODIUM (NA)			CHLORIDE (CL)		
POTASSIUM (K)			SULFATE (SO4)	2.9	0.060
IRON (FE)			FLUORIDE (F)		
MANGANESE (MN)			NITRATE (NO3 AS N)		
ALUMINUM (AL)			NO3+NO2 (TOT AS N)		
HYDROGEN (H+)	0.00	0.000	PHOSPHATE(PO4 AS P)		
TOTAL CATIONS		0.000	TOTAL ANIONS		2.280

LABORATORY PH	7.95	TOTAL HARDNESS AS CACO3	
FIELD WATER TEMPERATURE (C)		TOTAL ALKALINITY AS CACO3	111
DISSOLVED SOLIDS CALCULATED		LAB TURBIDITY (JTU)	180.
LAB CONDUCTIVITY-UMHOS-25C	213.	SODIUM ADSORPTION RATIO	

ADDITIONAL PARAMETERS

SEDIMENT,TOT,SUSP (MG/L)	366.	COPPER,TR (MG/L AS CU)	< 0.01
COPPER,TOTAL(MG/L AS CU)	< 0.01	MANGANESE,TR(MG/L AS MN)	.16
MANGANESE, TOT (MG/L-MN)	.31	IRON,TR (MG/L AS FE)	.84
IRON, TOTAL (MG/L AS FE)	9.0	CADMIUM, TR (MG/L AS CD)	< 0.001
CADMIUM,TOT (MG/L AS CD)	< 0.001	ZINC,TR (MG/L AS ZN)	.01
ZINC, TOTAL (MG/L AS ZN)	.06	LEAD,TR (MG/L AS PB)	< 0.05
LEAD, TOTAL (MG/L AS PB)	< 0.05	ARSENIC,TR (MG/L AS AS)	.002
ARSENIC,TOT (MG/L AS AS)	.006		

REMARKS: MIKE HORSE DAM FAILURE WATER TURBID, BROWN COLOR

EXPLANATION: MG/L=MILLIGRAMS PER LITER MEQ/L=MILLIEQUIVILENTS PER LITER
ALL CONSTITUENTS DISSOLVED (DISS) EXCEPT AS NOTED. TOT=TOTAL SUSP=SUSPENDED
(M)= MEASURED(R)=REPORTED (E)=ESTIMATED M=METERS TR=TOTAL RECOVERABLE

SAMPLE NO SAMPLER DR HANDLING 2000 ANALYST KEV LAB WQBH
COMPLETED 08-04-75 COMPUTER RUN 08/06/75 PROGRAM SYS 75 FUND 0650

STND DEV. ION BALANCE 9.99	CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
SEGMENT MPDES	0.0	0.0	0.0	0.0	0.0	2.6	97.4	0.0	0.0

STATE HEALTH DEPT. WATER QUALITY BUREAU HELENA, MONTANA 59601

STATE	MONTANA	COUNTY	LEWIS+CLARK
LAT.-LONG.	465537N 11251 6W	SAMPLE LOCATION	14N 10W 34BDC
STATION CODE		ANALYSIS NUMBER	75W1054
DATE SAMPLED	06-24-75	DRAINAGE BASIN	76F
TIME SAMPLED	1650	WATER FLOW RATE	
METHOD SAMPLED	GRAB	FLOW MEASUREMENT METHOD	NOT MEASURED
SAMPLE SOURCE	STREAM	ALTITUDE OF LAND SURFACE	
WATER USE	UNUSED	TOTAL WELL DEPTH BELOW LS	
AQUIFER(S)		SWL ABOVE(+) OR BELOW LS	
SAMPLED BY	USFS	SAMPLE DEPTH BELOW SURFACE	

SAMPLING SITE: BLACKFOOT RIVER AT BLACKFOOT CANYON CAMP

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)			BICARBONATE(HCO3)	136.	2.229
MAGNESIUM (MG)			CARBONATE (CO3)	0.	0.0
SODIUM (NA)			CHLORIDE (CL)		
POTASSIUM (K)			SULFATE (SO4)	3.1	0.065
IRON (FE)			FLUORIDE (F)		
MANGANESE (MN)			NITRATE (NO3 AS N)		
ALUMINUM (AL)			NO3+NO2 (TOT AS N)		
HYDROGEN (H+)	0.00	0.000	PHOSPHATE(PO4 AS P)		
TOTAL CATIONS		0.000	TOTAL ANIONS		2.294

LABORATORY PH	7.95	TOTAL HARDNESS AS CACO3	
FIELD WATER TEMPERATURE (C)		TOTAL ALKALINITY AS CACO3	112
DISSOLVED SOLIDS CALCULATED		LAB TURBIDITY (JTU)	170.
LAB CONDUCTIVITY-UMHOS-25C	215.	SODIUM ADSORPTION RATIO	

ADDITIONAL PARAMETERS

SEDIMENT,TOT,SUSP (MG/L)	316.	COPPER,TR (MG/L AS CU)	< 0.01
COPPER,TOTAL(MG/L AS CU)	.01	MANGANESE,TR(MG/L AS MN)	.15
MANGANESE, TOT (MG/L-MN)	.30	IRON,TR (MG/L AS FE)	.70
IRON, TOTAL (MG/L AS FE)	8.0	CADMIUM, TR (MG/L AS CD)	< 0.001
CADMIUM,TOT (MG/L AS CD)	< 0.001	ZINC,TR (MG/L AS ZN)	.01
ZINC, TOTAL (MG/L AS ZN)	.06	LEAD,TR (MG/L AS PB)	< 0.05
LEAD, TOTAL (MG/L AS PB)	< 0.05	ARSENIC,TR (MG/L AS AS)	.001
ARSENIC,TOT (MG/L AS AS)	.005		

REMARKS: MIKE HORSE DAM FAILURE WATER TURBID, BROWN COLOR

EXPLANATION: MG/L=MILLIGRAMS PER LITER MEQ/L=MILLIEQUIVILENTS PER LITER
ALL CONSTITUENTS DISSOLVED (DISS) EXCEPT AS NOTED. TOT=TOTAL SUSP=SUSPENDED
(M)= MEASURED(R)=REPORTED (E)=ESTIMATED M=METERS TR=TOTAL RECOVERABLE

SAMPLE NO SAMPLER OR HANDLING 2000 ANALYST KEV LAB WQBH
COMPLETED 08-04-75 COMPUTER RUN 08/06/75 PROGRAM SYS 75 FUND 0650

STND DEV. ION BALANCE 9.99	CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
SEGMENT MPDES	0.0	0.0	0.0	0.0	0.0	2.8	97.2	0.0	0.0

MONTANA DEPARTMENT OF FISH AND GAME

RPT 2200.1 SPECIES DIVERSITY ANALYSIS PAGE 4

JANUARY 12, 1976

STATION: POPS PLACE

NUMBER OF SAMPLERS: 3

SAMPLING PERIOD: 11-1-72

RANK	ABUNDANCE	PERCENT OF TOTAL
1	158	62.0
2	64	25.1
3	15	5.9
4	8	3.1
5	2	0.8
6	2	0.8
7	2	0.8
8	1	0.4
9	1	0.4
10	1	0.4
11	1	0.4
TOTAL	255	100.0

	SHANNON	BRILLOUIN
DIVERSITY	1.62	1.53
MAXIMUM DIVERSITY	3.46	3.32
MINIMUM DIVERSITY	0.37	0.31
REDUNDANCY	0.60	0.60
EVENNESS	0.47	0.46
EQUITABILITY	0.20	0.23
SPECIES RICHNESS	1.41	1.30

STATION: POPS PLACE

NUMBER OF SAMPLERS: 4

SAMPLING PERIOD: 10-2-75

RANK	ABUNDANCE	PERCENT OF TOTAL
1	34	85.0
2	2	5.0
3	1	2.5
4	1	2.5
5	1	2.5
6	1	2.5
TOTAL	40	100.0

	SHANNON	BRILLOUIN
DIVERSITY	0.95	0.76
MAXIMUM DIVERSITY	2.58	2.27
MINIMUM DIVERSITY	0.83	0.66
REDUNDANCY	0.94	0.94
EVENNESS	0.37	0.33
EQUITABILITY	0.18	0.19
SPECIES RICHNESS	0.77	0.57

MONTANA DEPARTMENT OF FISH AND GAME

RPT 2200.1 SPECIES DIVERSITY ANALYSIS PAGE 1

JANUARY 22, 1976

STATION: FLESHER

NUMBER OF SAMPLERS: 3

SAMPLING PERIOD: 10-19-71

RANK	ABUNDANCE	PERCENT OF TOTAL
1	351	24.9
2	243	17.3
3	208	14.8
4	157	11.2
5	102	7.2
6	81	5.8
7	57	4.0
8	46	3.3
9	32	2.3
10	30	2.1
11	28	2.0
12	15	1.1
13	8	0.6
14	8	0.6
15	6	0.4
16	5	0.4
17	5	0.4
18	4	0.3
19	4	0.3
20	3	0.2
21	3	0.2
22	3	0.2
23	2	0.1
24	2	0.1
25	2	0.1
26	1	0.1
27	1	0.1
28	1	0.1
TOTAL	1408	100.0

	SHANNON	BRILLOUIN
DIVERSITY	3.33	3.27
MAXIMUM DIVERSITY	4.81	4.73
MINIMUM DIVERSITY	0.23	0.20
REDUNDANCY	0.32	0.32
EVENNESS	0.69	0.69
EQUITABILITY	0.32	0.36
SPECIES RICHNESS	3.01	2.91

STATION: FLESHER

NUMBER OF SAMPLERS: 3

SAMPLING PERIOD: 11-1-72

RANK	ABUNDANCE	PERCENT OF TOTAL
1	425	32.9
2	336	26.0
3	125	9.7
4	81	6.3
5	69	5.3
6	35	2.7
7	34	2.6
8	26	2.0
9	21	1.6
10	20	1.5
11	20	1.5
12	18	1.4
13	17	1.3
14	15	1.2
15	13	1.0
16	11	0.9
17	8	0.6
18	5	0.4
19	5	0.4
20	2	0.2
21	2	0.2
22	2	0.2
23	2	0.2
TOTAL	1292	100.0

	SHANNON	BRILLOUIN
DIVERSITY	3.04	2.99
MAXIMUM DIVERSITY	4.52	4.45
MINIMUM DIVERSITY	0.20	0.18
REDUNDANCY	0.34	0.34
EVENNESS	0.67	0.67
EQUITABILITY	0.29	0.34
SPECIES RICHNESS	2.75	2.65

MONTANA DEPARTMENT OF FISH AND GAME

RPT 2200.1 SPECIES DIVERSITY ANALYSIS PAGE 1

JANUARY 12, 1976

STATION: FLESHER

NUMBER OF SAMPLERS: 3

SAMPLING PERIOD: 10-2-75

RANK	ABUNDANCE	PERCENT OF TOTAL
1	67	60.4
2	8	7.2
3	6	5.4
4	5	4.5
5	4	3.6
6	4	3.6
7	3	2.7
8	2	1.8
9	2	1.8
10	2	1.8
11	2	1.8
12	1	0.9
13	1	0.9
14	1	0.9
15	1	0.9
16	1	0.9
17	1	0.9
TOTAL	111	100.0

	SHANNON	BRILLOUIN
DIVERSITY	2.41	2.14
MAXIMUM DIVERSITY	4.09	3.71
MINIMUM DIVERSITY	1.17	0.96
REDUNDANCY	0.57	0.57
EVENNESS	0.59	0.58
EQUITABILITY	0.36	0.40
SPECIES RICHNESS	2.06	1.74

APPENDIX C-2

MONTANA DEPARTMENT OF FISH AND GAME

RPT 2200.1 SPECIES DIVERSITY ANALYSIS PAGE 1

FEBRUARY 19, 1976

STATION: POPS PLACE

NUMBER OF SAMPLERS: 1

SAMPLING PERIOD: 10-19-71

RANK	ABUNDANCE	PERCENT OF TOTAL
1	23	48.9
2	10	21.3
3	7	14.9
4	2	4.3
5	1	2.1
6	1	2.1
7	1	2.1
8	1	2.1
9	1	2.1
TOTAL	47	100.0

	SHANNON	BRILLOUIN
DIVERSITY	2.17	1.87
MAXIMUM DIVERSITY	3.17	2.77
MINIMUM DIVERSITY	1.17	0.93
REDUNDANCY	0.50	0.49
EVENNESS	0.69	0.68
EQUITABILITY	0.39	0.44
SPECIES RICHNESS	1.78	1.42

STATION: POPS PLACE

NUMBER OF SAMPLERS: 1

SAMPLING PERIOD: 10-19-71

RANK	ABUNDANCE	PERCENT OF TOTAL
1	12	34.3
2	12	34.3
3	5	14.3
4	4	11.4
5	1	2.9
6	1	2.9
TOTAL	35	100.0

	SHANNON	BRILLOUIN
DIVERSITY	2.11	1.82
MAXIMUM DIVERSITY	2.58	2.24
MINIMUM DIVERSITY	0.92	0.72
REDUNDANCY	0.29	0.28
EVENNESS	0.82	0.81
EQUITABILITY	0.41	0.48
SPECIES RICHNESS	1.70	1.34

STATION: POPS PLACE

NUMBER OF SAMPLERS: 1

SAMPLING PERIOD: 10-19-71

RANK	ABUNDANCE	PERCENT OF TOTAL
1	32	28.3
2	27	23.9
3	24	21.2
4	13	11.5
5	12	10.6
6	2	1.8
7	1	0.9
8	1	0.9
9	1	0.9
TOTAL	113	100.0

	SHANNON	BRILLOUIN
DIVERSITY	2.47	2.30
MAXIMUM DIVERSITY	3.17	2.96
MINIMUM DIVERSITY	0.58	0.48
REDUNDANCY	0.27	0.26
EVENNESS	0.78	0.78
EQUITABILITY	0.36	0.42
SPECIES RICHNESS	2.11	1.88

STATION: POPS PLACE

NUMBER OF SAMPLERS: 1

SAMPLING PERIOD: 11-1-72

RANK	ABUNDANCE	PERCENT OF TOTAL
1	46	47.4
2	39	40.2
3	5	5.2
4	5	5.2
5	2	2.1
TOTAL	97	100.0

	SHANNON	BRILLOUIN
DIVERSITY	1.60	1.49
MAXIMUM DIVERSITY	2.32	2.19
MINIMUM DIVERSITY	0.33	0.27
REDUNDANCY	0.35	0.37
EVENNESS	0.69	0.68
EQUITABILITY	0.24	0.29
SPECIES RICHNESS	1.35	1.20

STATION: POPS PLACE

NUMBER OF SAMPLERS: 1

SAMPLING PERIOD: 11-1-72

RANK	ABUNDANCE	PERCENT OF TOTAL
1	72	80.0
2	7	7.8
3	3	3.3
4	2	2.2
5	1	1.1
6	1	1.1
7	1	1.1
8	1	1.1
9	1	1.1
10	1	1.1
TOTAL	90	100.0

	SHANNON	BRILLOUIN
DIVERSITY	1.26	1.09
MAXIMUM DIVERSITY	3.32	3.05
MINIMUM DIVERSITY	0.79	0.64
REDUNDANCY	0.81	0.81
EVENNESS	0.38	0.36
EQUITABILITY	0.19	0.21
SPECIES RICHNESS	1.07	0.88

STATION: POPS PLACE

NUMBER OF SAMPLERS: 1

SAMPLING PERIOD: 11-1-72

RANK	ABUNDANCE	PERCENT OF TOTAL
1	40	58.8
2	22	32.4
3	3	4.4
4	2	2.9
5	1	1.5
TOTAL	68	100.0

	SHANNON	BRILLOUIN
DIVERSITY	1.41	1.29
MAXIMUM DIVERSITY	2.32	2.15
MINIMUM DIVERSITY	0.44	0.36
REDUNDANCY	0.48	0.48
EVENNESS	0.61	0.60
EQUITABILITY	0.23	0.27
SPECIES RICHNESS	1.18	1.01

STATION: POPS PLACE

NUMBER OF SAMPLERS: 1

SAMPLING PERIOD: 10-2-75

RANK	ABUNDANCE	PERCENT OF TOTAL
1	9	81.8
2	2	18.2
TOTAL	11	100.0

	SHANNON	BRILLOUIN
DIVERSITY	0.68	0.53
MAXIMUM DIVERSITY	1.00	0.80
MINIMUM DIVERSITY	0.44	0.31
REDUNDANCY	0.56	0.57
EVENNESS	0.68	0.65
EQUITABILITY	0.20	0.23
SPECIES RICHNESS	0.49	0.30

STATION: POPS PLACE

NUMBER OF SAMPLERS: 1

SAMPLING PERIOD: 10-2-75

RANK	ABUNDANCE	PERCENT OF TOTAL
1	10	90.9
2	1	9.1
TOTAL	11	100.0

	SHANNON	BRILLOUIN
DIVERSITY	0.44	0.31
MAXIMUM DIVERSITY	1.00	0.80
MINIMUM DIVERSITY	0.44	0.31
REDUNDANCY	1.00	1.00
EVENNESS	0.44	0.39
EQUITABILITY	0.13	0.14
SPECIES RICHNESS	0.31	0.18

STATION: POPS PLACE

NUMBER OF SAMPLERS: 1

SAMPLING PERIOD: 10-2-75

RANK	ABUNDANCE	PERCENT OF TOTAL
1	8	88.9
2	1	11.1
TOTAL	9	100.0

	SHANNON	BRILLOUIN
DIVERSITY	0.50	0.35
MAXIMUM DIVERSITY	1.00	0.78
MINIMUM DIVERSITY	0.50	0.35
REDUNDANCY	1.00	1.00
EVENNESS	0.50	0.45
EQUITABILITY	0.16	0.17
SPECIES RICHNESS	0.34	0.18

STATION: FLESHER

NUMBER OF SAMPLERS: 1

SAMPLING PERIOD: 10-19-71

RANK	ABUNDANCE	PERCENT OF TOTAL
1	88	24.6
2	79	22.1
3	64	17.9
4	34	9.5
5	21	5.9
6	20	5.6
7	16	4.5
8	13	3.6
9	5	1.4
10	5	1.4
11	4	1.1
12	2	0.6
13	2	0.6
14	2	0.6
15	1	0.3
16	1	0.3
TOTAL	357	100.0

	SHANNON	BRILLOUIN
DIVERSITY	3.01	2.90
MAXIMUM DIVERSITY	4.00	3.86
MINIMUM DIVERSITY	0.42	0.36
REDUNDANCY	0.28	0.27
EVENNESS	0.75	0.75
EQUITABILITY	0.36	0.41
SPECIES RICHNESS	2.66	2.49

STATION: FLESHER

NUMBER OF SAMPLERS: 1

SAMPLING PERIOD: 10-19-71

RANK	ABUNDANCE	PERCENT OF TOTAL
1	81	20.8
2	72	18.5
3	59	15.1
4	40	10.3
5	34	8.7
6	33	8.5
7	15	3.8
8	14	3.6
9	11	2.8
10	6	1.5
11	6	1.5
12	3	0.8
13	2	0.5
14	2	0.5
15	2	0.5
16	2	0.5
17	2	0.5
18	2	0.5
19	1	0.3
20	1	0.3
21	1	0.3
22	1	0.3
TOTAL	390	100.0

	SHANNON	BRILLOUIN
DIVERSITY	3.34	3.20
MAXIMUM DIVERSITY	4.46	4.28
MINIMUM DIVERSITY	0.54	0.46
REDUNDANCY	0.29	0.28
EVENNESS	0.75	0.75
EQUITABILITY	0.39	0.45
SPECIES RICHNESS	2.95	2.76

STATION: FLESHER

NUMBER OF SAMPLERS: 1

SAMPLING PERIOD: 10-19-71

RANK	ABUNDANCE	PERCENT OF TOTAL
1	191	28.7
2	101	15.2
3	85	12.8
4	83	12.5
5	37	5.6
6	35	5.3
7	27	4.1
8	26	3.9
9	20	3.0
10	15	2.3
11	5	0.8
12	4	0.6
13	4	0.6
14	4	0.6
15	4	0.6
16	3	0.5
17	3	0.5
18	3	0.5
19	3	0.5
20	2	0.3
21	2	0.3
22	2	0.3
23	2	0.3
24	1	0.2
25	1	0.2
26	1	0.2
27	1	0.2
TOTAL	665	100.0

	SHANNON	BRILLOUIN
DIVERSITY	3.31	3.21
MAXIMUM DIVERSITY	4.75	4.62
MINIMUM DIVERSITY	0.42	0.37
REDUNDANCY	0.33	0.33
EVENNESS	0.70	0.70
EQUITABILITY	0.35	0.40
SPECIES RICHNESS	2.96	2.81

STATION: FLESHER

NUMBER OF SAMPLERS: 1

SAMPLING PERIOD: 11-1-72

RANK	ABUNDANCE	PERCENT OF TOTAL
1	139	45.3
2	51	16.6
3	26	8.5
4	25	8.1
5	13	4.2
6	10	3.3
7	9	2.9
8	9	2.9
9	4	1.3
10	4	1.3
11	4	1.3
12	3	1.0
13	3	1.0
14	2	0.7
15	2	0.7
16	1	0.3
17	1	0.3
18	1	0.3
TOTAL	307	100.0

	SHANNON	BRILLOUIN
DIVERSITY	2.75	2.61
MAXIMUM DIVERSITY	4.17	3.99
MINIMUM DIVERSITY	0.54	0.46
REDUNDANCY	0.39	0.39
EVENNESS	0.66	0.65
EQUITABILITY	0.33	0.38
SPECIES RICHNESS	2.41	2.23

STATION: FLESHER

NUMBER OF SAMPLERS: 1

SAMPLING PERIOD: 11-1-72

RANK	ABUNDANCE	PERCENT OF TOTAL
1	169	36.1
2	115	24.6
3	58	12.4
4	31	6.6
5	17	3.6
6	14	3.0
7	12	2.6
8	11	2.4
9	8	1.7
10	8	1.7
11	6	1.3
12	4	0.9
13	4	0.9
14	3	0.6
15	2	0.4
16	2	0.4
17	1	0.2
18	1	0.2
19	1	0.2
20	1	0.2
TOTAL	468	100.0

	SHANNON	BRILLOUIN
DIVERSITY	2.84	2.73
MAXIMUM DIVERSITY	4.32	4.18
MINIMUM DIVERSITY	0.42	0.36
REDUNDANCY	0.38	0.38
EVENNESS	0.66	0.65
EQUITABILITY	0.32	0.37
SPECIES RICHNESS	2.52	2.36

STATION: FLESHER

NUMBER OF SAMPLERS: 1

SAMPLING PERIOD: 11-1-72

RANK	ABUNDANCE	PERCENT OF TOTAL
1	170	32.9
2	117	22.6
3	65	12.6
4	41	7.9
5	25	4.8
6	25	4.8
7	21	4.1
8	9	1.7
9	8	1.5
10	7	1.4
11	6	1.2
12	5	1.0
13	5	1.0
14	4	0.8
15	3	0.6
16	2	0.4
17	2	0.4
18	1	0.2
19	1	0.2
TOTAL	517	100.0

	SHANNON	BRILLOUIN
DIVERSITY	2.97	2.87
MAXIMUM DIVERSITY	4.25	4.12
MINIMUM DIVERSITY	0.36	0.31
REDUNDANCY	0.33	0.33
EVENNESS	0.70	0.70
EQUITABILITY	0.33	0.38
SPECIES RICHNESS	2.64	2.49

STATION: FLESHER

NUMBER OF SAMPLERS: 1

SAMPLING PERIOD: 10-2-75

RANK	ABUNDANCE	PERCENT OF TOTAL
1	16	55.2
2	4	13.8
3	3	10.3
4	2	6.9
5	1	3.4
6	1	3.4
7	1	3.4
8	1	3.4
TOTAL	29	100.0

	SHANNON	BRILLOUIN
DIVERSITY	2.14	1.74
MAXIMUM DIVERSITY	3.00	2.49
MINIMUM DIVERSITY	1.47	1.13
REDUNDANCY	0.56	0.55
EVENNESS	0.71	0.70
EQUITABILITY	0.44	0.49
SPECIES RICHNESS	1.70	1.25

STATION: FLESHER

NUMBER OF SAMPLERS: 1

SAMPLING PERIOD: 10-2-75

RANK	ABUNDANCE	PERCENT OF TOTAL
1	14	60.9
2	2	8.7
3	1	4.3
4	1	4.3
5	1	4.3
6	1	4.3
7	1	4.3
8	1	4.3
9	1	4.3
TOTAL	23	100.0

	SHANNON	BRILLOUIN
DIVERSITY	2.12	1.61
MAXIMUM DIVERSITY	3.17	2.50
MINIMUM DIVERSITY	1.98	1.49
REDUNDANCY	0.88	0.88
EVENNESS	0.67	0.65
EQUITABILITY	0.47	0.50
SPECIES RICHNESS	1.65	1.12

STATION: FLESHER

NUMBER OF SAMPLERS: 1

SAMPLING PERIOD: 10-2-75

RANK	ABUNDANCE	PERCENT OF TOTAL
1	37	62.7
2	7	11.9
3	3	5.1
4	2	3.4
5	2	3.4
6	2	3.4
7	1	1.7
8	1	1.7
9	1	1.7
10	1	1.7
11	1	1.7
12	1	1.7
TOTAL	59	100.0

	SHANNON	BRILLOUIN
DIVERSITY	2.10	1.78
MAXIMUM DIVERSITY	3.58	3.15
MINIMUM DIVERSITY	1.34	1.07
REDUNDANCY	0.66	0.66
EVENNESS	0.59	0.57
EQUITABILITY	0.36	0.39
SPECIES RICHNESS	1.74	1.39

STATE OF MONTANA

DEPARTMENT OF FISH AND GAME
Box 1063
Glendive, Mont.
59330

Feb. 21,1976

Dear Liter,

I recently discovered a paper that will help you deciede if the macroinvertebrate population changes you found in the Blackfoot River afterthe washout are significant.

Cairns(1967) states that,...."For biologically oriented readers my own operational definition of optimal is the ability to support an aquatic community in a pattern which does not vary more than 20 percent from the empirically estimated maximum steady-state diversity possible in each particular locale."

Cairns, J. 1967. The use of water quality control techniques in the management of aquatic ecosystems. Water Res. Bull.,3:47-53.

also see:

Cairns,J. and R.L.Kaesler. 1969. Cluster analysis of Potomac River survey stations based on Protozoan presence anbencs data. Hydrobiologia 34:414-432.

What this means to me is that variations of up to 20% of maximum observed diversity can be called normal and healthy but deviations over 20% are called unhealthy. For your data examine your pre-washout diversity and find the highest value and compare it with the post-washout diversity.

I hope this is of some help.

Sincerely,

Bob

Robert L. Newell

APPENDIX E

Data pertaining to live-caged cutthroat trout at four locations

Date Checked	Time	Alive	Dead	Size of Fish (in)	Water Temp °C	Comments
Cage Number 1 - Blackfoot River at Flesher Road, 11 cutthroat from Alice Creek collected at water temperature 16.4 C						
7/9/75	1515	11	0	4.3-7.1	18.2	Cage installed. Water fairly clear.
7/10/75	1115	9	1		14.7	1 fish escaped from hole in cage - main river temp 14.4 C. Water clear.
7/11/75	1300	3	6		16.7	All live fish active and seemed in good condition. Water clear.
7/12/75	1200	3	0		15.7	All live fish active. Main river temp 15.0 C. Water clear.
7/13/75	1530	2	0		16.8	1 fish escaped. Main river temp 17.2 C. Water clear. Live fish active. Cage removed from station.
Cage Number 2 - Blackfoot River at Pop's Place, 10 cutthroat from Alice Creek collected at water temperature 16.4 C.						
7/9/75	1700	10	0	4.5-6.8	14.8	Cage installed. Water gray-colored, very turbid.
7/10/75	1330	10	0		13.0	Water milky-gray color. Fish active.
7/11/75	1330	5	5		12.9	Dead fish decomposing. Water still turbid. 1 live fish stressed.
7/12/75	1215	1	4		11.1	Water clearing, can see streambottom. Tailings diverted into settling pond yesterday.
7/13/75	1550	0	1		13.3	Water turbid again - gray color. Cage removed.

Date Checked	Time	Alive	Dead	Size of Fish (in)	Water Temp °C	Comments
Cage Number 3 - Blackfoot River Ponds below Pass Creek, 10 cutthroat - 5 from Alice Creek, 5 from Pass Creek water temp 13.2 C.						
7/9/75	1750	10	0	4.0-7.3	16.6	Cage installed. Water gray-colored, very turbid.
7/10/75	1410	9	1		16.7	3 live fish distressed, the rest active. Water brown-gray color.
7/11/75	1345	5	4		16.3	Water turbid. One live fish distressed.
7/12/75	1230	3	2		14.8	Water clear. 2 live fish almost dead.
7/13/75	1610	3	0		15.6	Water gray again. Cage removed
Cage Number 4 - Shoue Gulch (Control Station) 10 cutthroat from pass Creek collected at water temp 13.2 C.						
7/9/75	1900	10	0	4.0-7.0	10.3	Cage installed. Water very clear.
7/10/75	1530	6	0		11.3	4 fish escaped through hole in cage. Water very clear. Fish active.
7/11/75	1400	6	0		11.1	All fish very active. Water very clear.
7/12/75	1340	6	0		10.8	All fish very active. Water very clear.
7/13/75	1635	6	0		11.4	Fish active. Water very clear despite recent rain.Cage removed.

MONTANA BUREAU OF MINES AND GEOLOGY

BUTTE, MONTANA 59701

July 21, 1975

Montana Fish & Game
Sam Mitchell Building
Helena, Montana 59601

Attention Mr. Liter Spence

Gentlemen:

This letter contains the requested analyses of the sample of mine tailings from the Blackfoot River above Shouey Gulch that you sent to our laboratory June 23, 1975.

To provide as much information as possible about the sample, I have done several things.

First, in preparing the sample for analysis, I extracted 358 ml of water from the sample by filtration. I estimate this to be about 80 to 90 per-cent of the total moisture the sample contained. By removing the moisture this way rather than by evaporation, I thought that we might obtain some information about the solubility or the reactivity of the tailings in water, as well as removing the bulk of the dissolved phase from the solid phase. Refer to Table I for the concentrations of the dissolved metals in the water.

The solid phase of the sample was then dried to constant weight at 105^0 cellsius to remove any remaining moisture, then blended to make the sample homogeneous. The sample was divided into two segments with a Jones Sample Splitter. Segment "A" was pulverized to -325 mesh and analyzed for total Cd,Cu,Fe,Ni,Pb, and Zn. See Table II for concentrations.

Segment "B" was passed through a series of sieves to separate the various particle sizes. Refer to Table III for per-cent particle size gradation values.

Each size gradient was divided into two equal parts. One part was pulverized to -325 mesh and analyzed for total Cd,Cu,Fe,Ni,Pb, and Zn. The other part is being sent to you for your inspection or visual comparison in conjunction with this report.

See Table IV for concentration values.

The solid phase was chemically decomposed by a mixture of nitric, hydrochloric, and hydrofluoric acid. The elemental measurements were made by atomic absorption spectrophotometry.

The dissolved phase (the water that was extracted from the solid phase) was also analyzed by atomic absorption spectrophotometry.

If you have any questions or if I can be of any further assistance, please call upon me at any time.

Yours truly,

L. A. Wegelin
Chief, Analytical Division

LAW:rlh

Enclosure

Copy to Marvin R. Miller

MONTANA BUREAU OF MINES AND GEOLOGY

BUTTE, MONTANA 59701

Mine Tailings Analyses Results July 21, 1975

Table I

Water Extract - (358 ml)	mg/l (ppm)
Cd	<.01
Cu	.01
Fe	.01
Ni	.02
Pb	.05
Zn	.13

Table II

Mine Tailings - Segment "A" -325 mesh pulverized	µg/g (ppm)	
Cd	18.1	
Cu	608.	
Fe	144,800.	
Ni	81.0	
Pb	1,232.	
Zn	2,780.	
Au*	.069	.002 troy oz./ton
Ag*	12.690	.370 troy oz./ton

* Note: Au and Ag were determined by fire assay

Table III

Size Gradation (Sieve) Analysis - Segment "B"

Tyler Sieve (mesh) U.S. Standard No.	Grams Recovered	% (W/W)
+60	77.1	5.8
-60	154.4	11.6
-80	118.5	8.9
-100	187.2	14.1
-150	208.8	15.7

(cont.)

Table III

Tyler Sieve (mesh) U.S. Standard No.	Grams Recovered	% (W/W)
-200	68.9	5.2
-250	178.2	13.4
-325	334.6	25.2

Total beginning weight of Segment "B" - 1,328.3 grams
Total recovered weight of Segment "B" - 1,327.4 grams

Per-cent recovery - 99.93

Table IV

each fraction pulverized to -325 mesh

Metal concentration/Particle size relationships

Tyler Sieve (mesh) U.S. Standard No.	Cd µg/g	Cu µg/g	Ni µg/g	Pb µg/g	Zn µg/g	Fe µg/g
+60	7.2	212	78	1,112	1,416	34,800
-60	10.6	312	67	928	1,748	31,600
-80	19.0	496	69	1,084	3,140	38,400
-100	29.0	952	75	976	4,836	64,800
-150	25.2	992	80	1,440	3,832	162,000
-200	17.5	768	92	1,424	2,776	212,000
-250	14.5	592	95	1,456	2,460	224,800
-325	16.0	492	101	1,712	2,388	222,400

Lab # 75-0562
Analyst - L.A. Wegelin
Date received-June 23, 1975

LAW:rlh

THE ANACONDA COMPANY

General Mining Division
INTERSTATE 10 E AND KOLB ROAD
P. O. BOX 27007
TUCSON, ARIZONA 85726

INTER-COMPANY CORRESPONDENCE

To: T.P. McNulty

Date: August 1, 1975

From: Rod Anderson

Subject: Heddleston Tailings Pond
North and South Side Tailings

DISCUSSION

The two samples which were taken on July 10, 1975 were received on July 15, 1975. In order to remove the samples from their containers the tailings were slurried with water, filtered and the solution was then measured and assayed. The wet filter cake was weighed. A small portion was cut for assay and weighed both wet and dry. This portion was also assayed. Table No I shows preparation results and Tables II and III show assay results.

ROD ANDERSON

RA/rc
cc: JFMahoney
FLaird
WUnger
JWhyte
DWaters

TABLE NO I

Sample Description	Wet Wt gms	Dry Wt gms	Filtrate Volume mls
North Side Tailings	5344	4708	4470
South Side Tailings	5602	5003	4100

TABLE NO II

Sample Description	Volume mls	pH	Milligrams/liter (ppm) Mn	Zn	Cu	Pb	Cd	As
North Side Filtrate	4470	7.5	4.6	0.5	1.9	0.2	<.01	.02
South Side Filtrate	4100	7.4	6.7	0.5	1.1	0.4	<.01	.06

TABLE III

Sample Description	Dry Wt gms	Percent Mn	Zn	Cu	Pb	Cd	As
North Side-washed cake	4708	0.88	0.16	.025	.09	<.001	.05
South Side-washed cake	5003	0.83	0.25	.050	.14	<.001	.05

GREAT FALLS TRIBUNE JUNE 27, 1975

Mike Horse Mine Dam eroded by runoff from heavy rains

By CARLA BECK
Tribune Staff Writer

The old Mike Horse Mine Dam, actually a huge mound of mine tailings backing up an old sediment pond, was eroded by runoff from a recent intense rainstorm, sending quantities of tailings into the headwaters of the Blackfoot River.

Formerly a White Hope Mines Inc. property, it is now owned by Anaconda Co. It is located in the Heddleston Mining District, 18 miles east of Lincoln and about three miles south of Montana Highway 200.

According to second-hand accounts, this is what apparently happened. During a rainstorm the night of June 19, a landslide blocked a diversion ditch that carried water around the old tailings deposit. It also plugged an outlet for a drainage that intercepted clean water at the head of the pond. The water then could not go out the normal outlets so it topped the tailings and eroded a large channel through the tailings.

Max Botz of the Water Quality Bureau of the Department of Health and Environmental Sciences said Anaconda crews have been at the site repairing the diversion ditch and reopening the old drainage outlet.

Frank Laird, head of environmental engineering for Anaconda's General Mining Division, Tucson, flew by company plane into Butte Thursday noon. He was reported en route to the Mike Horse area Thursday afternoon and could not be reached for comment. Jim Adler, Butte, who handles all exploratory work in the Heddleston and Stillwater, including land mine reclamation, also could not be reached.

An Anaconda official who did not want his name used said his information was sketchy at this point but that an engineer and others were examining the area to determine the best method of preventing further deterioration as well as deciding what should be done with the material that's been displaced.

James A. Posewitz, chief of the Environment and Information Division of the State Department of Fish and Game, said he could not fault Anaconda for not getting after the problem.

Botz said no damage assessment could be made at this time. He said what the bureau fears is that the tailings, all associated with metallic mining, will react with the water to form an acid condition and also release toxic metals into the water. He said there could be not only the immediate problem of suspended material but also the longterm problem due to toxicity.

"I can assure you there is substantial stream damage due to the ruptured dam. However, we won't know the actual details until we have the opportunity to get in there and evaluate the stream over a period of time. Fortunately, we have good water quality records from the past and records of biological conditions, so we can compare and make a judgment. It will take several years to really understand what effect this has had. We're hoping the effects won't be as bad as it looks now," Botz said.

Botz is hoping the high stream flow will mitigate the damage somewhat. He has surveyed the damage from the air and below Landers Fork the gray tailings could not be distinguished from the muddy water of the river.

"It's my opinion those tailings will go many miles down the Blackfoot and the Clark Fork. A lot won't deposit in the stream bottom but will be carried a great distance and be deposited in such small quantities that they won't be a problem," he explained, emphasizing that the worst problem will be near the dam.

10 Great Falls Tribune Sunday, June 29, 1975

Anaconda Co. correcting problem at dam

By CARLA BECK
Tribune Staff Writer

Anaconda Co. has corrected the immediate emergency at Mike Horse Mine Dam and is now evaluating the situation for future control.

This is the word from Frank Laird' head of environmental engineering for Anaconda's General Mining Division at Tucson. Laird arrived in the area Thursday to check the damages and assess the work being done on the 50-foot high tailings dam that eroded and spilled tailings into the headwaters of the Blackfoot River more than a week ago.

The dam, which Laird said he believed is leased by Anaconda, is located in the Heddleston Mining District, 18 miles east of Lincoln and about three miles south of Montana Highway 200.

Laird said a diversion ditch and headgate have been repaired and a culvert has been reopened. Saturday crews were to divert water so it will be independent of any flow through the tailings dam breach.

"We will have to evaluate what we are going to do in the future to prevent further channeling," Laird said. "There are many alternatives and they are all costly. But we are now investigating what will be necessary for future positive control."

Providing some background to the incident' Laird said the Mike Horse' a lead and zinc operation, apparently initiated the tailings pond in about 1941. The dam raised as the operation proceeded, until about 1952 or 1953. Since that time the mine has been inoperable and no active tailings have gone into the impoundment area.

Laird said the tailings cover the greater portion of the pond, so there was little oppportunity for a significant quantity of water to be impounded behind the dam. Yet he commented, and he was backed up by Liter Spence, planning ecologist with the State Department of Fish and Game, there was a cutthroat fishery in that pond before the dam was breached.

Spence speculated that the tailings had not been stirred up for some time and they had apparently been overlaid by a layer of silt, which produced water of a quality good enough to maintain the trout. "Everything was calm. Vegetation was growing in the pond and there was a food chain that took care of the fish'" he added.

Laird explained the precautions which had been followed at the dam. At the inlet, a headgate had been installed some years ago to divert water two ways—to a concrete culvert that went under the dam or to a diversion ditch that discharged in a solids area independent of the dam. This had been maintained by Anaconda through a contractor in Lincoln.

The contractor visited the site Wednesday, June 18, because of the rains, which were coming down on heavy snow in the area. Thursday, June 19, he attempted to visit the site but the road to it was flooded in early morning. That evening he visited the site by helicopter and the dam was tight. Little or no water was overflowing the dam. Laird said the breach in the tailings dam occurred between 10 p.m. Thursday and 6 a.m. Friday. The tailings were first visible in the flooded area Friday morning.

Laird said the contractor had a crew working on the road Saturday and that equipment to repair the dam had been moved in Sunday. The crew began making repairs Monday.

Laird said Anaconda has helped fund a study in the area for many years and this study should indicate the damage to the stream and its life. "We have a good base line from which to work'" he said.

Spence explained that Fish and Game made a contractual agreement with Anaconda in 1970. "They partially funded it and we conducted a study of the water quality' fish population and aquatic insects. I spent a little over three years collecting samples. I'm just completing the report now," he said.

James Posewitz, chief of the Environmental and Information Division of the Department of Fish and Game, said the purpose of the study is in the event any company decides to develop the Heddleston mining body, it will be done with a minimum disruption of the wildlife resource.

Spence said Friday the immediate problem is to get the water off the tailings. "That big gash in the dam is down to bedrock and the creek is just going down through there now' carrying very fine material. It's in those tailings where the problem is going to occur'" Spence said. He said cutthroat are spawning in the upper Blackfoot now.

Spence said he has to agree with others who have expressed fears about the potential for extensive damage to the river due to oxidation of the metals along the stream' forming acids and toxic metals in the water.

"When you see how bad it looks; it's hard to imagine it won't have detrimental effects on the river," he added.

Spence said he thinks Anaconda is sincere in trying to do the immediate job. "My feeling is that maybe if there had been someone there from top management to get the thing going full-speed ahead' it would have been better. It's frustrating to watch that gray water going down the river. But then, I'm not a contractor and I don't know the problems they have," he said.

Spence said there has to be a more final solution than the patchwork going on now. "I don't know the engineering answer, but anything running into that pond now is going to come out that hole," he added.

He called tailing ponds "timebombs that are scattered wherever there has been mining and which are just setting there waiting for circumstances to cause something like this."

Missoulian June 28, 1975

Potentially Toxic Tailings Released Into Blackfoot River

LINCOLN (AP) — State authorities say heavy rains on June 19 washed away part of a dam made of old mine tailings and sent potentially toxic effluent into one of western Montana's most popular fishing rivers.

Water-quality specialist Max Botz of the state Department of Health and Environmental Sciences said it was not known how much the acids stored in the old Mike Horse Dam had poisoned the Blackfoot River.

The dam is located about 18 miles east of Lincoln.

Botz said he feared the tailings would react with water to form acids and to release toxic metals.

He said the department had kept detailed water-quality records which would help evaluate the damage, but added the assessment would take several years to complete.

"I can assure you there is substantial stream damage due to the ruptured dam....We're hoping the effects won't be as bad as it looks now," he said.

The Anaconda Co. sent Frank Laird, head of environmental engineering of the General Mining Division, to Butte on Thursday. Laird was reported traveling to the old dam later in the day.

An Anaconda spokesman said the firm was working on dam repair and minimizing damage to the popular waterway.

Independent Record June 29, 1975

Eroded dam poisons Blackfoot River

LINCOLN (AP) — State authorities say heavy rains on June 19 washed away part of a dam made of old mine tailings and sent potentially toxic effluent into one of western Montana's most popular fishing rivers.

Water-quality specialist Max Botz of the state Department of Health and Environmental Sciences said it was not known how much the acids stored in the old Mike Horse Dam had poisoned the Blackfoot River.

The dam is located about 18 miles east of Lincoln.

Botz said he feared the tailings would react with water to form acids and to release toxic metals into solution.

"I can assure you there is substantial stream damage due to the ruptured dam ... We're hoping the effects won't be as bad as it looks now," he said.

An Anaconda spokesman said the firm was working on dam repair and minimizing damage to the popular waterway.

Botz said the dam, formerly owned by the White Hope Mines, Inc., and purchased by Anaconda, was damaged when torrential rains caused a landslide which blocked drainage outlets.

With normal channels plugged, water began to spill over the top of the tailings, eroding a large gap.

Missoulian June 30, 1975

Company Says Pollution Halted

LINCOLN (AP) — The Anaconda Co. says it has stopped the flow of possibly toxic lead and zinc mine tailings into the trout-rich Blackfoot River from an eroded dam.

Frank Laird, Anaconda's environmental engineering chief, said the company is evaluating the situation to prevent any future recurrence of the incident.

The 50-foot-high tailings dam eroded and spilled spoils into the river as heavy rains pounded large areas of western Montana. Officials said they first spotted the freed tailings June 20.

"That big gash in the dam is down to bedrock, and the creek is just going down through there now carrying very fine material," said Liter Spence, a state Fish and Game Department ecologist.

"It's in those tailings where the problem is going to occur," Spense said, adding that cutthroat trout currently are spawning in the upper Blackfoot River.

A potential for extensive damage to the river exists because of oxidation of the metals along the stream, forming acids and toxic metals in the water, Spence said.

"When you see how bad it looks, it's hard to imagine it won't have detrimental effects on the river," Spence said.

According to Laird, construction crews began repairing the dam last Monday. The crews repaired a diversion ditch and headgate and were to have water totally diverted from the dam breach last Saturday, Laird said.

"We will have to evaluate what we are going to do in the future to prevent further channeling," Laird said. "There are many alternatives, and they are all costly."

Laird said the Mike Horse lead and zinc mine apparently initiated the tailings pond about 1941. The dam rose until the mine discontinued operation about 1953, he said. The dam is located about 18 miles east of here.

Spence said the current patchwork repairs will have to be supplimented by a more complete solution guaranteeing there will be no recurrence of the spillage.

"I don't know the engineering answer," Spence said, "but anything running into that pond now is going to come out that hole."

The ecologist called tailings ponds "timebombs that are scattered wherever there has been mining, and which are just sitting there waiting for circumstances to cause something like this."

APPENDIX I

PHOTOGRAPHS

All photographs were taken by Liter Spence,
Montana Fish, Wildlife and Parks, Helena, MT.

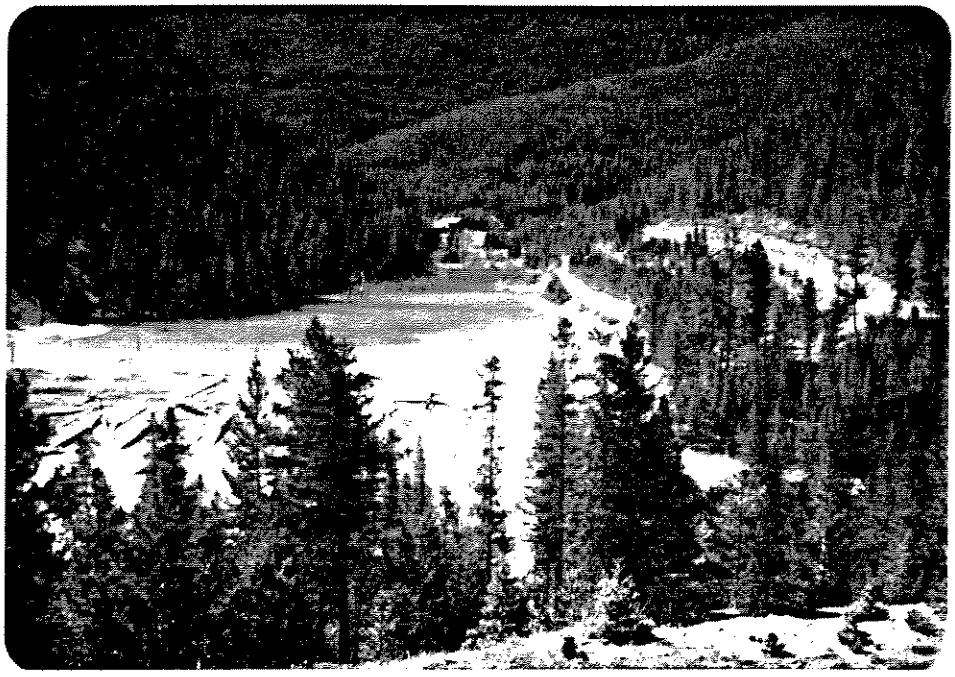


Photo 1. Mike Horse tailings dam before failure.
June 15, 1971.

Photo 2. Mike Horse Dam after reconstruction by the
Anaconda Company. Fall, 1975.

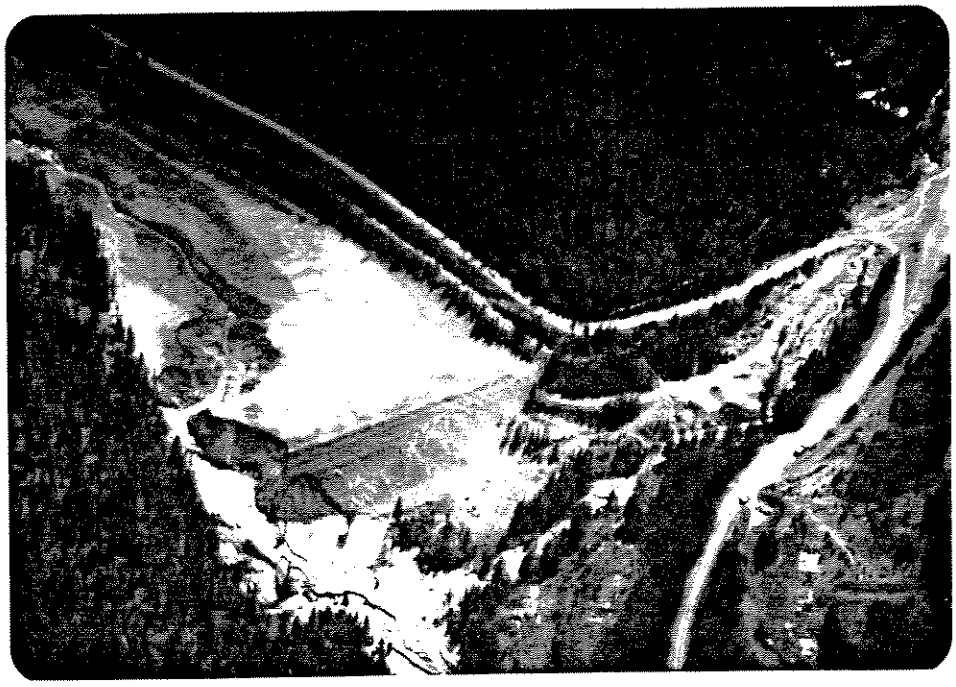


Photo 3. Aerial view of breached Mike Horse Dam. June 24, 1975.

Photo 4. Breach in Mike Horse Dam, looking at dam from downstream. West side of breach is on the right. June 24, 1975.

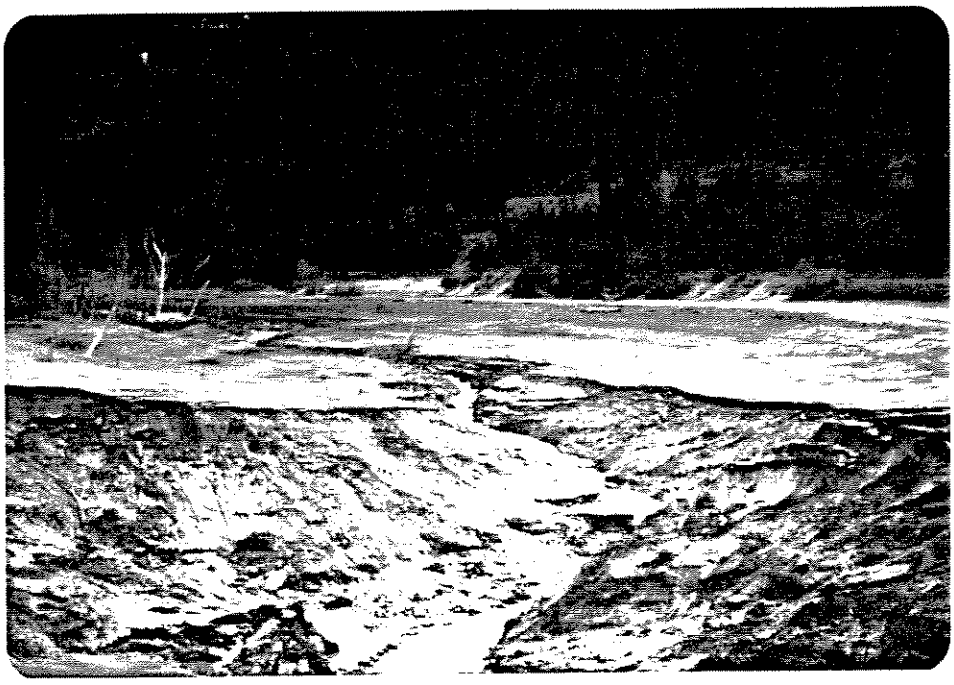


Photo 5. Channelized tailings behind breached Mike Horse Dam. View is from dam site looking up reservoir. June 23, 1975.

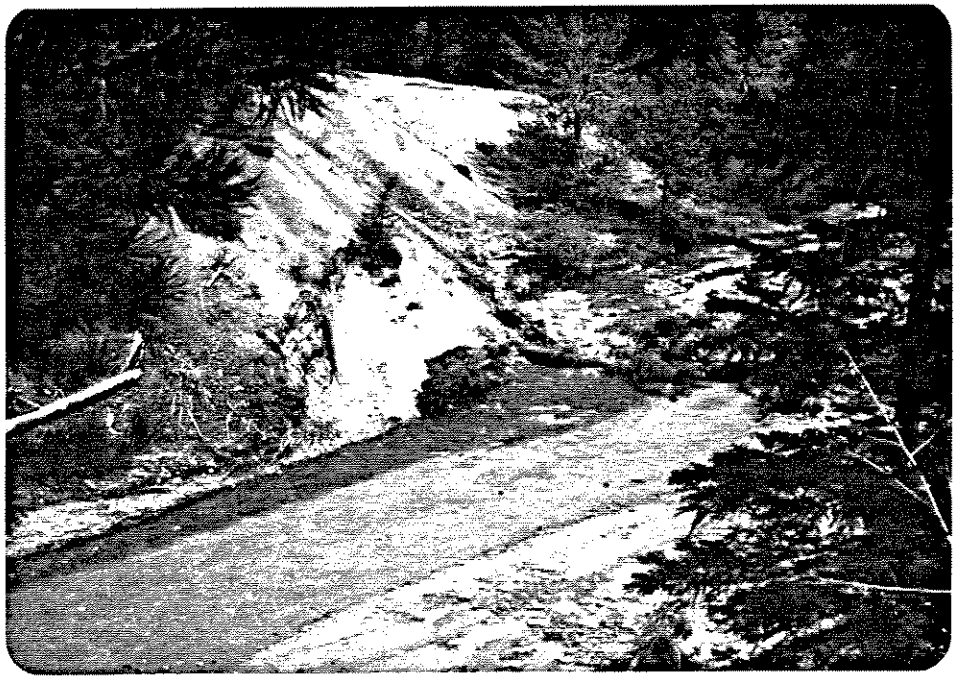


Photo 6. Confluence of Anaconda Creek (clear water) and Beartrap Creek (gray water) below Mike Horse Dam. June 23, 1975.

Photo 7. Mike Horse Mine Road above Shoue Gulch after Mike Horse Dam failure. View is upstream. June 23, 1975.

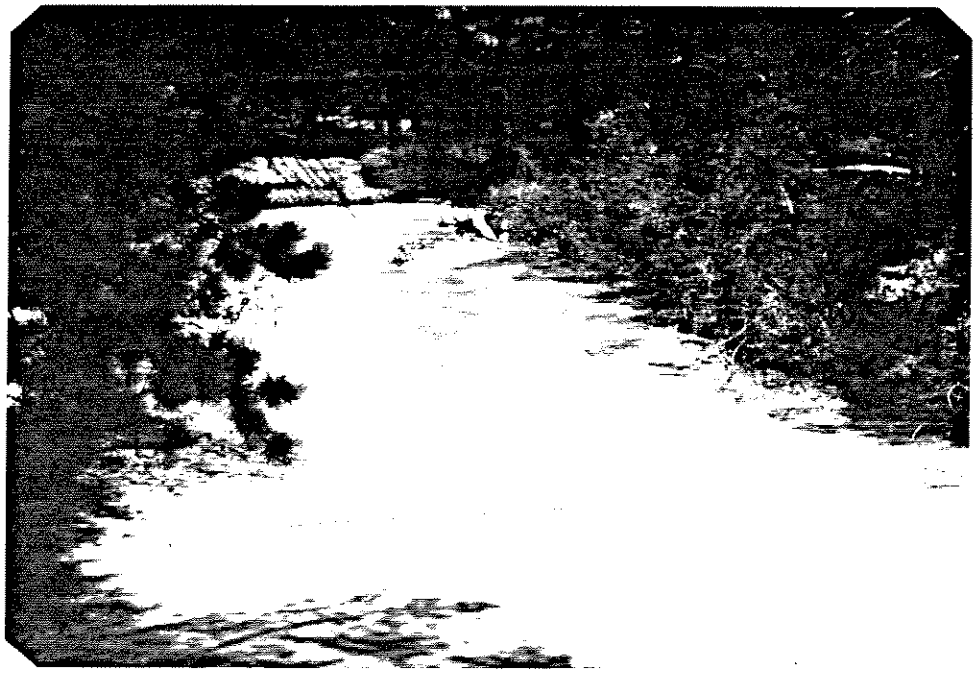


Photo 8. Blackfoot River at Pop's Place after Mike Horse Dam failure. View is upstream. June 24, 1975.

Photo 9. Blackfoot River at Flesher Pass Road bridge after Mike Horse Dam failure. View is upstream. June 23, 1975.

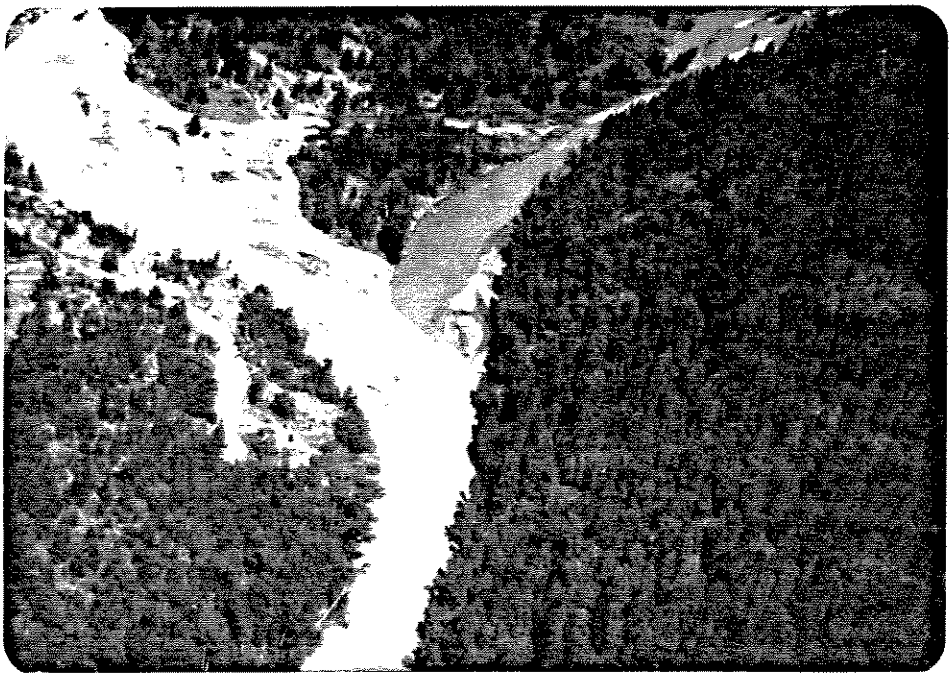
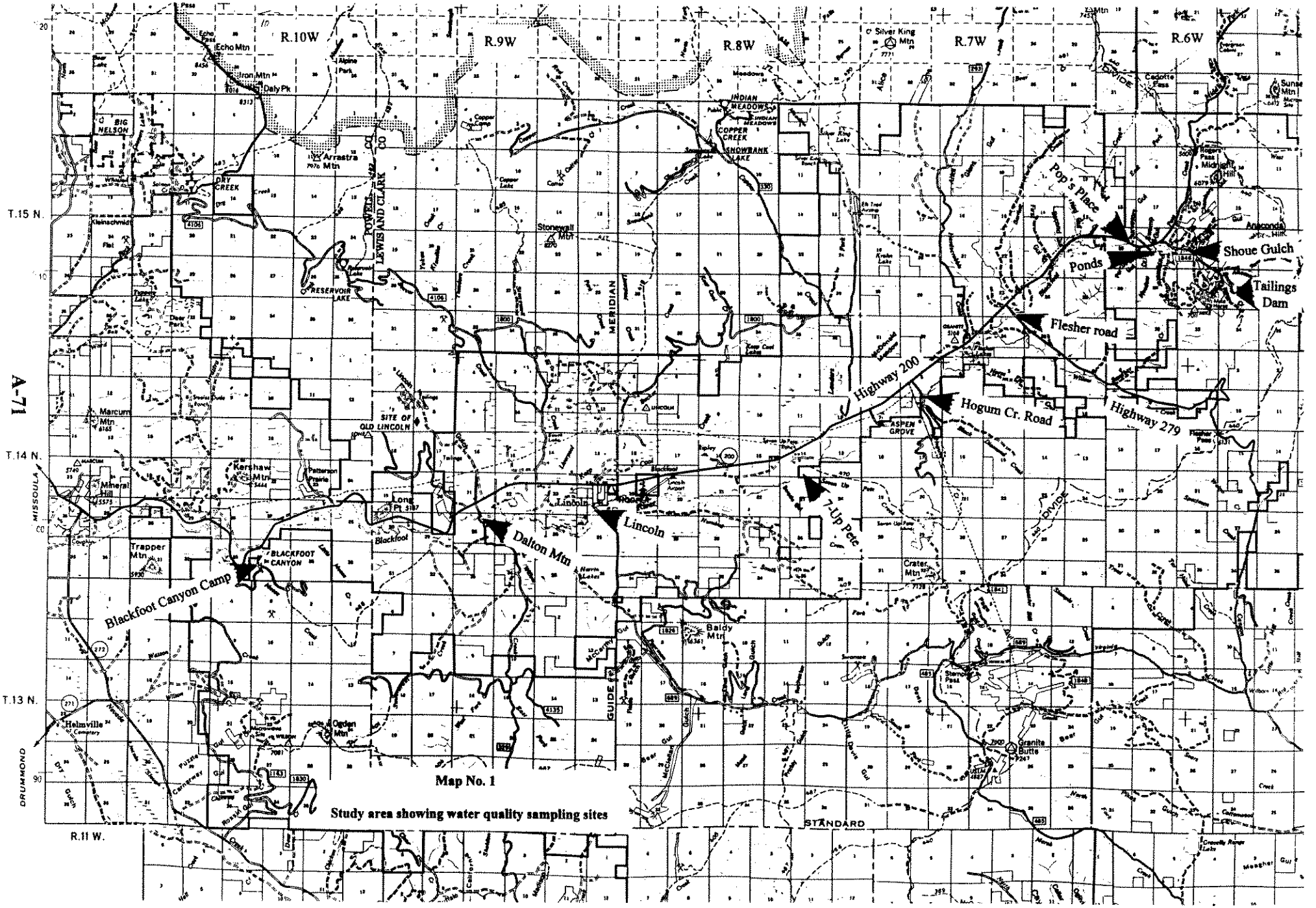
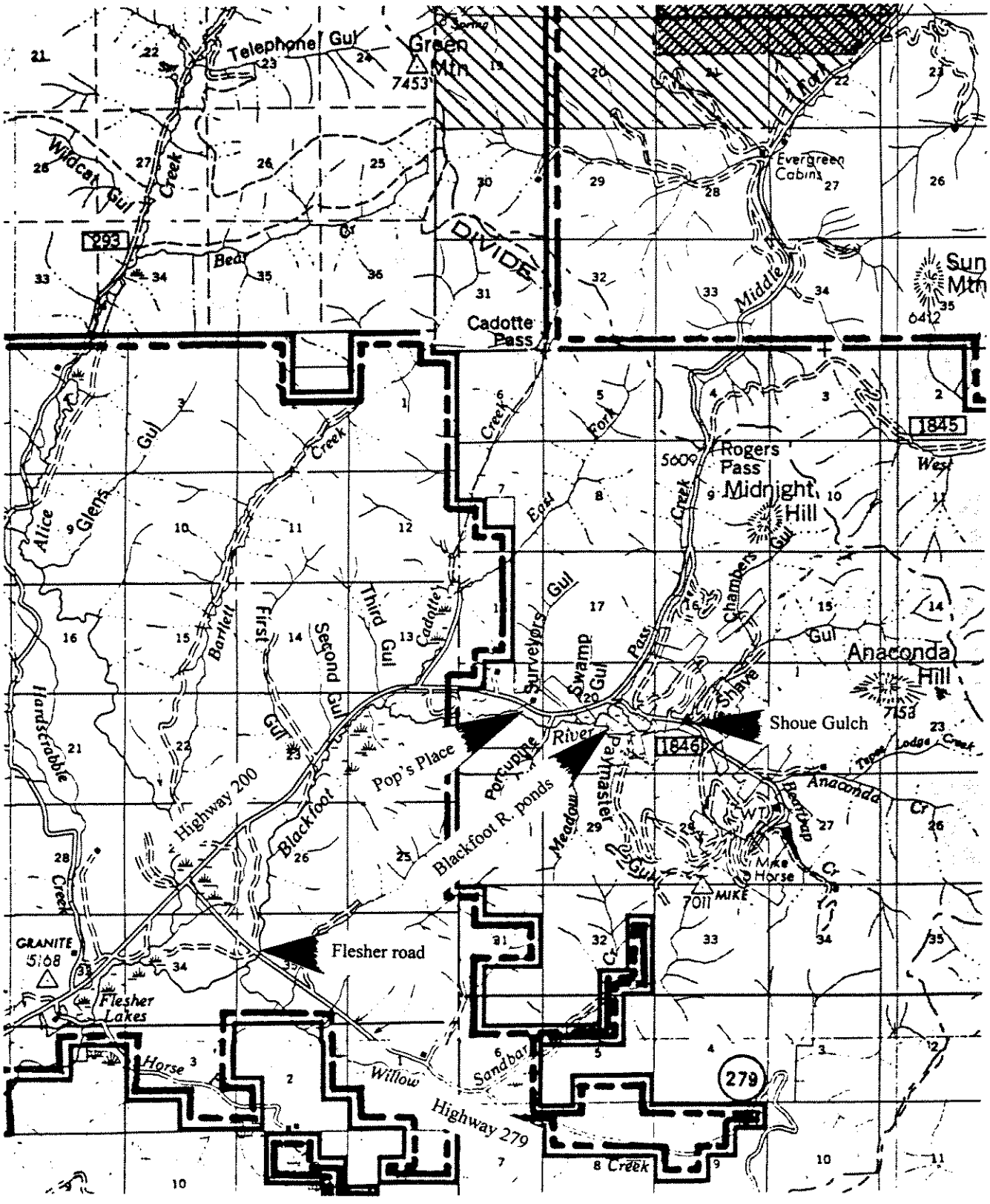


Photo 10. Confluence of Landers Fork (left) with Blackfoot River (top) after Mike Horse Dam failure. June 24, 1975.

APPENDIX J

MAPS


R.10W
R.9W
R.8W
R.7W
R.6W
T.15 N.
T.14 N.
T.13 N.
R.11 W.
A-71
Pop's Place
Ponds
Shoue Gulch
Tailings Dam
Flesher road
Highway 200
Hogum Cr. Road
Highway 279
Lincoln
Dalton Mtn
7-Up Pete
Blackfoot Canyon Camp
Map No. 1
Study area showing water quality sampling sites



Map No. 2

Study area showing locations of fish live cages