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#85350
REGION 2

PROGRESS REPORT

BLACKFOOT RIVER WATER QUALITY STUDY

MONTANA FISH AND GAME DEPARTMENT*
Environmental Resources Division
Helena, Montana

February 1971

*Prepared by Mrs. Arlene Dale, Missoula, Montana in June 1970, under contractual agreement with the Montana Fish and Game Department.

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BLACKFOOT RIVER WATER QUALITY STUDY

Montana Fish and Game Department

INTRODUCTION

This report is a compilation of water quality data collected from February, 1968 to March, 1970, to determine the existing water quality of the Blackfoot River and its tributaries. The major portion of the data collected is presented, except for laboratory determinations which were not available at the time the report was prepared. This is a progress report; data collection will continue for an indefinite period. The primary object of the report is to record data, and not to provide an interpretation or conclusions concerning data collected.

With the exception of mining in the upper reaches of the drainage about the turn of the century and during the 1940's, little use has been made of the river for industrial waste disposal. Drainage from these mining sites still contributes significant amounts of metals to the upper Blackfoot River. Logging and agricultural activities reportedly result in heavy siltation during spring runoff, although no specific studies have been made to determine the severity of this situation. The present quality of water in this drainage represents a relatively unpolluted condition, except above Lincoln where some mine drainage occurs, and during spring runoff.

For several years the reactivation of mining by The Anaconda Company in the Heddleston mining district has been under study. To assess potential or real mining pollution, knowledge of the present state of water quality is needed. Certain factors, such as pH and dissolved oxygen, are accurate indicators of the ability of the stream to sustain various species of plant and animal life. Rather small changes in some of these factors may make the stream uninhabitable for certain species, and thus affect the ecology of the entire aquatic habitat.

The Blackfoot River drainage is an important recreational area, and high water quality standards must be maintained to perpetuate recreational use. Deterioration of present water quality by mining wastes or other human activities is prohibited by law and by regulations administered by the Montana Water Pollution Control Council and State Department of Health.

METHODS

The area encompassed in the study is the main Blackfoot River drainage from its headwaters to its mouth at Bonner, Montana. Six sampling stations on the main Blackfoot River and 24 tributaries were included for chemical analyses (Appendices A and B). Collections on the main Blackfoot River were made at intervals of four to six weeks during the two-year period. Tributary streams were sampled at intervals of about three months. Tests conducted in the field were for water temperature, dissolved oxygen, pH, alkalinity, hardness, CO_2 and turbidity. Field tests were made with a Hach Model DR-EL water analysis kit. Water samples were collected and sent to the State Department of Health Laboratory for standard water quality analyses. A list of field and laboratory analyses that were performed is presented in Appendix C, and methods and precision discussed in Appendix D.

In addition to water quality determinations performed by the State Department of Health, the U.S. Geological Survey, in cooperation with the Montana Fish and Game Department, collected and analyzed water samples and measured stream-flow at the gaging station on the Blackfoot River near Lincoln across the road from Pop's

Place. Between October 1, 1968 and September 30, 1970, streamflow and water temperature were measured continuously. Daily samples were collected and analyzed for specific conductance. On the basis of specific conductance, 1 to 3 samples likely to represent extreme amounts of total dissolved solids were selected each month and analyzed in the laboratory for common constituents. Samples were collected at monthly intervals. Engineeers using Geological Survey recommended techniques made field determinations for specific conductance, dissolved oxygen, pH, and alkalinity. Infrequent sediment samples were collected and analyzed spectrographically for trace elements. On four occasions, diurnal variations in water temperature, air temperature, dissolved oxygen and pH were determined by measurements every two hours for 24 hours.

RESULTS

Information contained in this report is listed in the Table of Contents. Of the many water quality factors studied in this project, the ones judged most significant with regard to maintaining aquatic life have been summarized for this report. These data are presented in tables and graphs for ease of comparison of the tributary streams and the six stations on the Blackfoot River. The data not included in this report have been summarized in a notebook and are available at the Fish and Game Department office in Helena, Montana.

At this time no interpretation of results is offered. When further information concerning the ecology of the Blackfoot River drainage has been collected, the data will be interpreted as they relate to the stream biota.

ACKNOWLEDGEMENTS

Several groups have contributed to this study, among them the Montana Fish and Game Department, the University of Montana, the State Department of Health,

and the United States Geological Survey. The Montana Fish and Game Department has been responsible for the major part of the study. The report was prepared under the direction of, and edited by Mr. Ralph W. Boland, Pollution Control Biologist for the Fish and Game Department. Chemical analyses of water samples were performed at the Department of Health Laboratory. Dr. George F. Weisel of the University of Montana has given direction to the project and supervised student assistants in collecting and conducting field tests on water samples. (Dr. Weisel and Mr. Robert Newell have published a separate report of the studies in which they were involved.)[1/] The United States Geological Survey, as part of a cooperative program with the Montana Fish and Game Department, began stream flow measurements and water quality sampling on the Blackfoot River near Lincoln in September of 1968. The station is about 20 miles east of Lincoln and across the road from Pop's place.

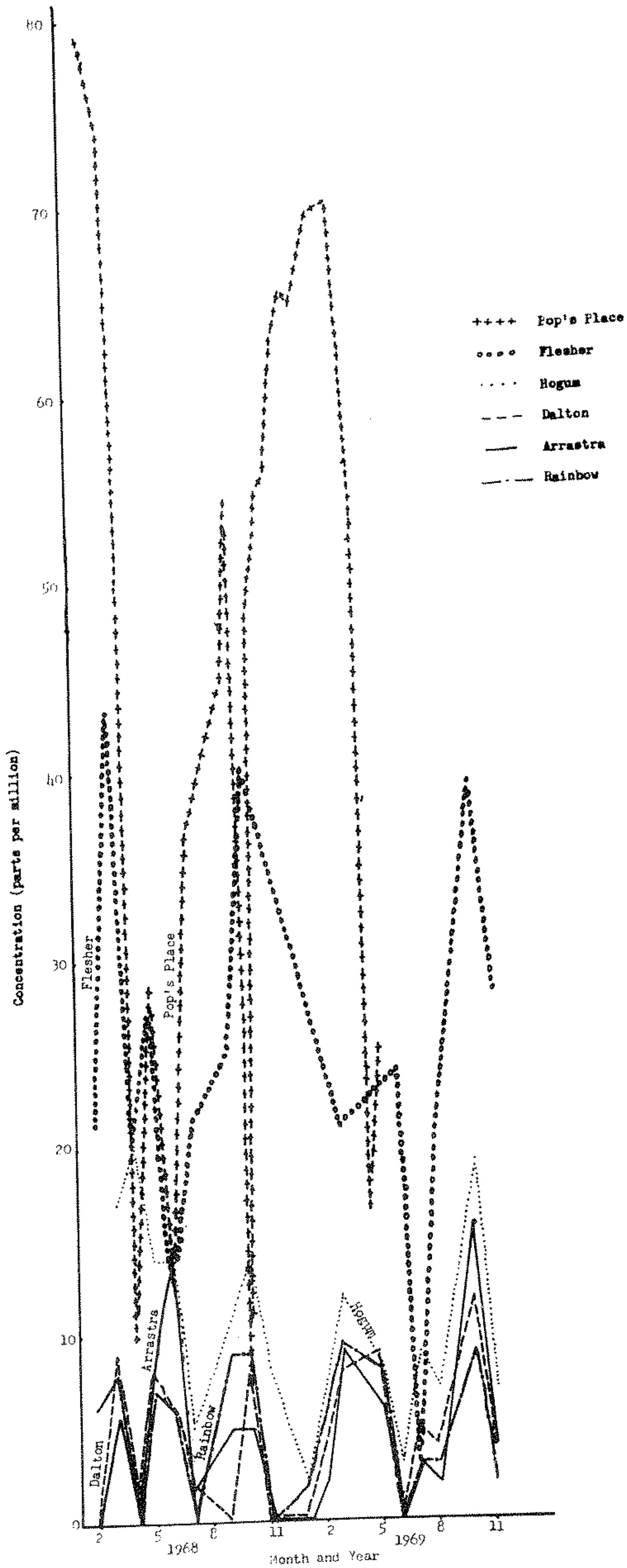
[1/] Quality & Seasonal Fluctuations of Headwater Streams in Western Montana. Bulletin 38. Mont. Forest & Conservation Experiment Station, School of Forestry, Univ. of Mont., Missoula. August, 1970.

TABLE I - RESULTS OF U.S. GEOLOGICAL SURVEY SPECTROGRAPHIC ANALYSES (ppb), BLACKFOOT RIVER NEAR LINCOLN (ACROSS FROM POP'S PLACE).

ELEMENT		DATE OF COLLECTION			
		9-10-68	10-10-68	11-7-68	8-22-69
Aluminum	Al	23	17	19	23
Barium	Ba	140	120	100	170
Beryllium*	Be	.6	1	1	2
Bismuth*	Bi	3	6	3	6
Boron	B	13	7	16	8
Cadmium*	Cd	30	11	52	55
Chromium*	Cr	3	4	2	5
Cobalt*	Co	3	6	3**	6
Copper	Cu	7	9	7	6
Germanium*	Ge	ND	6	5	6
Iron	Fe	24	15	13	24
Lead*	Pb	3	3	2	3
Lithium	Li	2	1	1	2
Manganese	Mn	180	200	200	140
Molybdenum*	Mo	.6	1	2	1
Nickel*	Ni	3	3	5	4
Rubidum	Rb	2	1	1	.2
Silver*	Ag	.3	.3	.2	.3
Strontium	Sr	60	60	67	75
Tin*	Sn	6	6	3	6
Titanium*	Ti	3	4	1	3
Vanadium*	V	3	4	2	3
Zinc	Zn	450	500	550	450

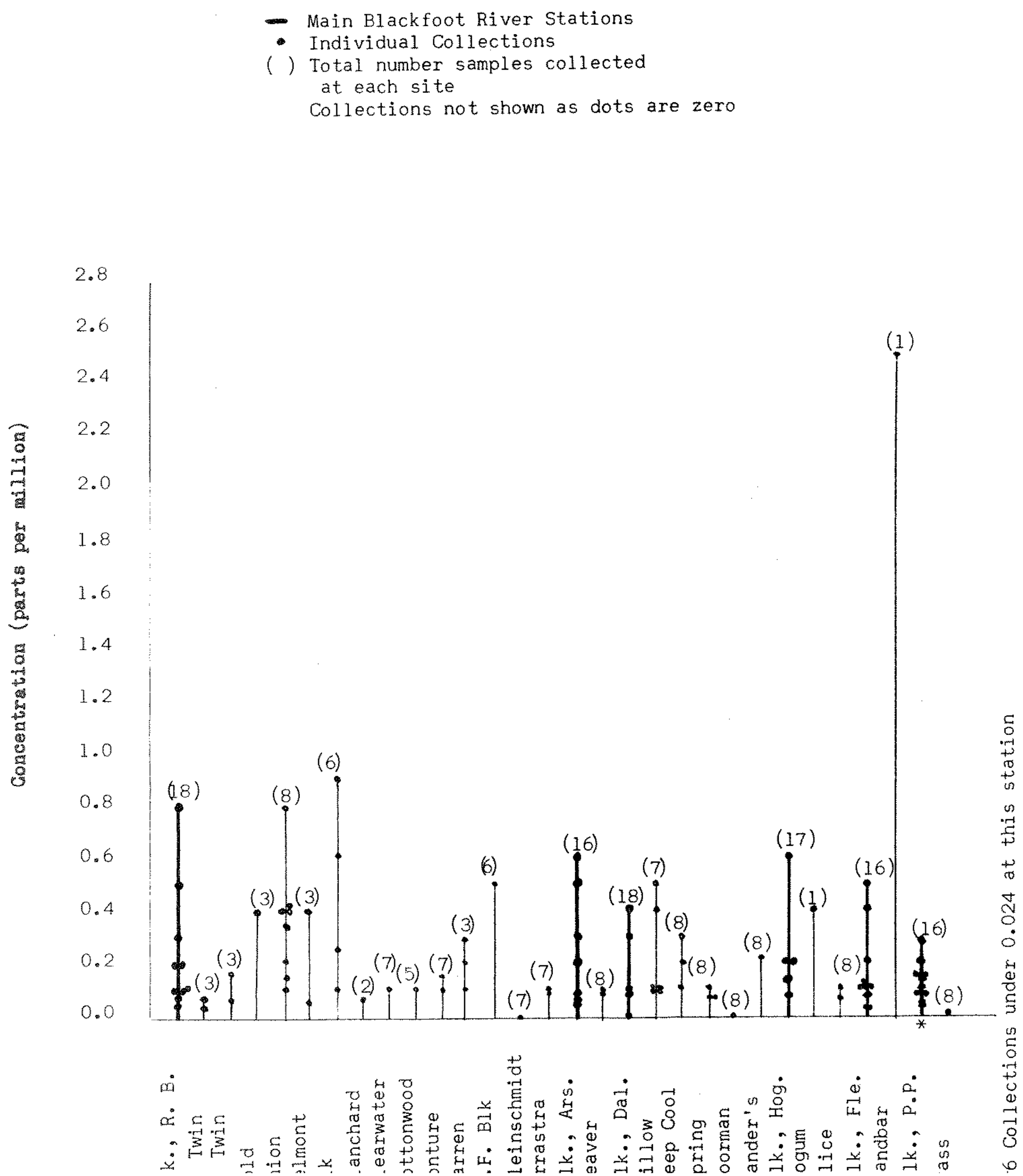
*Less Than Figure Shown
**Not Less Than Figure Shown

Figure I. SULFATE AT MAIN BLACKFOOT RIVER STATIONS, FEBRUARY, 1968 TO DECEMBER, 1970.



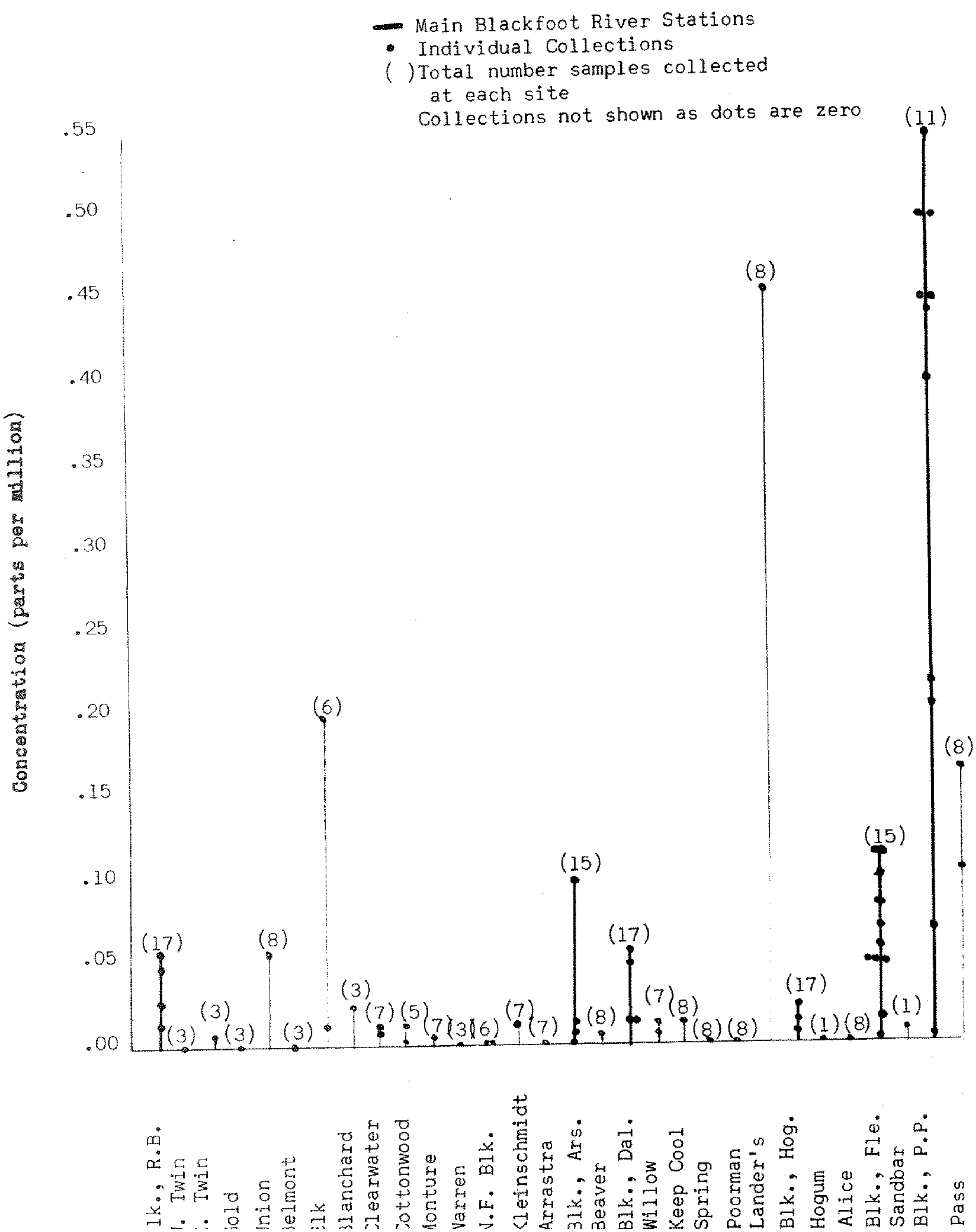
GRAPH 2

IRON IN BLACKFOOT RIVER AND TRIBUTARY STREAMS
FEBRUARY 1968 TO DECEMBER 1969



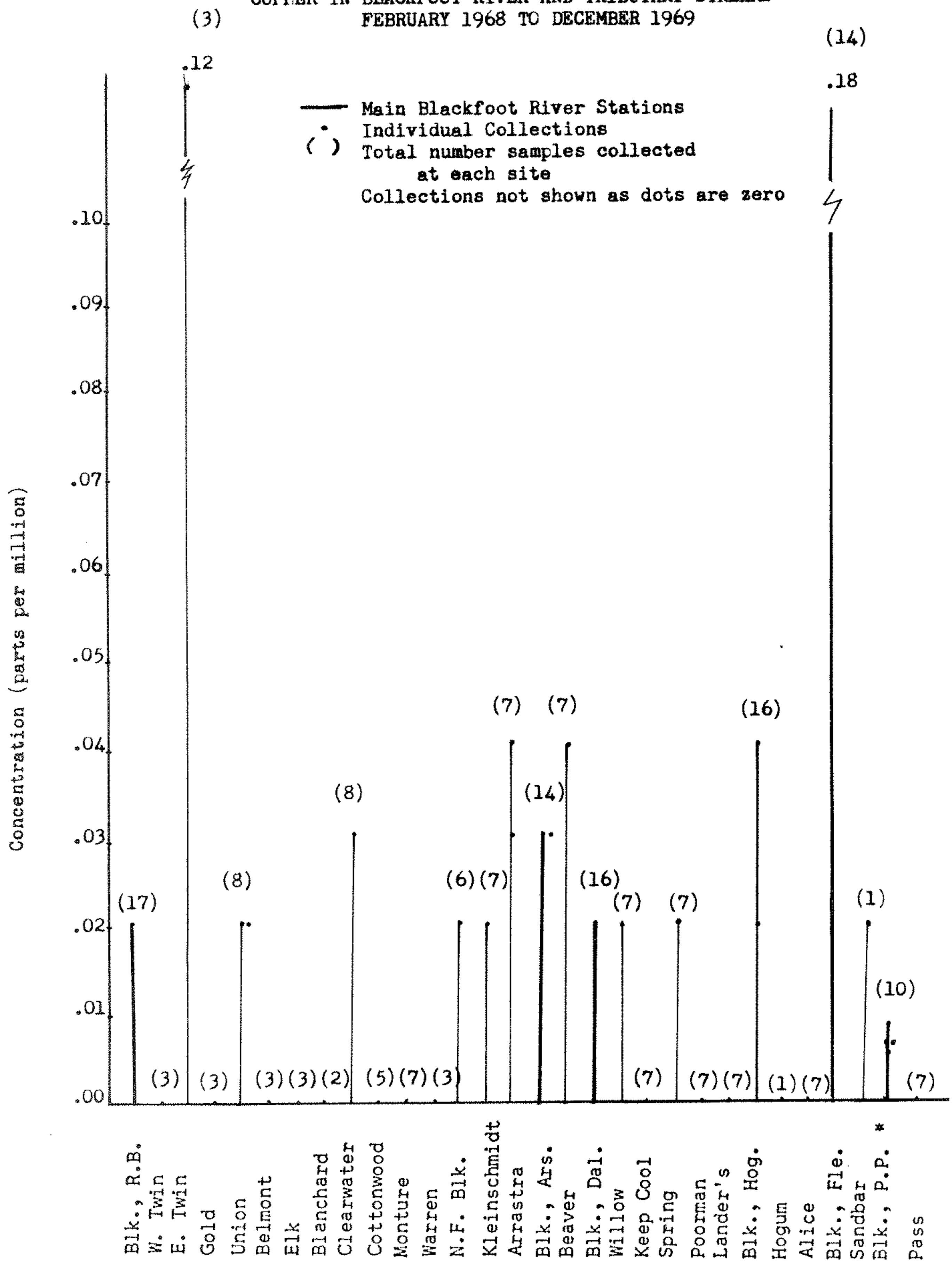
GRAPH 3

ZINC IN BLACKFOOT RIVER AND TRIBUTARY STREAMS
FEBRUARY 1968 TO DECEMBER 1969



GRAPH 4

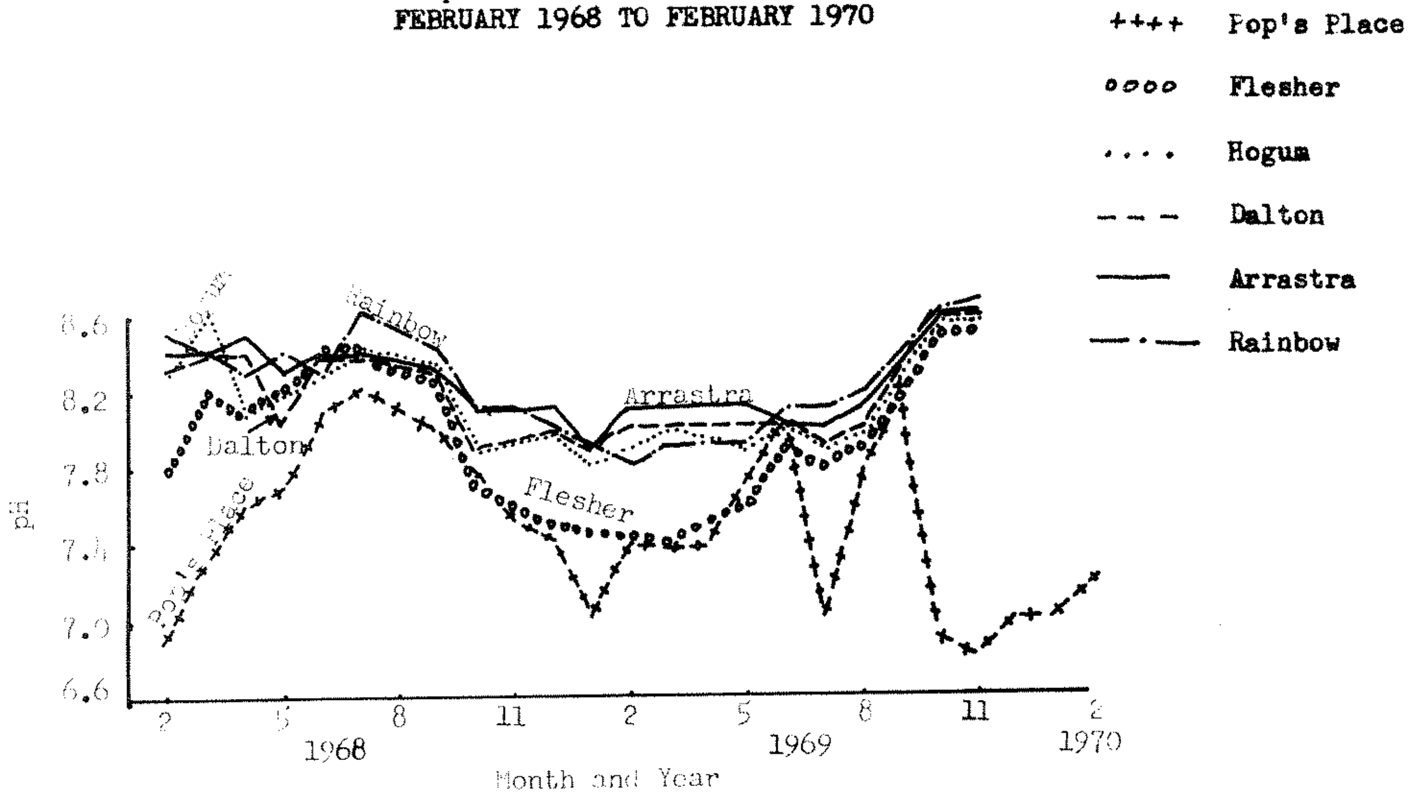
COPPER IN BLACKFOOT RIVER AND TRIBUTARY STREAMS
FEBRUARY 1968 TO DECEMBER 1969



* Four samples shown are from trace metals analysis by USGS.

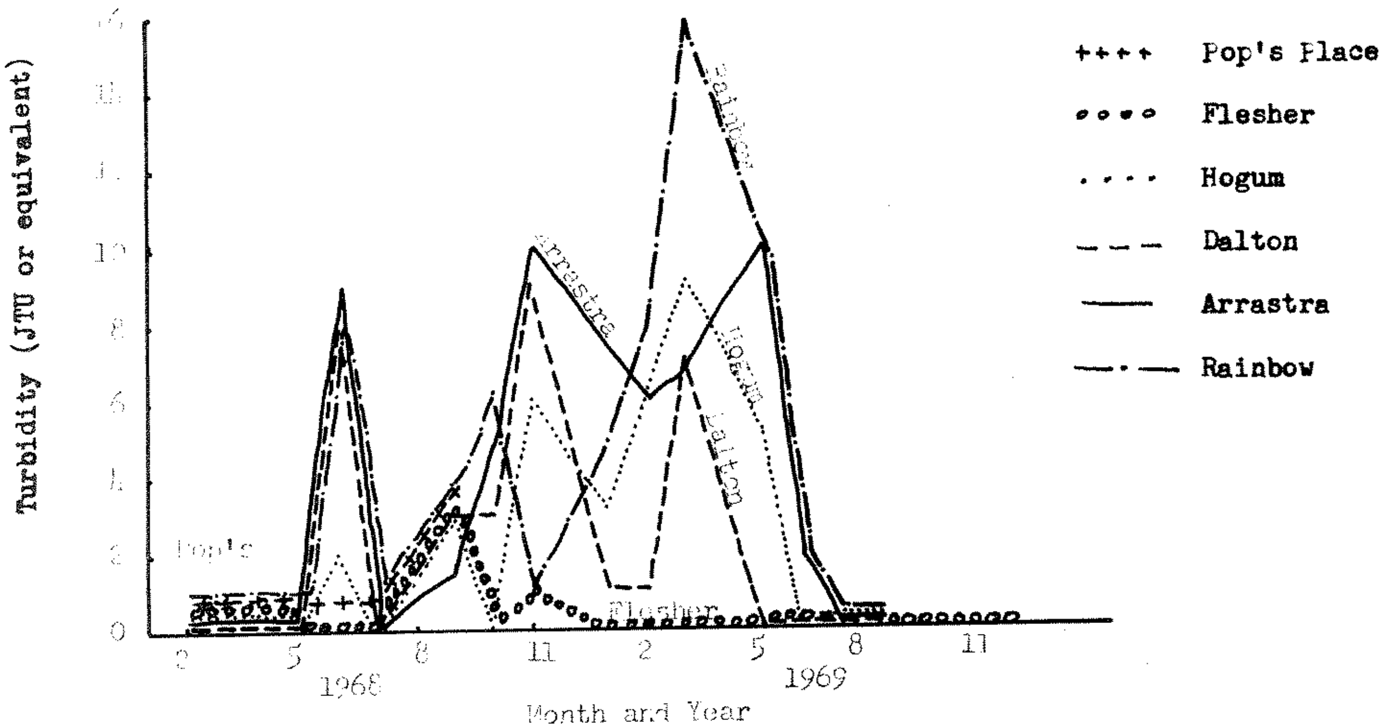
GRAPH 5

pH OF MAIN BLACKFOOT RIVER
FEBRUARY 1968 TO FEBRUARY 1970



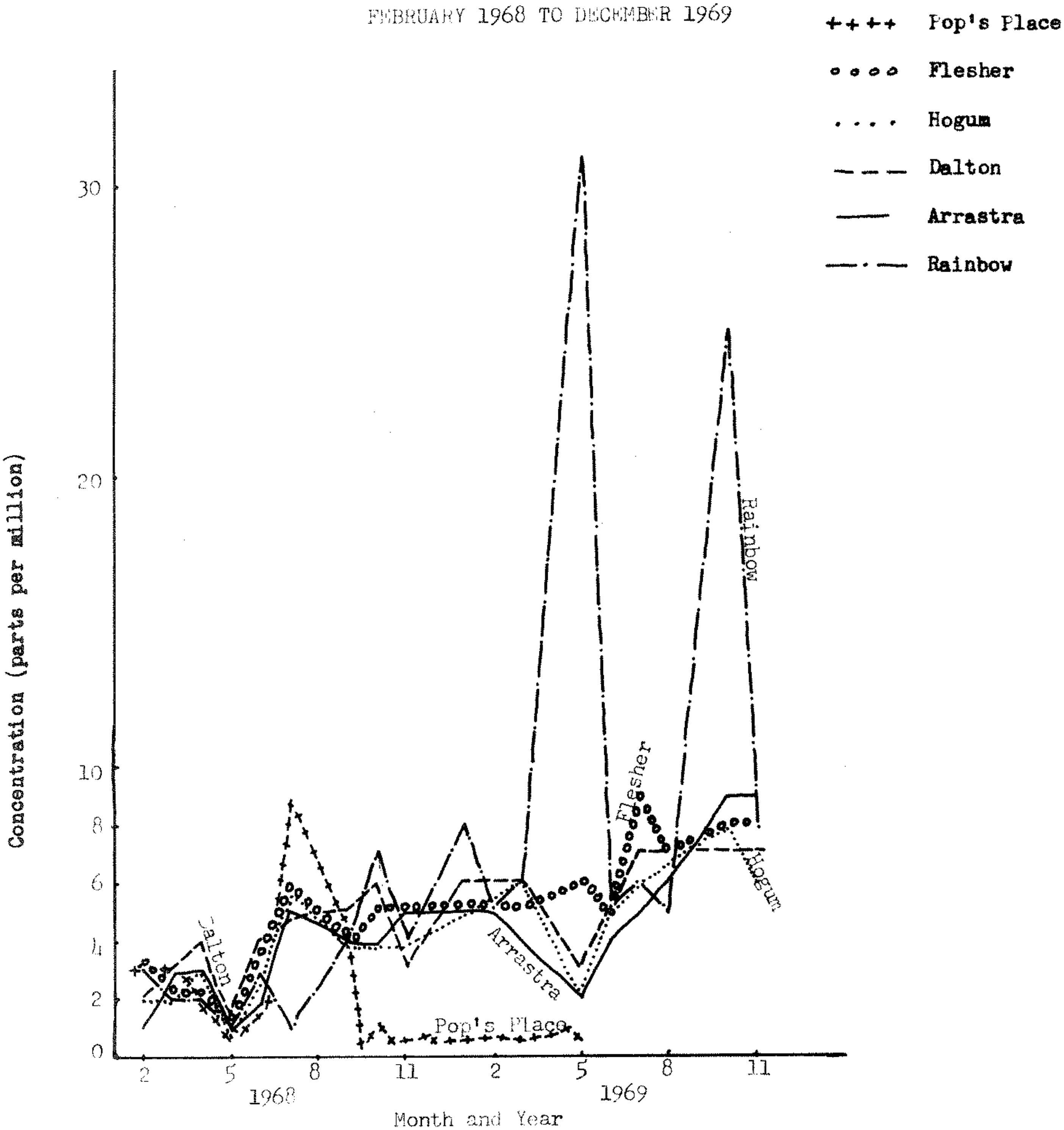
GRAPH 6

LABORATORY TURBIDITY OF MAIN BLACKFOOT RIVER
FEBRUARY 1968 TO DECEMBER 1969



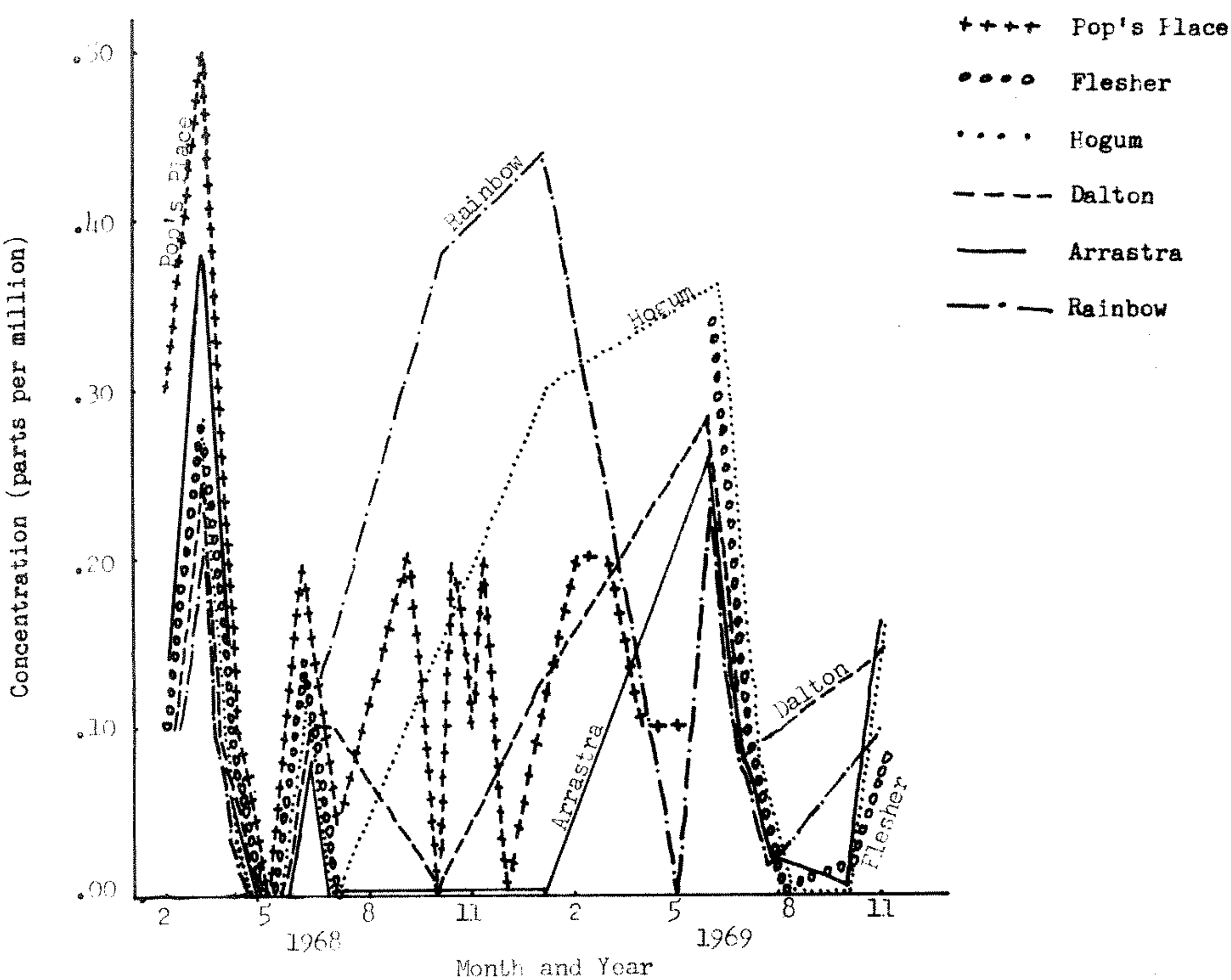
GRAPH 7

CHLORIDE IN MAIN BLACKFOOT RIVER
FEBRUARY 1968 TO DECEMBER 1969



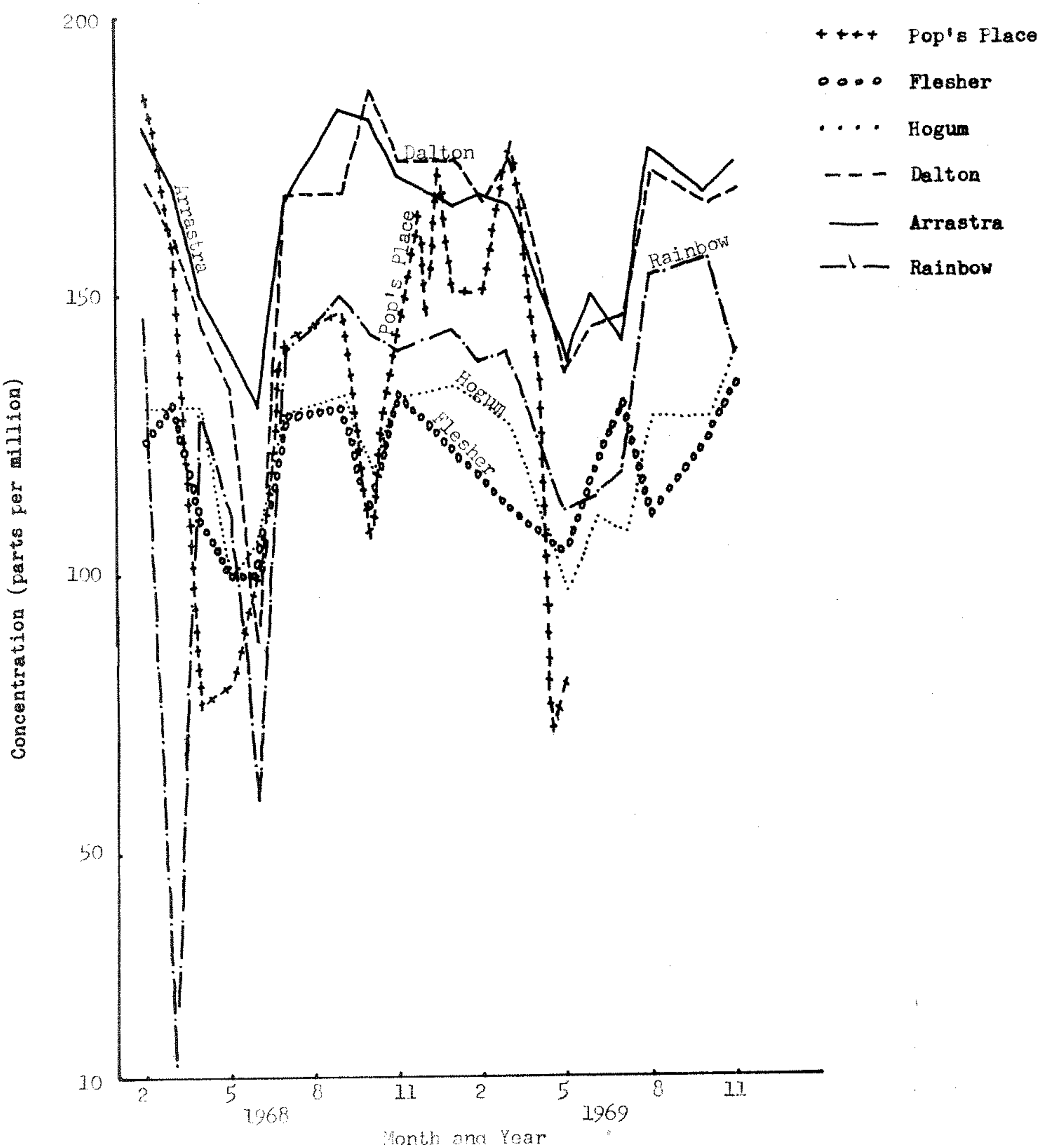
GRAPH 8

FLUORIDE IN MAIN BLACKFOOT RIVER
FEBRUARY 1968 TO DECEMBER 1969



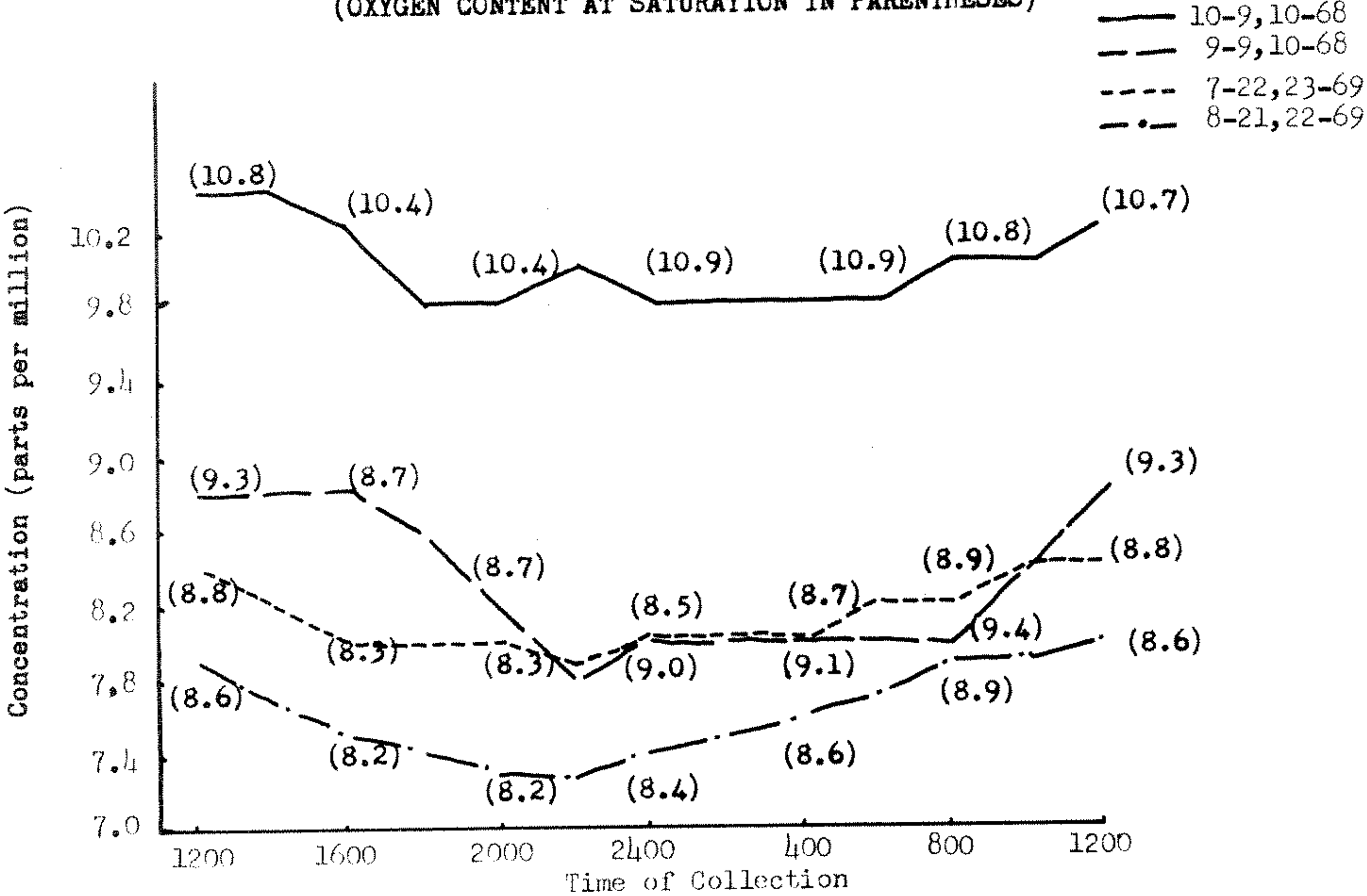
GRAPH 9

TOTAL DISSOLVED SOLIDS IN MAIN BLACKFOOT RIVER
FEBRUARY 1968 TO DECEMBER 1969



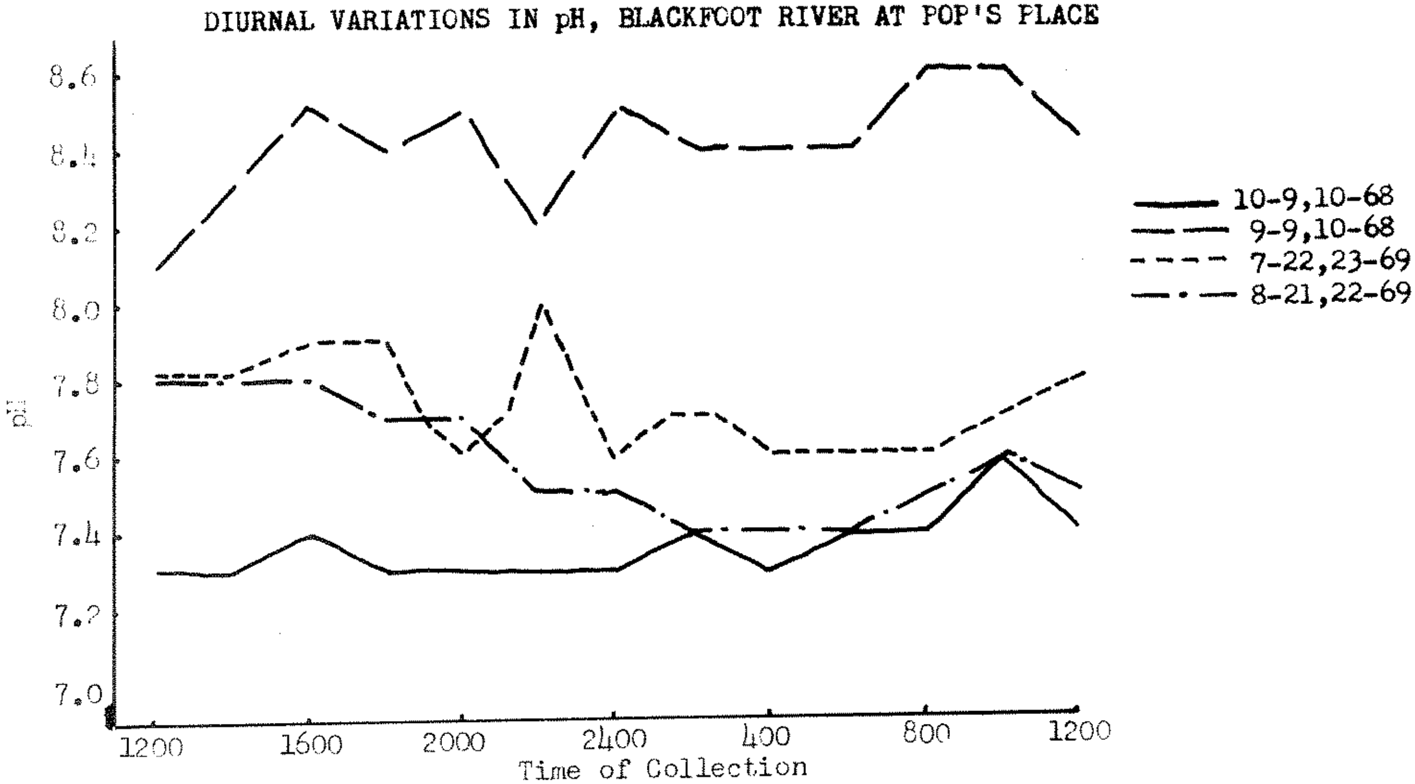
GRAPH 10

DIURNAL VARIATIONS IN DISSOLVED OXYGEN, BLACKFOOT RIVER AT POP'S PLACE (OXYGEN CONTENT AT SATURATION IN PARENTHESES)



GRAPH 11

DIURNAL VARIATIONS IN pH, BLACKFOOT RIVER AT POP'S PLACE



GRAPH 12

HARDNESS OF MAIN BLACKFOOT RIVER
FEBRUARY 1968 TO DECEMBER 1969

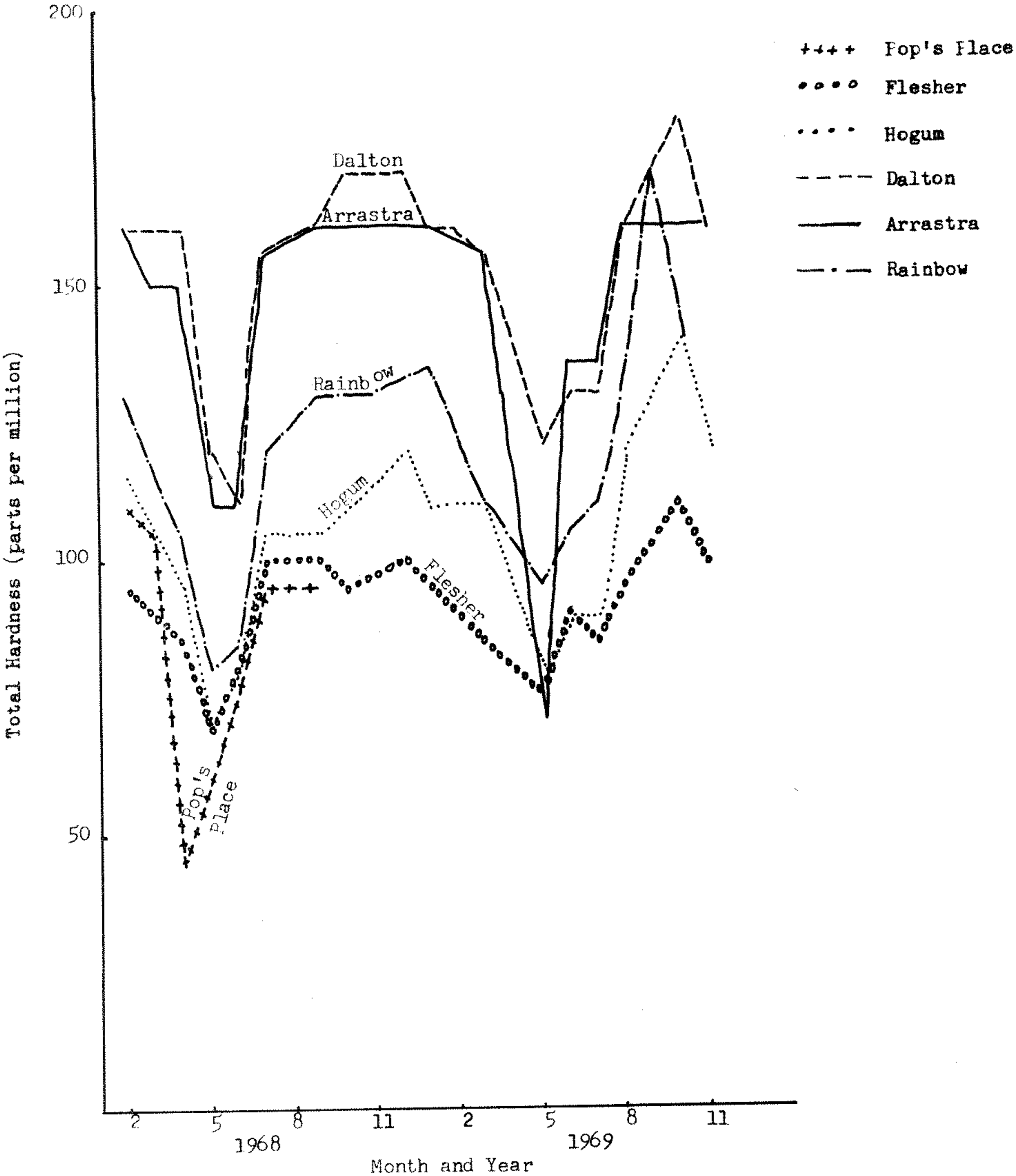


TABLE II. FIELD TURBIDITY (JTU) FOR BLACKFOOT R. TRIBUTARIES, FEBRUARY 1968 TO DECEMBER 1969.

	W. Twin Cr.	E. Twin Cr.	Gold Cr.	Union Cr.	Belmont Cr.	Elk Cr.	Blanchard Cr.	Clearwater R.	Cottonwood Cr.	Monture Cr.	Warren Cr.	N.F. Blackfoot R.	Kleinschmidt Cr.	Arrastra Cr.	Beaver Cr.	Willow Cr.	Keep Cool Cr.	Spring Cr.	Poorman Cr.	Lander's Fork	Hogum Cr.	Alice Cr.	Sandbar Cr.	Pass Cr.
1-68																								
2-68															0		0	0	0	6		7		8
3-68	0	4		40		60		0		0			2	0		10								
4-68			0		0		0		0		30	0												
5-68															8		10	0	18	5		4		0
6-68	0	0		25		18		0		2			0	0		15								
7-68			0		0				0		8	0												
8-68																								
9-68															0		0	0	0	0		0		0
10-68	0	0		15		10		0		0			0	0		2								
11-68			0		0		0		0		5	0												
12-68																								
1-69															0		0	0	0	0		0		0
2-69				5				0		0			0	0		0								
3-69				120											0		0	0	0	0		0		0
4-69																								
5-69						28		0-2	2	0		0	0	0		15								
6-69				15											0		0	0	0	0		0		0
7-69						24		0	0	0		0	0-2	0		17							27	
8-69				20											0		0	0	0	0		0		0
9-69																								
10-69																								
11-69																								
12-69																								

Tributary sampling discontinued

TABLE III. SULFATE (PPM) IN BLACKFOOT RIVER TRIBUTARIES, FEBRUARY 1968 TO DECEMBER 1969.

	West Twin Cr.	East Twin Cr.	Gold Cr.	Union Cr.	Belmont Cr.	Elk Cr.	Blanchard Cr.	Clearwater R.	Cottonwood Cr.	Monture Cr.	Warren Cr.	N.F.Blackfoot R.	Kleinschmidt Cr.	Arrastra Cr.	Beaver Cr.	Willow Cr.	Keep Cool Cr.	Spring Cr.	Poorman Cr.	Lander's Fork	Hogum Cr.	Alice Cr.	Sandbar Cr.	Pass Cr.
1-68																								
2-68															0		0	0	11	0		0		[illegible]
3-68	0	8		11		14		3		6			5	3		11								
4-68			0		0		0		20		0	0												
5-68															8		7	4		6		7		[illegible]
6-68	0	0		8		12		0		0	3	2	6	4		6								
7-68			4		0				2															
8-68																								
9-68															2		5	0	5	3		3		[illegible]
10-68	4	5		11		13		4		7			6	6		8								
11-68			0		0		0		2		3	2												
12-68																								
1-69															0		0	0	4	3		0		[illegible]
2-69				8				2		3			5	4		10								
3-69				18											7		0	15	13	12		11		[illegible]
4-69																								
5-69						7		4	7	7		5	5	4		8								
6-69				0											1		0	0	5	0		0		[illegible]
7-69						7		0	1	1		1	2	1		17							11	
8-69				11											1		3	5	7	1		1		
9-69																								
10-69						13		7		11		12	13	14		15					22			
11-69				12											2		1	11	10	5		0		[illegible]
12-69																								

Tributary sampling discontinued except Hogum Cr.

TABLE IV. CHLORIDE (PPM) IN BLACKFOOT RIVER TRIBUTARIES, FEBRUARY 1968 TO DECEMBER 1969

	West Twin Cr.	East Twin Cr.	Gold Cr.	Union Cr.	Belmont Cr.	Elk Cr.	Blanchard Cr.	Clearwater R.	Cottonwood Cr.	Monture Cr.	Warren Cr.	N.F.Blackfoot R.	Kleinschmidt Cr.	Arrastra Cr.	Beaver Cr.	Willow Cr.	Keep Cool Cr.	Spring Cr.	Poorman Cr.	Lander's Fork	Hogum Cr.	Alice Cr.	Sandbar Cr.	Pass Cr.
1-68																								
2-68															2		2	3	2	3		2		3
3-68	2	2		6		2		3		2			2	1		3								
4-68			2		3		2		3		3	2												
5-68															1		1	1		1		1		1
6-68	2	2		2		3		3		1	5	7	3	3.5		2								
7-68			5		5				6															
8-68																								
9-68															4		3	4	4	3		4		4
10-68	2	3		6		5		3		6			4	5		7								
11-68			4		4		4		4		4	4												
12-68																								
1-69															5		6	5	4	5		5		5
2-69				5				4		4			4	2		5								
3-69				6											6		5	4	4	4		5		11
4-69																								
5-69						4		3	7	3		4	4	2		3								
6-69				7											5		6	5	5	4		4		6
7-69						8		6	6	6		6	7	6		8							7	
8-69				10											9		9	7	7	6		6		[illegible]
9-69																								
10-69						9		8		9		8	11	9		8					10			
11-69				11											10		8	8	8	9		7		8
12-69																								

Tributary sampling discontinued except Hogum Cr.

TABLE V. FLUORIDE (PPM) IN BLACKFOOT RIVER TRIBUTARIES, FEBRUARY 1968 TO DECEMBER 1969.
Page 1

	W. Twin Cr.	E. Twin Cr.	Gold Creek	Union Creek	Belmont Cr.	Elk Cr.	Blanchard Cr.	Clearwater R.	Cottonwood Cr.	Monture Cr.	Warren Cr.	N.F. Blackfoot R.	Kleinschmidt Cr.	Arrastra Cr.	Beaver Cr.	Willow Cr.	Keep Cool Cr.
1-68																	
2-68															0.1		1.0
3-68	0.34	0.44		0.10		0.28		0.00		0.00			0.00	0.38		0.38	
4-68			0.00		0.00		0.00		0.00		0.06	0.06					
5-68															0		0
6-68	0.04	0.10		0.24		0.28		0.04		0.14	0.00	0.02	0.10	0.00		0.14	
7-68			0.00		0.00				0.00								
8-68																	
9-68																	
10-68	0.26									0							
11-68											0.2						
12-68																	
1-69															0		0.34
2-69																	
3-69																	
4-69																	
5-69																	
6-69				0.28											0.38		0.32
7-69						0.18		0.08	0.10	0.06		0.06	0.06	0.06		0.10	
8-69				0.10											0		0.02
9-69																	
10-69						0.10				0		0	0	0.10		0	
11-69				0.12											0.08		0.08
12-69																	

Tributary sampling discontinued

TABLE V. FLUORIDE (PPM) IN BLACKFOOT RIVER TRIBUTARIES, FEBRUARY 1968 TO DECEMBER 1969.
PAGE 2

	Spring Cr.	Poorman Cr.	Lander's Fork	Hogum Cr.	Alice Cr.	Sandbar Cr.	Pass Cr.
1-68							
2-68	0.1	0.2	0.1		0.1		0.1
3-68							
4-68							
5-68	0		0		0		0.16
6-68							
7-68							
8-68							
9-68							
10-68							
11-68							
12-68	0.52	0.02	0.28		0		0.28
1-69							
2-69	0.1						
3-69							
4-69							
5-69	0.36	0.36	0.36		0.38		0.40
6-69						0.10	
7-69	0	0.04	0		0		0
8-69							
9-69				0.08			
10-69	0.16	0.08	0		0		0
11-69							
12-69							

Tributary sampling discontinued except Hogum Cr.

TABLE VI. TOTAL DISSOLVED SOLIDS (PPM) IN BLACKFOOT RIVER TRIBUTARIES, FEBRUARY 1968 TO DECEMBER 1969.
Page 1

	W. Twin Cr.	E. Twin Cr.	Gold Cr.	Union Cr.	Belmont Cr.	Elk Cr.	Blanchard Cr.	Clearwater R.	Cottonwood Cr.	Monture Cr.	Warren Cr.	N.F. Blackfoot R.	Kleinschmidt Cr.	Arrastra Cr.	Beaver Cr.	Willow Cr.	Keep Cool Cr.
1-68																	
2-68															150		170
3-68	24	44		190		180		86		90			160	136		100	
4-68			100		110		60		150		140	150					
5-68															110		180
6-68	10	24		242		186		60		46	122	136	140	72		100	
7-68			110		160				176								
8-68															158		142
9-68																104	
10-68	30	50		242		168		90		90			140	128			
11-68			100		154		86		154		132	142					
12-68															142		160
1-69																114	
2-69				206				84		126			156	90	136		136
3-69				150													
4-69																78	
5-69						128		80	132	62		106	144	88	132		160
6-69				168												88	
7-69						136		64	164	54		110	156	116	170		164
8-69				242													
9-69																138	
10-69						188		90		108		132	152		170		164
11-69				220													
12-69																	

Tributary sampling discontinued

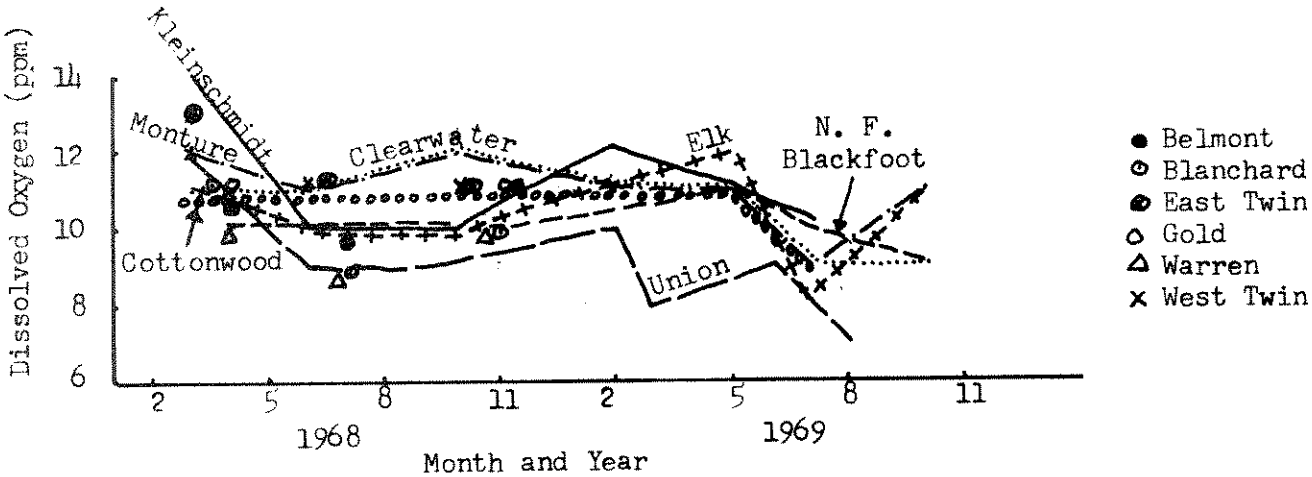
TABLE VI. TOTAL DISSOLVED SOLIDS (PPM) IN BLACKFOOT RIVER TRIBUTARIES, FEBRUARY 1968 TO DECEMBER 1969.
PAGE 2

	Spring Cr.	Poorman Cr.	Lander's Fork	Hogum Cr.	Alice Cr.	Sandbar Cr.	Pass Cr.
1-68							
2-68	180	140	146		120		100
3-68							
4-68							
5-68	180		130		90		70
6-68							
7-68							
8-68							
9-68	170	160	162		132		98
10-68							
11-68							
12-68							
1-69	166	134	128		120		68
2-69							
3-69	180	132	130		128		96
4-69							
5-69							
6-69	162	134	116		126		86
7-69						88	
8-69	190	142	132		150		74
9-69							
10-69				132			
11-69	168	118	124		118		86
12-69							

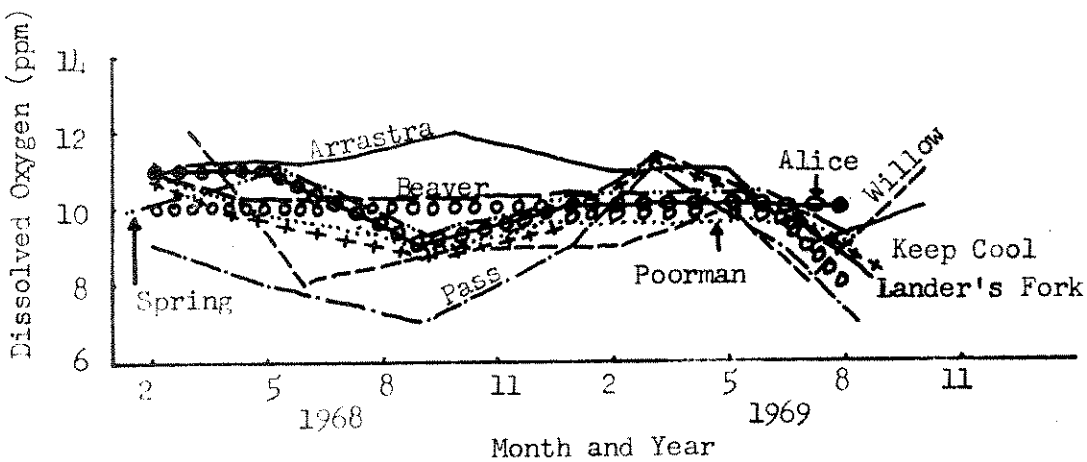
Tributary sampling discontinued except Hogum Cr.

GRAPH 13

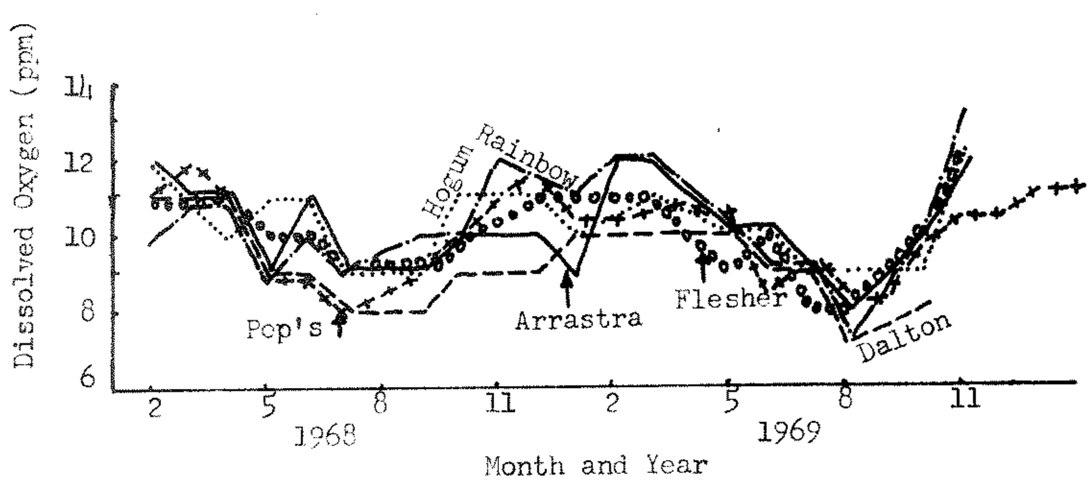
DISSOLVED OXYGEN IN BLACKFOOT RIVER TRIBUTARY STREAMS BELOW OVANDO
FEBRUARY 1968 TO DECEMBER 1969



GRAPH 14
DISSOLVED OXYGEN IN BLACKFOOT RIVER TRIBUTARY STREAMS ABOVE OVANDO,
FEBRUARY 1968 TO DECEMBER 1969.

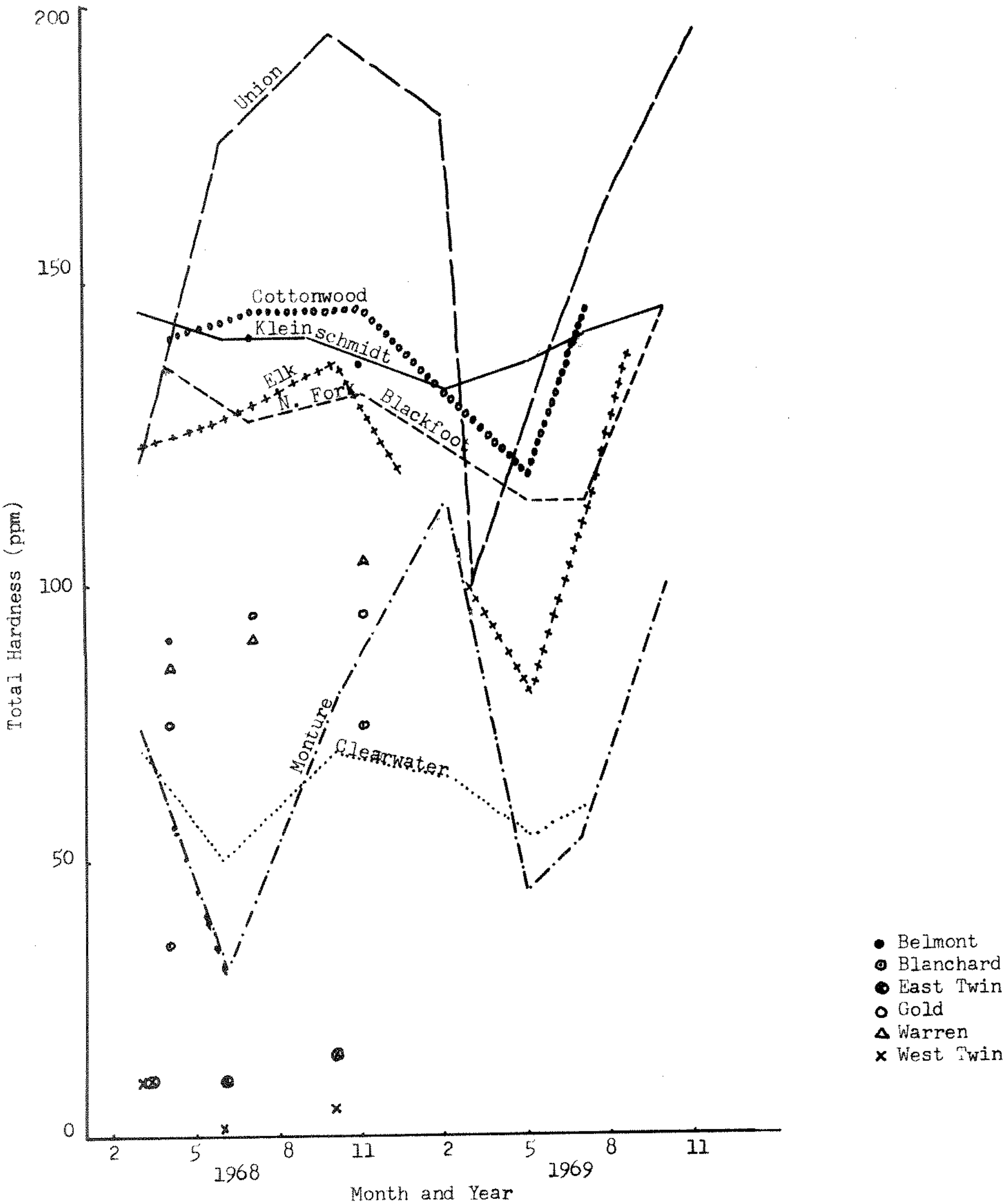


GRAPH 15
DISSOLVED OXYGEN IN MAIN BLACKFOOT RIVER
FEBRUARY 1968 TO DECEMBER 1969.



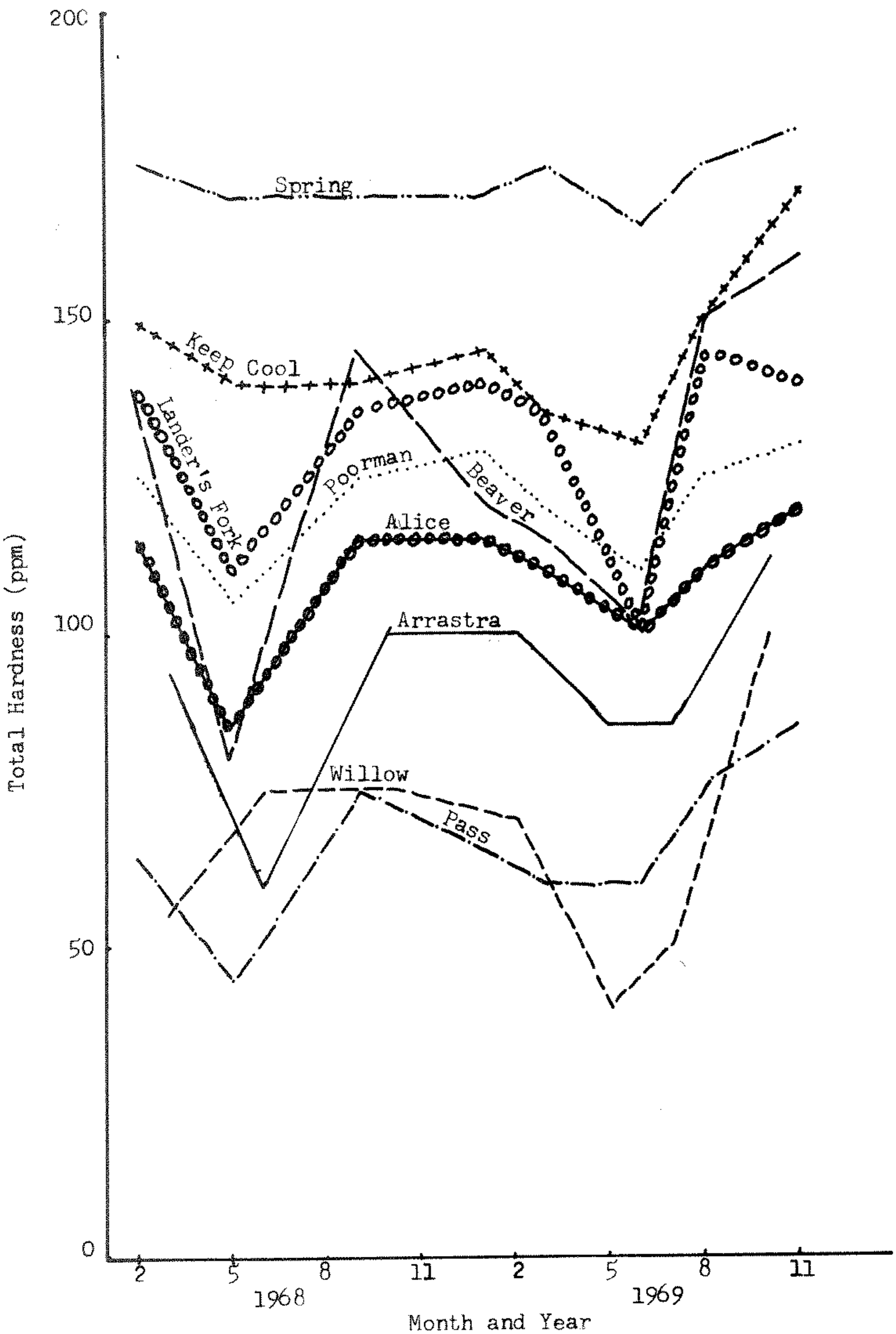
GRAPH 16

HARDNESS OF BLACKFOOT RIVER TRIBUTARY STREAMS BELOW OVANDO
FEBRUARY 1968 TO DECEMBER 1969

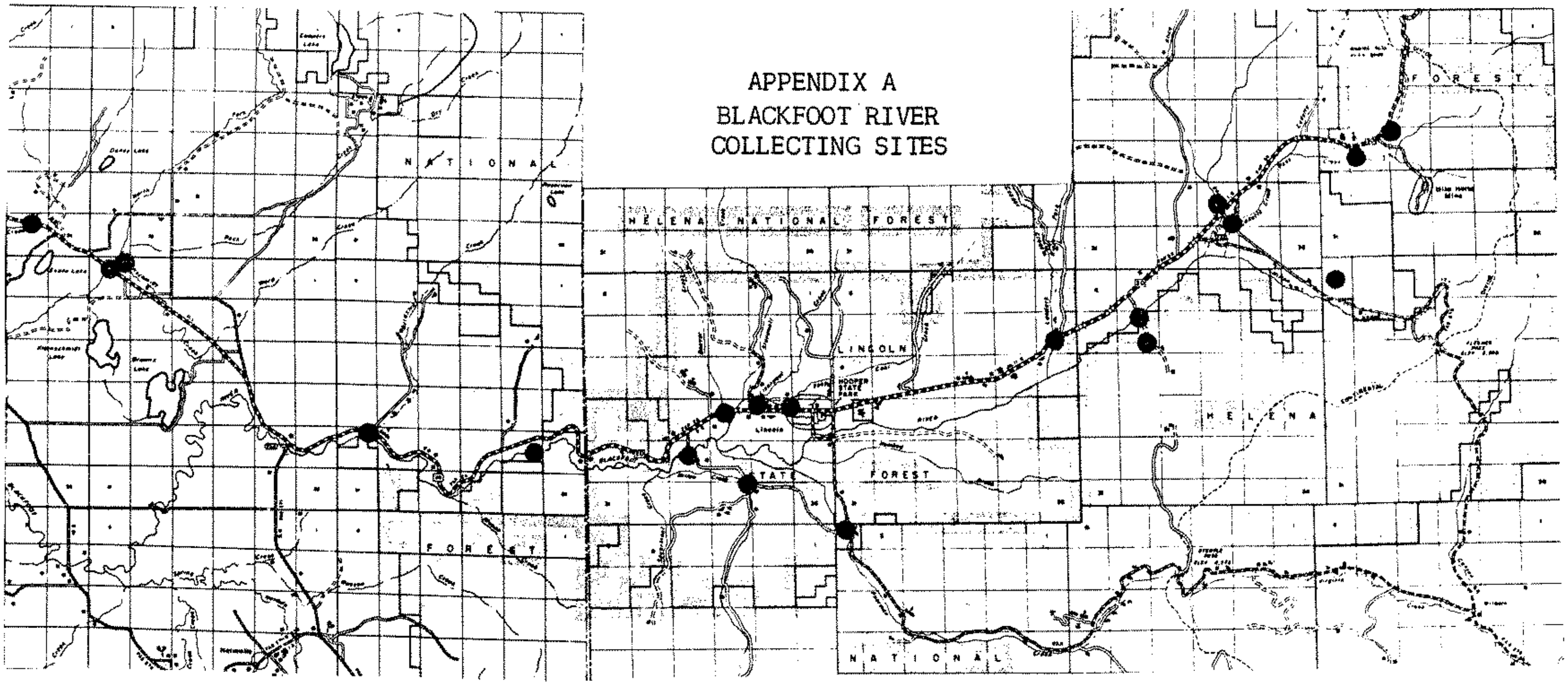


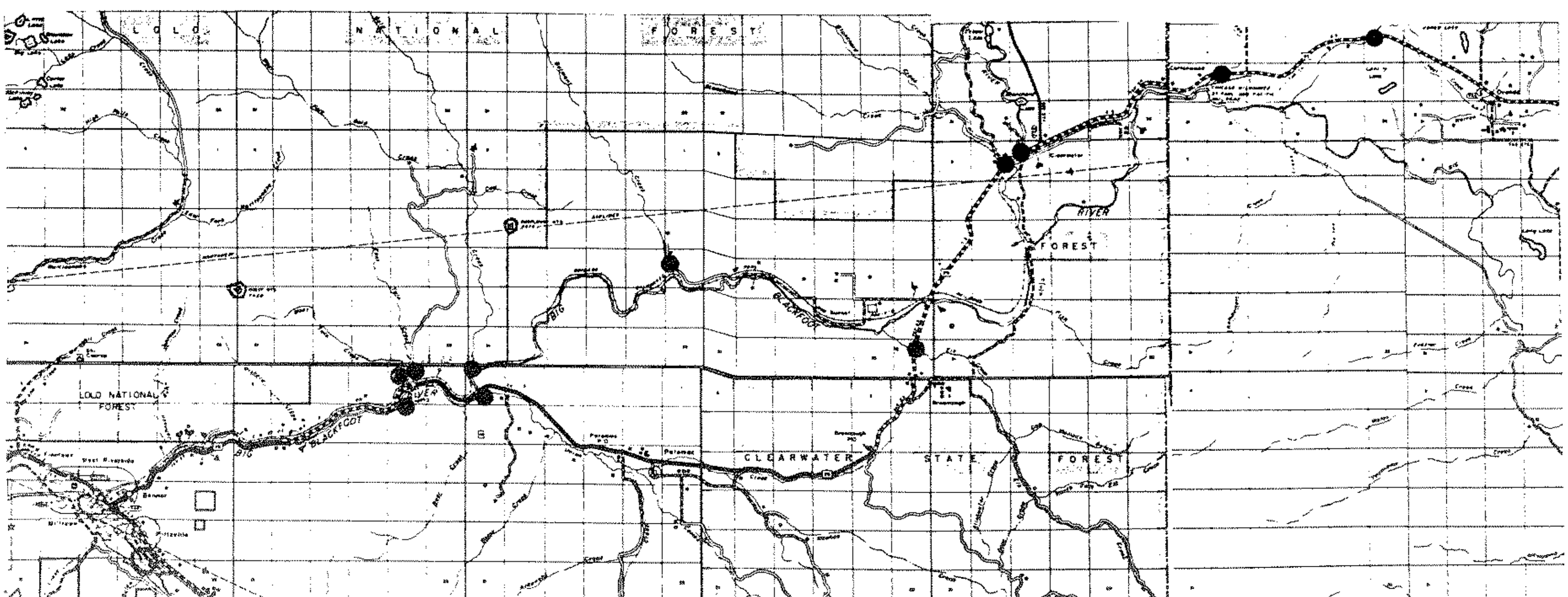
GRAPH 17

HARDNESS OF BLACKFOOT RIVER TRIBUTARY STREAMS ABOVE OVANDO
FEBRUARY 1968 TO DECEMBER 1969



APPENDIX A
BLACKFOOT RIVER COLLECTING SITES





APPENDIX B

BLACKFOOT RIVER STUDY

Streams Sampled by the MONTANA FISH AND GAME DEPARTMENT

SITE NO.	LOCATION	MILEAGE FROM MOUTH
1	Blackfoot River at Rainbow Bend	9.7 - 0.0
2	West Twin Creek	10.0 - 0.0
3	East Twin Creek	10.3 - 0.0
4	Gold Creek	13.0 - 0.0
5	Union Creek	12.32- 0.0
6	Belmont Creek	21.2 - 0.1
7	Elk Creek	27.9 - 1.0
8	Blanchard Creek	33.8 - 2.6 - 0.2
9	Clearwater River	33.8 - 3.0
10	Cottonwood Creek	41.6 - 0.6
11	Monture Creek	44.2 - 3.0
12	Warren Creek	48.2 - 4.4
13	North Fork of the Blackfoot River	51.8 - 5.6
14	Kleinschmidt Creek	51.8 - 5.6 - 0.1
15	Arrastra Creek	79.9 - 0.1
16	Blackfoot River	84.7 - 0.0
17	Beaver Creek	94.6 - 0.0
18	Blackfoot River at Dalton Mountain road bridge	95.2
19	Willow Creek	94.2 - 1.2
20	Keep Cool Creek	95.8 - 2.2
21	Spring Creek (and Spring Creek overflow)	95.8 - 2.0 - 0.2
22	Poorman Creek	97.6 - 2.2

Blackfoot River Study, Streams Sampled
Page 2

E NO.	LOCATION	MILEAGE FROM MOUTH
23	Lander's Fork	103.8 - 0.8
24	Blackfoot River at Hogum Creek Bridge	106.8
25	Hogum Creek	106.6 - 0.2
26	Alice Creek	109.6 - 0.7
27	Blackfoot River at Flescher Pass Bridge	110.7
28	Sandbar Creek	110.6 - 2.6
29	Blackfoot River at Pop's Place	114.5
30	Pass Creek	115.3 - 0.4

APPENDIX C

LIST OF FIELD AND LAB ANALYSES MADE BY THE STATE DEPARTMENT OF HEALTH LABORATORY AND THE MONTANA FISH AND GAME DEPARTMENT

Field Analyses	Laboratory Analyses
Water temperature	Turbidity
Air temperature	Total dissolved solids
pH	Hardness
Dissolved oxygen	Carbonate
Alkalinity	Bicarbonate
Calcium hardness	Sulfate
Total hardness	Chloride
Turbidity	Fluoride
Carbon dioxide	Nitrate
	Calcium
	Magnesium
	Sodium and potassium
	Iron
	Arsenic
	Zinc
	Lead
	Copper

APPENDIX D

State of Montana

State Department of Health

JOHN S. ANDERSON, M.D.
EXECUTIVE OFFICER

HELENA, MONTANA

May 12, 1970

Mrs. Arlene Dale
Hiway 93 South
Missoula, Montana 59801

Dear Mrs. Dale:

I have listed below additional information as requested in your letter. I do hope that this information will enable you to complete your evaluation.

Total Dissolved Solids:

Page 244-245 Standard Methods of Water Analysis. We have modified this method somewhat. We use 2" x 1/4" stainless steel planchets and 50 ml. of water. The accuracy of this method is the same as for Standard Methods of Water Analysis.

Fluorine, Spadns Method, page 144-145. The color is determined by a Beckman DBG spectrophotometer. Our precision and accuracy should equal that shown on these pages as we follow this method to a T. We do not make a distillation because we do not have sufficient interferences to warrant the use of distillation.

Chloride Argentometric Method, page 86-87. Precision and accuracy as shown.

Hardness - EDTA Titrimetric Method, page 147 to 152. Precision and accuracy as shown.

Iron - Phenanthroline Method, page 156-159. Precision and accuracy as shown.

Lead - Single extraction mixed color dithizone method. Page 163-165. This method is somewhat modified. We use the mixed color single extraction method and Standard Methods of Water Analysis uses the mixed color double extraction procedure. The color evaluation is done with a model DBG Spectrophotometer. 2 ug. of Pb can be detected and reproduced within 5%.

The above procedure is patterned after the method recommended by the American Conference of Governmental Industrial Hygienists.

Carbonate and Bicarbonate or Alkalinity are determined by indicator and titration method as described on pages 50 and 51 of the Standard Methods for Water Analysis. The precision and accuracy is as described on page 52.

Magnesium is determined taking the difference of calcium and hardness as the hardness test contains both the calcium and magnesium. The precision and accuracy for this test should be the same as for calcium.

Sulfate is determined by the Gravimetric Method with drying of residue as described on page 290-291. The method will reproduce results within 5 mg/liter.

Turbidity is done Spectrophotometrically with prepared standards of turbidity from 0 to 100 ppm and the precision and accuracy is better than that with the use of the Jackson turbidimeter.

Sodium and Potassium combined are determined by calculation. I have no actual figure as to precision and accuracy but am sure it is within reasonable limits as our calculated total dissolved solids are based on this figure and they usually check within 5% of the actual determined total dissolved solids.

Copper and Zinc are determined by atomic absorption in 1% nitric acid. On a 100 ml. sample of water. The detection limit for copper is .025 ppm but some are found to contain as low as .01 ppm with less accuracy. Zinc can be detected at .01 ppm.

Sincerely,

Ludwig Champa

Ludwig S. Champa, Chief Chemist
Division of Disease Control

LSC:cs

PS

Calcium is determined by the EDTA Titrimetric method using Murexide (Ammonium Purpurate) as the indicator. This method is shown on pages 74-76. Precision and accuracy as shown.

Arsenic was analyzed using the silver diethyl dithio carbomate method shown on pages 56-58. Precision and accuracy as shown. 250 ml. size sample is used and evaporated with Sodium Carbonate to a volume of about 35 ml. The arsine is then liberated in our design arsine generator into silver diethyl dithio carbomate and measured photometrically. All of our color measurements are made with a Beckman Model DBG spectrophotometer.