MONTANA DEPARTMENT OF FISH AND GAME
FISHERIES DIVISION

JOB PROGRESS REPORT
Research Project Segment

State Montana Title Reservoir Investigations

Project No. F-34-R-9 Title Noxon Rapids-Cabinet Gorge Reservoir Study

Job No. 1-A

Cooperators Washington Water Power Company

Period Covered 1 July 1974 - 30 June 1975

ABSTRACT

Company and department personnel determined dissolved gas saturation levels of water entering Noxon Rapids Reservoir and leaving Cabinet Gorge Reservoir during periods of reservoir spilling and generator operation. A company diver examined the culvert connecting Deep Pond to Cabinet Gorge Reservoir. The department chemically treated Triangle Pond to remove non-game fish and replanted it with fluvial westslope cutthroat trout.

DISCUSSION

Triangle Pond is located about five miles west of Noxon, Montana, within the Cabinet Gorge Reservoir project boundaries. It has a surface area of about eight acres and a maximum depth of about 34 feet. The water supply is intergravel exchange with Cabinet Gorge Reservoir and it fluctuates with the reservoir but at a slower and lesser rate.

Triangle Pond has been managed as a single species sport fishery since 1964 when it was first chemically treated to remove rough fish. It was treated again in 1968 to remove a large population of sunfish. Sampling done in 1973 and 1974 indicated that large numbers of longnose suckers (Catastomus catastomus) were present and materially reducing survival of planted westslope cutthroat trout (Salmo clarki subsp). The pond was treated with rotenone in August 1974, at a rate of about 1.5 ppm.

The pond was planted with about 4,000 young-of-the-year fluvial westslope cutthroat trout in early October 1974. Sampling to determine success of the program will be delayed until fall 1975.

Fluvial westslope cutthroat trout are tentatively described as a type of cutthroat whose adult life is spent in large streams or river, but ascends tributaries for spawning. Young fish rear in these tributaries for up to two years before moving into the river. Habitat manipulation of Western Montana's larger streams and rivers in past years and in the future may result in extinction of wild populations of this type cutthroat trout. Parents of cutthroat planted in

Triangle Pond were obtained from Kootenai River before inundation by Libby Reservoir. It is hoped that Triangle Pond will serve both as a brood lake for this fish and a valuable sports fishery for the Noxon area. It is not contemplated at this time to prohibit angling on this lake.

Deep Pond is connected to Cabinet Gorge Reservoir by a culvert underneath the Burlington Northern railroad tracks and should provide an excellent sport fishery if fish passage between the pond and reservoir can be eliminated. This pond is about 13 surface acres with a maximum depth of 55 feet. Its water supply is from a small surface spring and interchange with the reservoir. A company diver inspected the culvert in the summer of 1974 and thought that elimination of fish passage by installation of a stand pipe might be feasible. Washington Water Power Company is tentatively planning on budgeting funds for continued investigations and possibly installation in 1976 or 1977.

Sampling of Noxon Rapids and Cabinet Gorge Reservoirs to determine success of burbot (Lota lota) and kokanee (Oncorhynchus nerka) was not done in fiscal-year 1975. Some sampling in both reservoirs and Triangle Pond has been scheduled for summer-fall 1975.

Dissolved gas saturation of water entering Noxon Rapids Reservoir and leaving Cabinet Gorge Reservoir were determined for the months of April through August, 1974. Sampling was to be done weekly during periods when water was being spilled over any of three dams, Thompson Falls, Noxon Rapids or Cabinet Gorge, and biweekly during times when water was being released through the power houses.

Personnel from the company and department were to share the sampling; each party taking alternate sample dates. Labor disputes within the company resulted in their biological personnel being assigned to power house duty and unable to fulfill their part of the sampling schedule. Department personnel could not do the entire sampling resulting in several omitted scheduled samplings.

Gas saturation levels were determined using a Weiss saturometer following methods developed by the U.S. Environmental Protection Agency. The data and description of the sampling stations are listed in Table 1 and locations of the stations are shown in Figure 1. The original sampling schedule included 10 stations starting at the Thompson Falls Dam forebay and extending to the tailrace of the Cabinet Gorge Dam. Idaho Fish and Game Department requested that a station be sampled in the Clark Fork River about 8 miles downstream from Cabinet Gorge Dam. This additional station was added to the schedule in May, 1974. The lower four stations, numbers 8,9,10 and 11, are located in Idaho and the remainder are in Montana.

Station numbers 7 and 9 were sampled during the month of April and omitted thereafter. Both these stations were located directly opposite stations 6 and 10 on the tailraces of Noxon Rapids and Cabinet Gorge Dams. It had been hoped that sampling each side of the tailrace would yield information about saturation levels below power house releases and spillway releases. Apparently power house and spillway releases had mixed before reaching the opposing stations.

Station 5 located in the Noxon Rapids Dam forebay had higher water temperatures than any station above or below. This station was located on the toe of the dam and in a backwater area subject to slower water exchange than most other parts of the forebay.

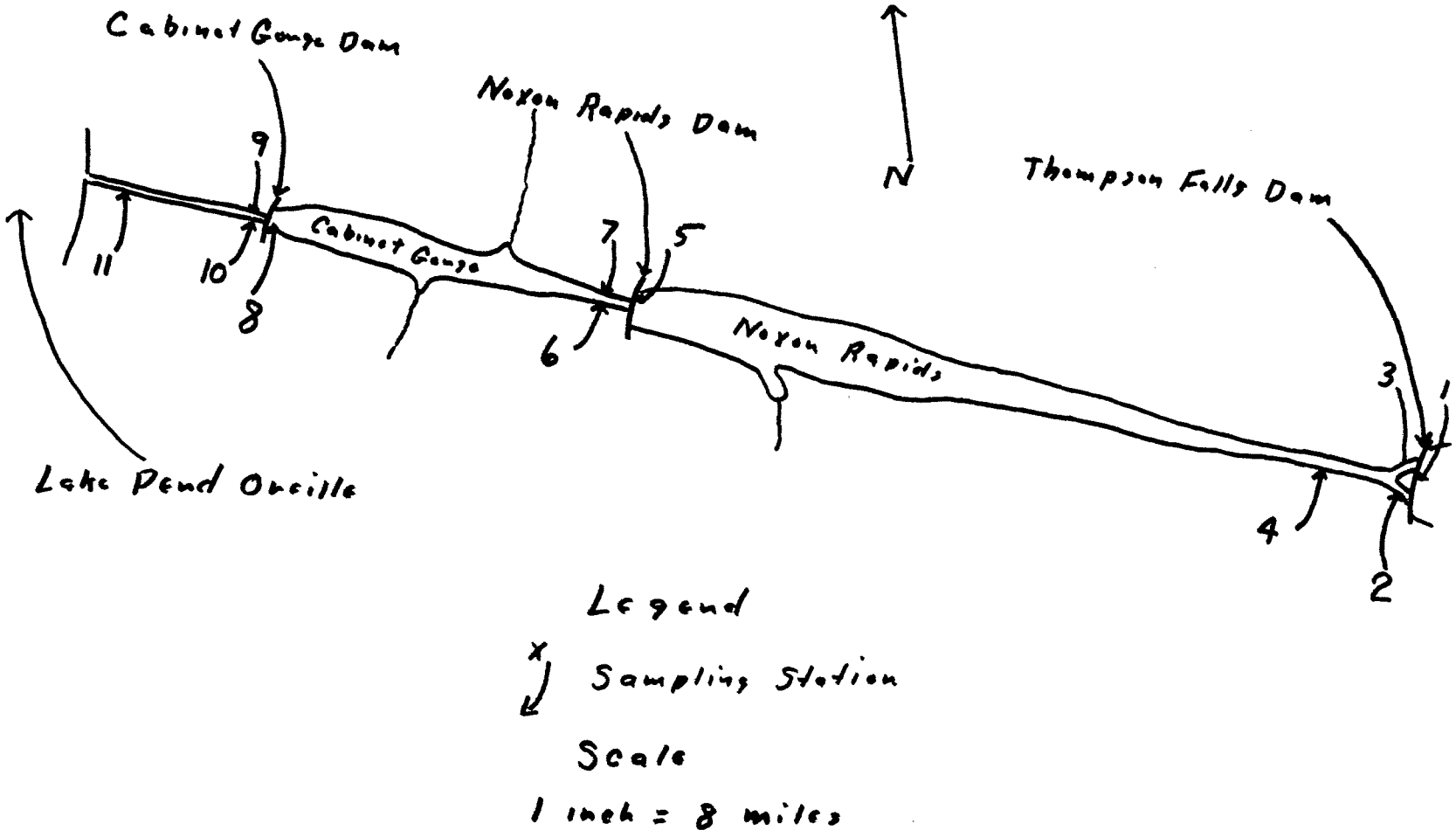

Figure 1. Location of dissolved gas sampling stations

Table 1. Description of Sampling Stations, Dissolved Gas Monitoring- Clark Fork River April thru August 1974

Sampling Station	Description
1	Thompson Falls Reservoir forebay- located immediately upstream and between powerhouse and spillway entrances.
2	Below Thompson Falls Dam spillway - on south bank directly above mouth of Prospect Creek.
3	Below Thompson Falls Dam powerhouse - located on north bank in dam's afterbay.
4	Flatiron Ridge boat landing - immediately upstream from boat landing, landing about 4 miles downstream from Thompson Falls dam.
5	Noxon Rapids Reservoir forebay - located on north bank of reservoir near spillway entrances and on toe of dam.
6	Cabinet Gorge Reservoir south bank - located immediately upstream from the mouth of Pilgrim Creek.
7	Cabinet Gorge Reservoir north bank - located immediately upstream from the mouth of Government Creek. Both stations 6 and 7 are about 2.5 miles downstream from Noxon Rapids Dam and are in the Noxon Rapids tailrace.
8	Cabinet Gorge Reservoir forebay - on south bank of reservoir immediately upstream from dam on spillway side.
9	Cabinet Gorge tailrace north bank - located directly opposite lower end of spawning channel.
10	Cabinet Gorge tailrace south bank - located on upper end of spawning channel, both stations 9 and 10 are about 1 mile below Cabinet Gorge Dam.
11	Clark Fork River near Clark Fork, Idaho - located immediately downstream of south abutment of county bridge crossing Clark Fork River at Clark Fork, Idaho

Table 1. Dissolved Gas Monitoring - Clark Fork River
April 22,29; May 6,13,29; June 4,12; July 26;
August 9,21,1974

Sampling Station	Date Time	Water Temp	Barometric * Pressure	Total Gas	Reservoir Discharge (cfs) Spill	Plant	Total
1	4-22 1500 hrs	6.8°C	748 mm	104%			
2	4-22 1530	7.0	748	109	30,400	8,600	39,000
3	4-22 1600	6.8	748	103	30,400	8,600	39,000
4	4-22 1630	7.0	748	107			
5	4-23 1230	11.6	745	109			
6	4-23 1030	7.1	748	107	7,720	37,040	44,740
7	4-23 1115	7.7	748	107	7,720	37,040	44,740
8	4-23 1730	7.5	752	107			
9	4-23 1500	7.8	757	127	20,640	27,850	48,490
10	4-23 1700	7.5	752	126	27,990	19,990	47,980
1	4-29 1115	6.8	702	103			
2	4-29 1220	6.8	702	113	47,120	8,580	55,700
3	4-29 1300	7.0	703	103	47,120	8,580	55,700
4	4-29 1345	7.2	703	111			
5	4-29 1515	9.9	703	111			
6	4-29 1600	8.5	706	119	27,500	37,170	64,670
7	4-29 1635	8.4	706	118	27,200	36,420	63,620
8	4-29 1750	8.7	705	120			
9	4-29 1830	8.8	707	136	51,950	17,120	69,070
10	4-29 1940	7.9	707	131	47,340	25,340	72,690

* Barometric Pressure uncorrected for sea level

Table 1. Continued

Sampling Station	Date Time	Water Temp.	Barometric * Pressure	Total Gas	Reservoir Discharge (cfs) Spill	Plant	Total
1	5-6 1045	9.5°C	693	104%			
2	5-6 1120	9.6	693	114	47,580	8,720	56,300
3	5-6 1150	9.7	694	105	47,580	8,720	56,300
4	5-6 1225	9.7	695	106 1/			
5	5-7 1320	9.5	694	106 1/			
6	5-7 1335	8.8	698	116	34,350	35,350	69,580
7		Station Discontinued					
8	5-7 1220	8.7	698	114			
9	5-7 1300	8.7	698	134	38,700	27,400	66,100
10	5-7 1130	8.0	699	130	38,000	29,600	67,600
11	5-7 1050	8.8	700	128			70,070
1	5-13 1300	6.8	694	102			
2	5-13 1325	6.8	694	113	59,280	8,420	62,700
3	5-13 1400	6.9	695	102	54,250	8,420	62,700
4	5-13 1440	6.9	697	111			
5	5-13 1545	7.9	696	111			
6	5-13 1625	8.0	700	116	27,500	36,480	63,980
7		Station Discontinued					
8	5-13 1730	8.0	700	114			
9		Station Discontinued					
10	5-13 1830	8.0	701	136	52,300	30,000	52,300
11	5-13 0930	8.0	701	133			67,000

* Barometric Pressure uncorrected for sea level
1/Leak in saturometer, readings unreliable

Table 1. Continued

Sampling Station	Date Time	Water Temp.	Barometric * Pressure	Total Gas	Reservoir Discharge (cfs) Spill	Plant	Total
1	5-29 1130 hrs	10.5°C	689 mm	103%			
2	5-29 1155	10.4	689	111	45,660	8,840	54,500
3	5-29 1220	10.5	690	103	45,660	8,840	54,500
4	5-29 1300	10.4	691	111			
5	5-29 1400	11.1	691	110			
6	5-30 1130	10.4	702	119	38,000	26,580	64,580
8	5-29 1900	10.2	697	113			
10	5-29 1830	9.7	698	128	24,000	34,300	58,300
11	5-29 1750	10.2	698	129			59,900
1	6-4 1050	11.4	692	102			
2	6-4 1120	11.3	692	114	50,140	8,660	58,800
3	6-4 1150	11.5	692	103	50,140	8,660	58,800
4	6-4 1290	11.5	693	112			
5	6-4 1400	12.3	692	111			
6	6-4 1510	11.6	696	116	40,600	27,460	68,000
8	6-4 1610	11.2	695	115			
10	6-4 1800	9.9	697	129	36,000	33,200	69,200
11	6-4 1720	11.2	698	130			70,200

*Barometric Pressure uncorrected for sea level

Table 1. Continued

Sampling Station	Date Time	Water Temp.	Barometric * Pressure	Total Gas	Reservoir Discharge (cfs) Spill	Plant	Total
1	6-12 1030 hrs	12.5°C	694 mm	105%			
2	6-12 1050	12.5	694	117	64,620	8,480	73,100
3	6-12 1130	12.6	694	106	64,620	8,480	73,100
4	6-12 1220	12.6	699	116			
5	6-12 1330	14.4	694	115			
6	6-12 1400	11.4	696	124	44,390	28,170	72,560
8	6-12 1520	10.9	695	121			
10	6-12 1610	10.9	698	132	41,800	30,700	72,500
11	6-12 1750	11.0	699	132			64,700
1	7-26 1000	19.5°C	696 mm	101			
2	7-26 1020	19.5	696	109	15,700	8,800	24,500
3	7-26 1100	19.5	697	105	15,700	8,800	24,500
4	7-26 1200	19.6	698	107			
5	7-26 1310	21.7	697	108			
6	7-26 1390	19.4	700	111	0	15,360	15,360
8	7-26 1440	19.4	700	114			
10	7-26 1510	19.4	703	114	0	28,040	28,040
11	7-26 1550	19.1	703	113			28,040

* Barometric Pressure uncorrected for sea level

Table 1. Continued

Sampling Station	Date Time	Water Temp.	Barometric * Pressure	Total Gas	Reservoir Discharge (cfs) Spill	Plant	Total
1	8-9 1050 hrs	18.8°C	697 mm	100%			
2	8-9 1120	18.8	697	103	200	10,000	10,200
3	8-9 1150	18.9	698	103	530	10,000	10,530
4	8-9 1230	19.1	698	103			
5	8-9 1330	22.5	697	105			
6	8-9 1400	21.3	701	103	0	14,770	14,770
8	8-9 1450	21.0	701	105			
10	8-9 1540	19.8	702	104	0	23,890	23,890
	8-9 1610						
1	8-21 1000	18.1	696	101			
2	8-21 1020	18.1	696	104	4,540	10,460	15,000
3	8-21 1100	18.1	697	103	4,540	10,460	15,000
4	8-21 1140	18.4	698	103			
5	8-21 1240	20.8	697	103			
6	8-21 1310	19.2	701	100	0	14,260	14,260
8	8-21 1400	19.5	701	101			
10	8-21 1440	19.1	703	102	0	26,770	26,770
11	8-21 1530	19.1	703	102			24,920

* Barometric Pressure uncorrected for sea level

Reservoir discharge in cubic feet per second (cfs) are given for the stations immediately below dams and are divided into power house (Plant) and spillway discharge. Total flow is given for the Clark Fork River near Clark Fork, Idaho (station 11). Stations 2 and 3 give the only data about differences in saturation levels related to discharges from a power house or spillway.

Gas supersaturation is usually created by water entraining excess air and plunging into a deep pool where the air is forced into solution by the increased atmospheric pressure. Once forced into solution under pressure, the mixture does not return readily to a gaseous state when the pressure is reduced. The physics of gas saturation would seem to preclude its occurrence at Thompson Falls and Noxon Rapids Dams and at the Cabinet Gorge Power House.

The data indicate that the Thompson Falls power house did induce a small, but measureable increase in gas saturation. The same is likely true for both the Noxon Rapids and Cabinet Gorge power houses. The spillways at both Thompson Falls and Noxon Rapids are surface spillways compared to the free-falling spillway at Cabinet Gorge Dam. All three spillways increased the level of gas saturation or supersaturation.

Large rip-rap abutes the Thompson Falls spillway apron throwing the water into the air and creating a shallow plunge. Two of the eight spillway bays at Noxon Rapids Dam have a ski jump which throws the water into a high arc plunging into a deep stilling basin. The spillways at Cabinet Gorge Dam release the water into a free fall of about 200 feet into a deep stilling basin. The Cabinet Gorge Dam spillway and stilling basin design are ideal for inducement of high supersaturation levels.

Sampling during times of spillway discharges clearly show that each of the three dams is adding gas saturation and supersaturation levels. Equilibration of supersaturated water does not occur in either Noxon Rapids or Cabinet Gorge Reservoirs or in the Clark Fork River below Cabinet Gorge Dam. Sampling during periods when all reservoir releases were through the power house indicated little change in saturation levels from forebay to tailrace stations.

Effects of gas supersaturated water upon the biological communities in the reservoirs and river are not known.

The Washington Water Power Company, Montana Power Company (owners and operators of Thompson Falls Dam) and Idaho Fish and Game Department have received copies of the sampling data and will receive a copy of this report.

Prepared by Joe E. Huston

Date July 10, 1975

Waters referred to:		
	Cabinet Gorge Reservoir	05-8512-05
	Noxon Rapids Reservoir	05-9328-05
	Triangle Pond	05-9685-30
	Thompson Falls Reservoir	05- 9664-05
	Clark Fork River	05-1440-01