Evaluation of Lower Umatilla River Channel Modifications Below Three Mile Dam, 1985

Final Report

by

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ABSTRACT

The second year of a study to evaluate passage of adult anadromous salmonids through channel modifications made in the lower Umatilla River below Three Mile Dam was terminated due to inadequate returns of upriver bright fall chinook salmon (Oncorhynchus tshawytscha). Sampling of returning adults was discontinued on November 15, when it became apparent that insufficient numbers of fall chinook salmon were returning to the river to allow the evaluation. Stream flows were monitored through December 31 to document flow conditions present during the period when returns of fall chinook salmon were anticipated. This report summarizes results prior to termination of the study. Arrival of upriver bright fall chinook salmon at the mouth of the Umatilla River was monitored by boat electrofishing below river kilometer (RKm) 1. Attempts to examine passage of salmon through channel modifications were made using marked and radiotagged fish. Forty-eight jack and six adult salmon were marked and released above a weir placed at RKm 2. Five of the adults were also fitted with radiotransmitters.

Thirty fall chinook were collected while boat electrofishing at the mouth of the Umatilla River. Fifteen of those collected were captured between October 14 and October 18, after flows had reached 150 cfs. No salmon were captured at the weir or at Three Mile Dam until flows reached 150 cfs. One radiotagged salmon migrated to the dam at flows of 245 cfs. Only one marked jack salmon was recovered at Three Mile Dam.

INTRODUCTION

This study was conducted to determine whether channel modifications in the Umatilla River below Three Mile Dam facilitated upstream passage of steelhead (Salmo gairdneri) and fall chinook salmon (Oncorhynchus tshawytscha) at various stream flows. The channel modifications were funded by Bonneville Power Administration (BPA #83-434) to improve passage of anadromous salmonids at low flows (<200 cfs). U.S. Army Corps of Engineers supervised construction which began in August and was completed in November 1984 (Sanguine 1985). In November and December 1984, steelhead passage to Three Mile Dam was examined (Nigro and Ward 1985). Although some steelhead held at sites in the lower river, those delays may have been volitional since observations were made early in the spawning run. Further background information and a description of the study area can be found in our 1984 annual report (Nigro and Ward 1985).

Our objective in 1985 was to determine flows at which upriver bright fall chinook salmon negotiate lower Umatilla River channel modifications and enter ladders at Three Mile Dam. Since fall chinook salmon enter the river immediately prior to spawning, delays in their migration may be much more critical than delays in steelhead migration. The 1981 brood was expected to return as 4-year olds from a release of 100,000 yearlings in 1983. The 1982 brood was expected to return as 3-year olds from a release of 225,000 yearlings in 1984. By mid-November 1985 it was apparent that inadequate numbers of fall chinook salmon were returning to the river to enable evaluation of the channel modifications. Sampling was terminated on November 15, although stream flows were monitored through December 31 to document flow conditions present during the period when returns of fall chinook salmon were anticipated.

Our 1985 approach included two significant changes from 1984. The first change was to enlist the assistance of the Stanfield, Westland, Hermiston and West Extension irrigation districts and the U.S. Bureau of Reclamation to augment or restrict flows as needed to evaluate passage under various flow regimes. This required coordination through a technical work group that met frequently to review river flow conditions and study progress. The second change was to install a weir and fish trap below channel modifications at river kilometer (RKm) 2. This approach was selected to minimize handling and eliminate transportation of salmon from traps in ladders at Three Mile Dam to release sites below the channel modifications (Appendix A).

METHODS AND MATERIALS

Field Sampling

This study was designed to compare passage of fall chinook salmon through lower Umatilla River channel modifications at four flow levels: <100 cfs (September 16-October 4), 101-200 cfs (October 7-October 25), 201-300 cfs (October 28-November 15) and >300 cfs (after November 15). Irrigation districts in the Umatilla River basin and the U.S. Bureau of Reclamation helped maintain desired flows through flow augmentation or restriction. Flows were augmented when needed by pumping water from the mouth of the Umatilla River into the nearby West Extension Irrigation District (WEID) canal. This allowed approximately 50 cfs of additional stream flow to bypass the WEID diversion at Three Mile Dam, spill over the dam and flow through the lower river channel modifications. Flows were restricted when needed by diverting stream flow at Three Mile Dam into the WEID canal and returning it to the river at the pump station near the river mouth. Up to 60 cfs were diverted in this manner. Stream flow was monitored daily through December 31 at a gauging station near RKm 3.3 and stream temperatures (C) and Secchi disk readings (cm) were recorded daily near Chinaman's Hole (RKm 2.1) to determine their relationship to salmon passage.

Arrival of upriver bright fall chinook salmon at the mouth of the Umatilla River was monitored by boat electrofishing below RKm 1 daily when possible from Auqust 19 through November 7. Captured fish were examined to determine sex, fork length (cm) and weight (Kg), marked with a serially numbered spaghetti tag and released.

Attempts to examine passage of fall chinook salmon through lower Umatilla River channel modifications were made using marked and radiotagged fish. A weir and fish trap were installed at RKm 2 to capture fall chinook salmon migrating upstream (Appendix A). Salmon collected in the trap were examined to determine sex, fork length and weight, and were marked with a serially numbered T-anchor tag. A hole was punched in the caudal fin of each tagged fish to enable identification if the tag was lost. All fish collected in the trap were released above the weir. Marked fall chinook salmon with fork lengths of at least 65 cm were also fitted with radio transmitters. Radio transmitters were inserted down the gullet and into the stomach of selected salmon and the antennae were anchored to the roof of the mouth with stainless steel hooks. Radio transmitters, insertion method and method of locating radiotagged fish were described in our 1984 annual report (Nigro and Ward 1985). A programmable receiver equipped with an omnidirectional antenna and a chart recorder was placed at Three Mile Dam to record arrival times of radiotagged salmon at the dam. Holding times below the dam were recorded.

An existing fish trap in the west ladder at Three Mile Dam and a newly installed trap in the east ladder were checked twice daily for marked fish. Tag numbers and recapture time of marked fish recovered in the ladders were recorded and the fish were released immediately above the dam. The traps at Three Mile Dam were also used for the initial capture of fall chinook salmon when the weir was breached due to high water. These fish were transported back to the weir site, examined, marked (and radiotagqed, if large enough) and released.

Data Analysis

Arrival times of upriver bright fall chinook salmon at the Umatilla River were determined from dates when marked fish recaptured at the weir first occurred in electrofishing catches or when unmarked fish were first captured at the weir. Travel times through channel modifications were estimated as the differences between times of release and recapture of marked fish and times when radiotagged fish were last located below modifications and first located near Three Mile Dam. Fish size and sex composition of the salmon run was examined, as well as run size and timing.

RESULTS

Thirty upriver bright fall chinook salmon were captured and marked while boat electrofishing below RKm 1 between September 20 and November 7 (Table 1). Three jack salmon (<60 cm) were eventually recaptured at the weir or in the traps at Three Mile Dam; two of which were initially captured between October 14 and October 18.

Eighty five fall chinook salmon were captured at the weir or at Three Mile Dam during the study (Table 1); of which only three were females. Forty-eight jack and six adult salmon were marked and released above the weir. Fifty-two of these fish were captured between October 21 and November 7 when flows ranged from 150-215 cfs (Table 1). The remaining two entered the trap at the weir on November 8 when the flow was 245 cfs. No salmon were captured before October 21 at flows less than 150 cfs. One of the jacks was recaptured at Three Mile Dam 47 hours after release. Flows during this period ranged from 181-206 cfs.

Of five adult chinook salmon radiotagged and released above the weir, one was poached within 2 hours of release, two fell back into the Columbia River after the weir was breached due to high flows, one died after holding between the weir and RKm 2.6 for 10 days and one negotiated the channel modifications and entered the west ladder at Three Mile Dam. This fish held between the weir and Chinaman's Hole for 12 days before moving upstream (Figure 1). It moved from the Brownell Diversion (RKm 3.2) to Three Mile Dam in 3.5 hours at flows of 245 cfs. It was found in the west ladder within 1.5 hours of its arrival at the dam.

Table 1. Catch of fall chinook salmon by date in the Umatilla River with corresponding mean stream flows (cfs), water temperatures (C) and Secchi disk readings (cm). Catch in parentheses indicates number of adults.

Date	Flow (range)	Temp. (range)	Secchi (range)	Location Captured		
				Below RKm 1	Weir (RKm 2)	Three Mile Dam
9/16-9/22	72 (55-82)	13.8 (13-14)	142 (120-160)	1	0	0
9/23-9129	40 (27-52)	13.0 (12-14)	152 (150-160)	4	0	0
9/30-10/6	58 (39-93)	11.8 (10-14)	146 (110-160)	4	0	0
10/7-10/13	147 (109-161)	11.6 (9-14)	104 (90-130)	1	0	0
10/14-10/20	167 (150-206)	13.4 (12-15)	94 (30-130)	15	0	0
10/21-10/27	180 (150-206)	12.0 (11-13)	125 (100-150)	No Effort	0	53(2)
10/28-l/3	188 (169-206)	9.8 (9-12)	158 (150-170)	4(l)	3(2)	16
11/4-11/7	190 (169-215)	10.5 (9-12)	165 (150-170)	1	3(l)	7
11/8-11/15	384 (245-572)	5.6 (1-11)	77 (40-130)	No Effort	2(l)	1
11/16-11/24	364 (245-442)	3.0 (1-6)	(60-70)	No Effort	No Effort	0

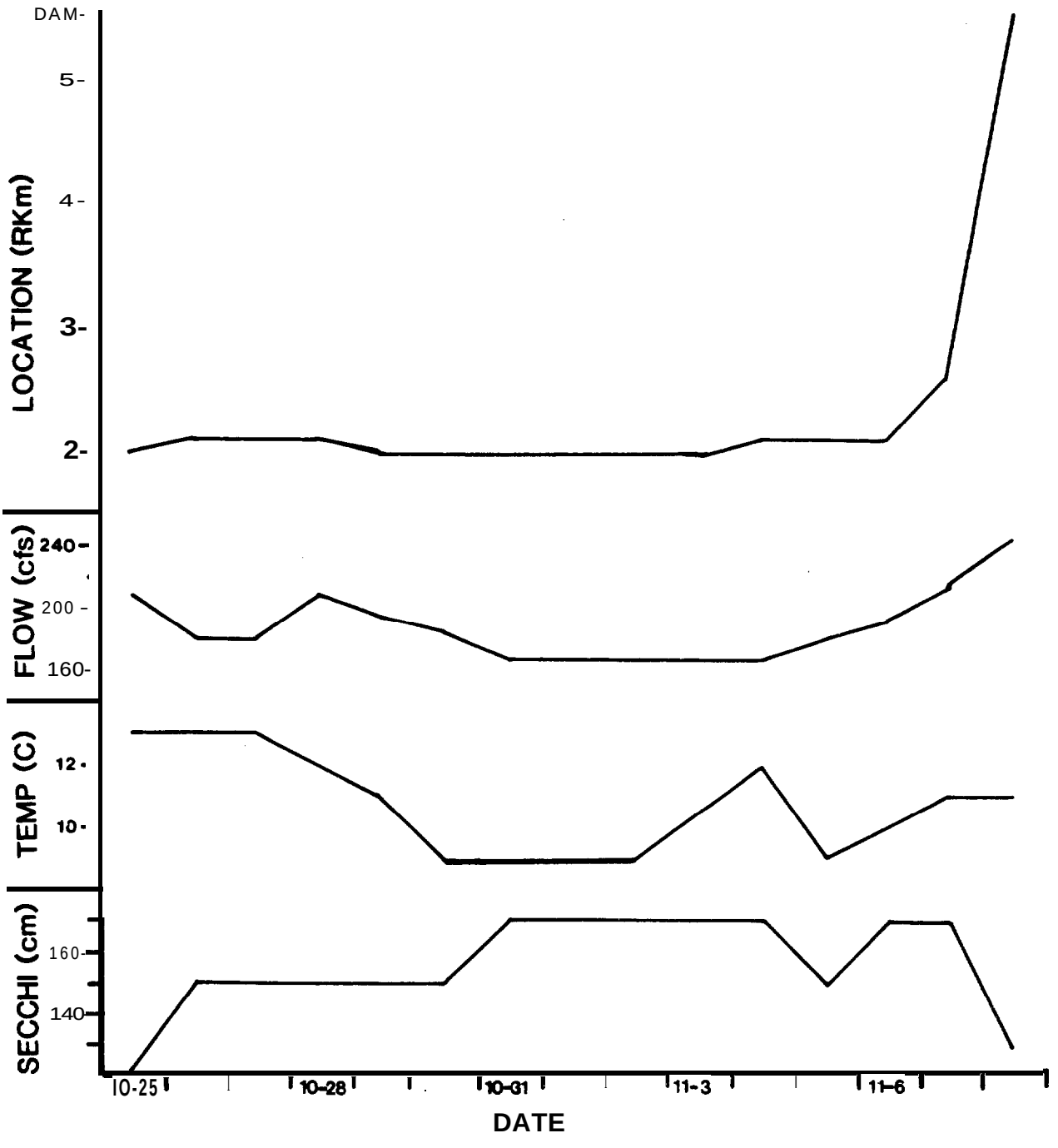

Figure 1. Daily locations of the only radiotagged salmon that migrated to Three Mile Dam, and corresponding stream flows, water temperatures and Secchi disk readings.

DISCUSSION

Our goal was to evaluate passage of upriver bright fall chinook salmon at four flow levels: <lOO cfs, 101-200 cfs, 201-300 cfs and >300 cfs. Based on data from the past-5 years, these flow levels were expected to occur over approximately 3-week intervals from September 16 through October 4, October 7 through October 25, October 28 through November 15 and after November 15. Natural flows were within 50 cfs of expected flows in each 3-week interval. Desired flows were realized through flow augmentation or restriction (Table 1).

The majority of the 1985 upriver bright fall chinook salmon run in the Umatilla River was expected to be 4-year-old adults from a release of 100,000 yearlings in 1983. Based on expected age composition and survival of fall chinook salmon released as yearlings, a run of over 200 adults was expected (Ron Boyce, Oregon Department of Fish and Wildlife, personal communication). Low numbers of adult salmon captured at the weir may have been due to lower than expected survival of smolts or adults, or delay and blockage of returning adults. Three redds were seen within 100 meters downstream of the weir, indicating that at least a few salmon could not find or chose not to enter the fish trap at the weir. However, the weir was breached twice due to high water, and although 75 jacks migrated to Three Mile Dam during one of these periods, only two adult salmon were captured at the dam (Table 1). The weir was designed to specifications that minimized delay and blockage of salmon (Burt Carnegie, Oregon Department of Fish and Wildlife, personal communication). But, if the weir did delay or block passage of salmon, numbers of adult salmon captured or observed below the weir and numbers captured at Three Mile Dam when the weir was breached indicate that run size was inadequate to allow evaluation of the channel modifications. Future evaluations should be attempted only after established runs of fall chinook salmon returning to the Umatilla River are sufficient to enable the capture and marking of enough fish to allow statistical comparisons of passage rates and travel times among flow levels.

Catches in the Umatilla River indicate that flow levels affect the attraction and passage of salmon. Although approximately 73,000 fall chinook salmon passed McNary Dam before October 1 and only 20,000 passed during October, the majority of our electrofishing catch occurred after October 14, when flows were above 150 cfs. All salmon collected at the weir or at Three Mile Dam were caught after flows reached 150 cfs. Further studies in the Umatilla basin will need to discern what flows are necessary to attract fall chinook salmon into the Umatilla River, and what flows are present when salmon arrive near the river mouth.

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APPENDIX A

Weir Description

A weir and fish trap (Figure A.l) were used at RKm 2 in the Umatilla River to capture fall chinook salmon migrating upstream because:

1. Nearly the entire run could be sampled, thereby increasing our chances of attaining statistically significant sample sizes for each flow level.

2. Captured salmon would not have to be transported.

3. Marked and radiotagged salmon would be prevented from falling back into the Columbia River.

The weir consisted of twenty 1.8-m long by 1.2-m high wooden-framed panels, each attached to a tripod fastened to the stream bed with concrete. The panels were constructed of 1.5-m lengths of 2.0-cm diameter steel conduit, which were spaced 2.5-cm apart. The weir was placed across the river at approximately a 30 degree angle and a 1.8-m square fish trap with an 8.9-cm opening was placed at the upstream end of the weir.

On October 21 the weir was breached due to high water caused by debris. Because we had not captured any salmon we used this opportunity to redesign the section of the weir near the trap. We increased the angle of the weir in this section and constructed it to resemble a "V," with the trap placed at the bottom of the "V" (Figure A.2). We later added a small trap near the center of the river.

The weir was again breached on November 9 when flows increased from 245-572 cfs within 12 hours. Based on the low numbers of salmon captured, we decided to remove rather than replace the weir.

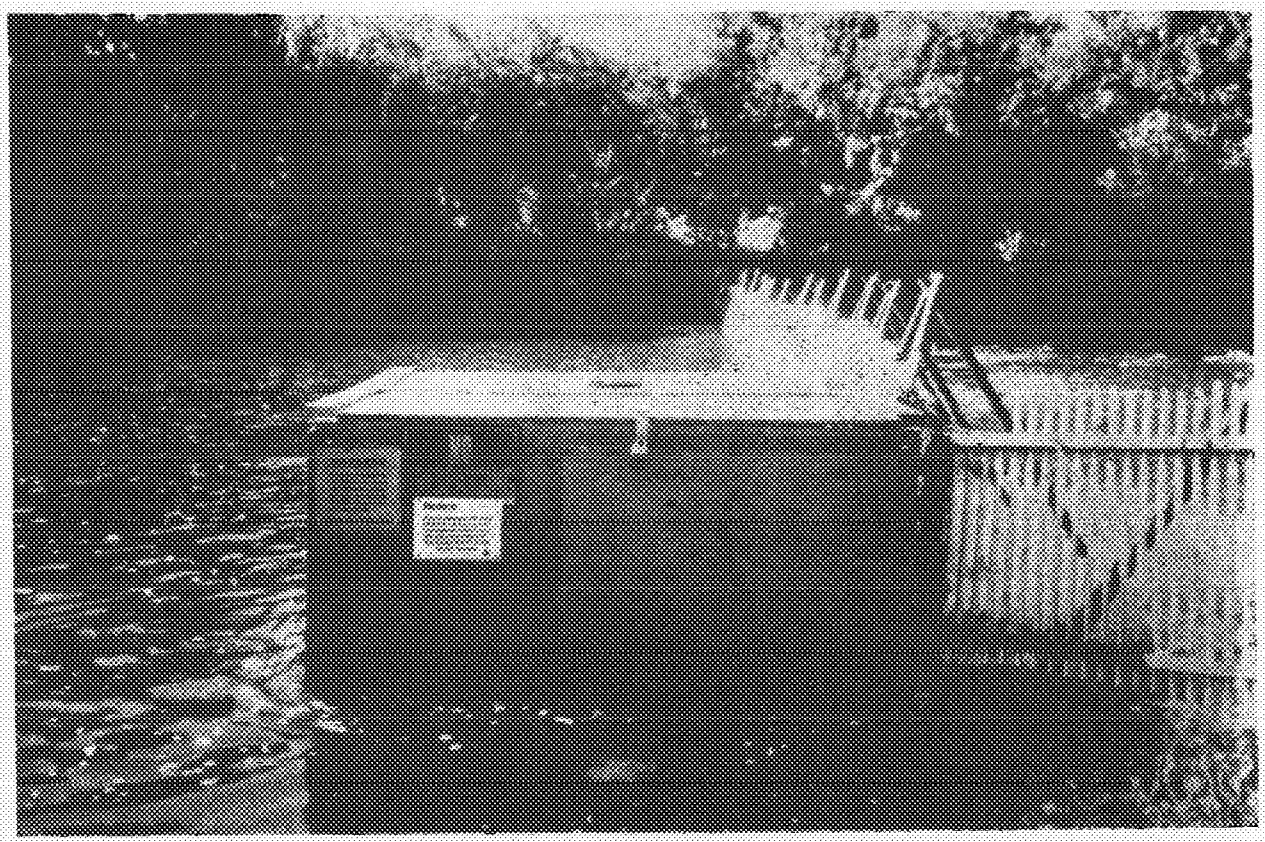

Figure A.1. Original design of weir at RKm 2.

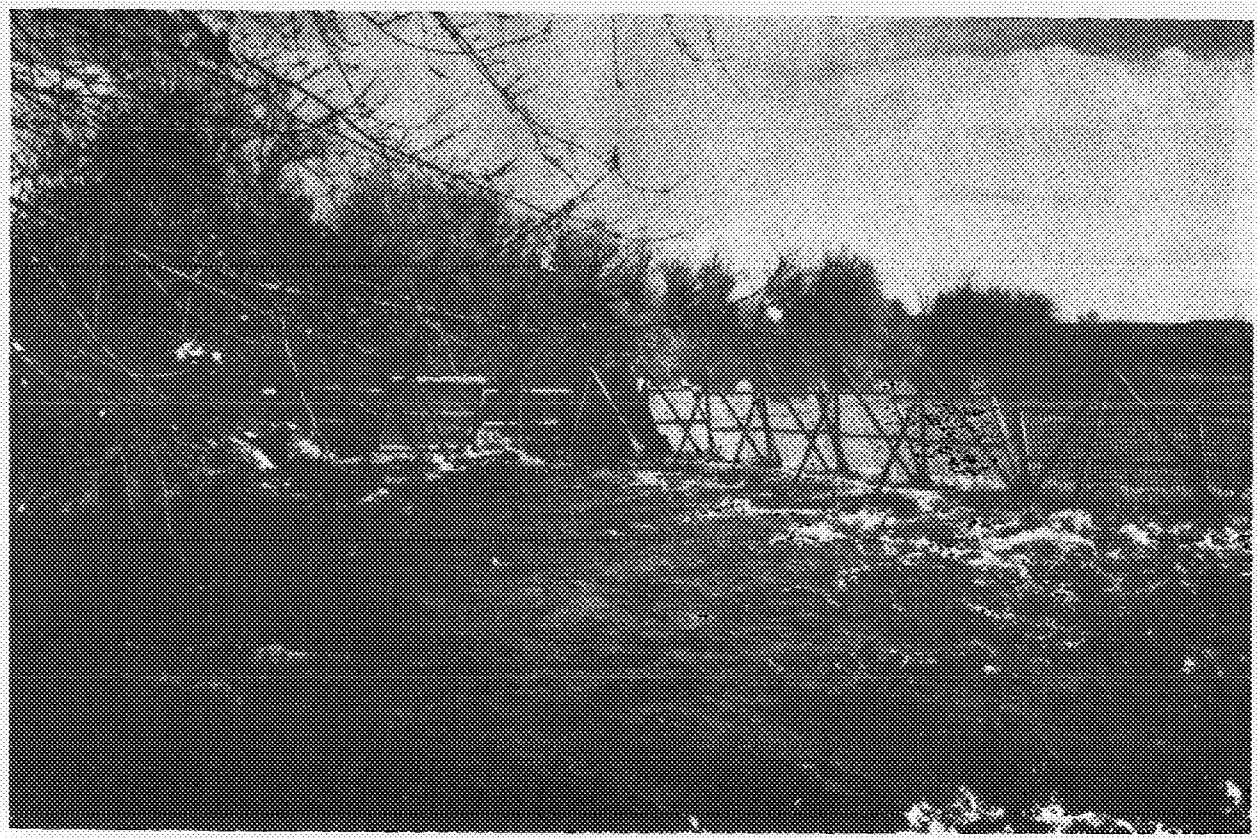

Figure A.2. Modified weir design after it was breached.

APPENDIX B

Lower Umatilla River Temperatures, Secchi Disk Readings and Stream Flows

Table B.l. Daily water temperatures, Secchi disk readings and stream flows in the Lower Umatilla River during the study period.

Date	Temperature (C)	Secchi (cm)	Flow (cfs)
9/16	14	120	68
9/17	14	140	80
9/18	14	140	75
9/19	14	150	82
9/20	13	160	55
9/21			
9/22			
9/23	12	150	27
9/24	13	150	52
9/25	14	150	43
9/26	13	150	39
9/27	13	160	38
9/28			
9/29			
9/30	10	150	39
10/1	11	160	42
10/2	12	160	48
10/3	14	150	66
10/4	12	110	93
10/5			
10/6			
10/7	12	110	109
10/8	11	100	161
10/9	9	90	161
l0/l0	14	100	161
10/11	12	130	157
10/12			
10/13			
10/14	15	90	150
10/15	12	100	161
lo/16	14	120	176
10/17	14	130	176
10/18	12	30	173
10/19			
10/20			
10/21	12	110	169
10/22	11	100	169
10/23	11	130	150
10/24	12	130	202
10/25	13	120	206
10/26	13	150	181
10/27			181
10/28	12	150	206
10/29		150	193
10/30	9	150	185
10/31	9	170	169

Table B.l. Continued.

Date	Temperature (c)	Secchi (cm)	Flow (cfs)
11/l			169
11/2	9	170	169
11/3			169
11/4	12	170	169
11/5	9	140	181
11/6	10	170	193
11/7	11	170	215
11/8	11	130	245
11/9	10	40	572
11/10	10	40	474
11/11		70	466
11/12	3	90	404
11/13	2	90	323
11/14	1		288
11/15	2	90	299
11/16			
11/17			
11/18	6	70	442
11/19	4	70	411
11/20	4	60	376
11/21	2	70	376
11/22	1	60	336
11/23	1		245
11/24			
11/25	1		245
11/26	1		245
11/27			
11/28			
11/29			
11/30			
12/2	1	200	276
12/3	2	200	193
12/4	3	200	245
12/5	2	130	336
12/6	2	200	508
12/7			
12/8			
12/9	2	40	741
12/10	1	60	663
12/11	1	60	582
12/12	1	80	419
12/13	1	100	376
12/14			
12/15			
12/16	1	100	311
12/17	1		282
12/18	1	200	250

Table B.l. Continued.

Date	Temperature (C)	Secchi (cm)	Flow (cfs)
12/19		200	
12/20	2	200	250
12/21			
12/22			
12/23	1	200	230
12/24			
12/25			
12/26	2	200	225
12/27	1	200	215
12/28			
12/29			
12/30	1	200	220
12/31	1	200	206