HABITAT IMPROVEMENT PROJECT

Fishery Division

OREGON STATE GAME COMMISSION
P. O. BOX 3503
PORTLAND, OREGON 97208

Tex Creek Project
Number 10

COLUMBIA RIVER FISHERY DEVELOPMENT PROGRAM

Closing Report

AGENCY: Oregon State Game Commission

PROJECT TITLE: Habitat Improvement to Enhance Anadromous Fish Production

PROJECT: 221.2-OG-2.2 CONTRACT NO: 14-17-0001-1014

PERIOD COVERED: December 6, 1960 through June 30, 1965

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ABSTRACT

The project objectives were to determine the possibility of raising the subterranean water in adequate amounts by installation of an underground weir; to determine what type of structure would be most feasible; and to formulate a biological evaluation program if the first two objectives were accomplished. Tex Creek, tributary to Murderers Creek which flows into the South Fork John Day River, was chosen as the study stream because of its history of steelhead use and loss of young due to intermittent flow in summer months.

The Tex Creek study was designed to test subterranean structures that might raise and direct subsurface water into the stream channel to prevent intermittent summer flow. Prior observations indicated that summer steelhead migrants were stranded when the stream dried. The number of small fish lost to drying of the streambed is often equal to the number of spring outmigrants. Summer steelhead fry emerge during the first of July, approximately 50 days prior to the test stream becoming intermittent.

The all-plastic structures which extended across the valley floor were effective in raising subsurface water, while the shorter barriers located across the stream channel only were not. To maintain a flow through the intermittent areas, it would be necessary to have subterranean structures traversing the valley floor for each 75 to 100 yards of stream length.

A trap was operated at the mouth of the stream to record upstream and downstream migrant fish. Observations indicated that the majority of adult steelhead arrive in Tex Creek during May. The sex of the adult fish in the run was equal each year of the study; however, they did not arrive in pairs. Each female spent an average of seven days in the stream and dug an average of two redds.

REPORT OF OPERATIONS

The study was essentially in three parts. The first dealt with the mechanics of design and installation of the subterranean structures hereafter referred to as weirs. The second and third parts were the practical and the biological evaluation of the weirs.

Under the mechanical phase, eight weirs of five different designs were tested. All were installed in sections of the stream that invariably became dry during late summer. The practical evaluation of each weir consisted of making periodic checks during the late summer to determine if it was affecting stream flow and to what extent. The biological evaluation and justification of the weirs was made by determining the number of young lost due to drying, and comparing the loss to the total outmigration. The possibility of redd location in areas that would become dry before fry emergence was also investigated.

An inclined screen trap was installed near the stream mouth to collect and count outmigrant juvenile steelhead. The stream contained both resident rainbow and juvenile steelhead. No attempt was made to differentiate between the two when they were trapped or salvaged since the steelhead were not smolting. It was originally planned to obtain a total count of the outmigration; however, high runoff during part of the migration prevented this in all but one year. At the trap, maximum-minimum water temperature data were collected and an attempt was made to correlate this with fish movement.

The trap structure contained an upstream adult trap of standard design. Number, date of arrival and sex of all adults entering the stream were recorded. Redd location and number were recorded. Periodic observations were made on selected redds until time of fry emergence in early July.

As the stream became intermittent, the stranded fish were collected by use of seine, electrofishing units and dipnets. They were then enumerated in two-inch size groups and released into Murderers Creek. No attempt was made to differentiate between steelhead and resident rainbow.

Weir Construction

In the summer of 1961 after the flow of Tex Creek had become intermittent, sites for six weirs were selected and the structures installed. All were installed at a 90-degree angle to the stream flow. Weirs Nos. 1 through 5 were short and traversed only the stream channel. Weir No. 6 crossed the entire valley floor.

The bottom depth of the weir was determined by the depth of the subterranean water. Water was generally found on top of a cemented silt-clay layer that underlays the area at a depth of 3.5 to 5 feet below the mean streambed level. However, at weirs Nos. 6, 7 and 8 a clay stratum was not reached, only compacted gravel. Table 1 gives a description and comparative cost of each weir.

Installation of Weirs

A backhoe was used to excavate the trenches for the various weirs. Because no cribbing was used while the ditches were being dug, considerable difficulty was encountered from caving in of the loose bank material. As the trench reached the subterranean water level, the water would collect and the washing action would cause sloughing of the bank. A sump pump was employed to draw down the water but was not entirely satisfactory as the intake would readily plug with suspended material.

The 10 mil plastic sheeting that was used for construction of the weirs came in rolls 20 by 100 feet. Because of lapping and wrinkling of the plastic

Table 1

Description and Cost of Tex Creek Weirs

Weir No.	Material	Length in Feet	Depth in Feet	Position in Stream	Cost: Material	Cost: Excavation	Cost: Labor	Cost: Total
1	2- by 12-inch plank	29	4.0	Flat barrier 90° to stream	$ 24	$ 97	$ 80	$201.00
2	Double layer, 10 mil plastic	35	4.5	Flat barrier 90° to stream	21	117	32	170.00
3	Double layer, 10 mil plastic	27	8.0	Flat barrier 90° to stream	18	90	64	172.00
4	2- by 12-inch plank, double layer, 10 mil plastic	28	4.5	Flat barrier 90° to stream	41	93	64	198.00
5	Double layer, 10 mil plastic	34	5.0	Flat barrier 90° to stream	21	113	34	168.00
6	Double layer, 10 mil plastic	120	8.5	Flat barrier traversing valley floor	72	60	40	172.00
7	Double layer, 10 mil plastic, 16 feet of 1- by 12-inch planking	270	5.5	V design traversing valley floor	218	230	120	568.00
8 1/	Double layer, 10 mil plastic, 16 feet of 1- by 12-inch planking	189	5.5	V design traversing valley floor	182	85	64	331.00

1/ Installed in 1963.

when buried, it was found that 100 feet would only provide approximately 80 linear feet of weir.

After two summer's observations it was apparent that the short weirs that crossed only the streambed (Nos. 1 through 5) were not effective. The all-plastic weir No. 6 that traversed the valley floor was raising water and maintaining a flow a short distance above and below it. The high water during spring runoff tore and shedded the plastic where it crossed the stream channel, reducing the height that the water level could be raised.

Using the experience gained from the first weirs, it was decided to construct two more. These were numbered 7 and 8 (see Table 1). They were constructed of plastic and extended across the valley floor. To protect the plastic from tearing where the weir crossed the stream channel, the plastic was backed with a 3- by 16-foot wall of rough 1- by 12-inch lumber. The top of the wall was level with the streambed.

The plastic wings of the weir that extended from the stream to the edge of the valley were not placed at a 90-degree angle to the flow as in the past. Instead they were placed at a 50-degree angle to the stream course. This gave the weirs an appearance of an open blunt-pointed V. It was hoped that the V shape would guide subterranean water back to the channel.

Weir No. 7 was further modified by having 2- by 12-inch wooden uprights placed at each end of the plank wall extending 2 feet above it. As the plastic was installed the top edge was maintained 1.5 to 2 feet above the creek bed level. To prevent the plastic from being pulled into the ditch when back-filling, the upper edge was held in place by wooden stakes. The weir then provided a fairly impervious layer from the subterranean water level to a height of 1.5 to 2 feet above the stream level. The only places water could work through the barrier were where the plastic was lapped around the ends of the weir, and through the space between the uprights. The various modifications were installed so that

the opening could be sealed during late summer. By raising the water an extra foot it was thought that additional upstream areas could be kept from drying. Weir No. 8 was essentially like No. 7 except no uprights were attached to the wooden wall. The weir was installed 75 yards downstream from weir No. 6 in an attempt to maintain a flow between the two structures.

Evaluation of Weirs

The short weirs (1 through 5) that traversed only the stream channel did not function. It is felt that the length was responsible for their inability to raise water, not the materials used. The all-wooden weir probably would not have raised water without a plastic face.

Weir No. 6 that traversed the valley floor did raise water and maintained a flow in the creek throughout the normal dry period. In 1963 it was maintaining a flow over a total of 26 yards, 18 yards above and 8 yards below the site. However, water action on the plastic undoubtedly reduced the efficiency of the structure.

Weir No. 7, the V design with the wooden backing, was the most successful of the weirs. After the opening was blocked it was maintaining a flow of 70 yards upstream in 1963 and maintained a continuous flow in 1964. However, in 1964 water conditions throughout the drainage were above average. Weir No. 8, the plastic and wooden weir installed 75 yards downstream from weir No. 6 did not raise water or noticeably change the flow at weir No. 6. The inability to raise water may have been due to a loose back-fill that permitted the water to escape around or under the plastic sheeting. Another contributing factor is that one wing could not be extended completely across the valley floor because of a U. S. Forest Service road. The gravel stratum under the road could allow substantial amounts of water to escape around the weir.

The number of weirs necessary to maintain a flow would depend on the gradient of the stream. However, the experience derived from weirs Nos. 6 and 7 would

indicate that in order to maintain a flow in Tex Cr. throughout the dry channel areas, it would be necessary to have a weir that traversed the valley floor every 75 to 100 yards.

On September 23 and October 17, 1964, measurements were taken on the upstream and downstream sides of each weir to determine the effect, if any, on the subterranean water. Table 2 summarizes the subterranean water level at each weir.

Table 2

Water Level at Subterranean Weirs during the Summer Dry Period

Date	Weir No.	Water Level below Streambed in Inches	
		Above Weir	Below Weir
September 23	1	26.50	25.75
	8	23.50	24.75
October 17	2 1/	Surface	Surface
	3	25.50	24.75
	4	25.00	25.25
	5	25.25	25.25
	6	Surface	Surface
	7	Surface	Surface

1/ Weir area goes dry during a normal year.

Tex Creek Trapping Facilities

The Tex Creek installation was a combination of a downstream juvenile trap and an upstream adult trap. The outmigrant trap originally consisted of two inclined wolf-type traps. Later, a third screen was constructed for the bypass flume. The latter was used only during times of high runoff. The bottoms of the two original screens were made of 1/8-inch perforated plate with 3/16-inch holes on 9/32-inch centers. One screen was later modified by redrilling the holes to 7/32-inch. The larger holes increased the water losing capacity without any apparent reduction in fish handling efficiency. The bottom of the bypass trap was made of woven 16-gauge screen wire with four holes per inch. The material

was not as efficient as the perforated plate. The screen had a tendency to collect debris more readily and was more difficult to clean.

Originally the trapped fish were collected in a pan at the rear of each trap. During the peak runoff, as the screen became plugged with debris, the water would overflow the incline causing extreme turbulence in the holding area. The turbulence resulted in some mortality of the collected fish. To prevent mortality, a four-inch pipe was attached by means of a flexible joint to each trap. The fish could then move out of the collecting pans down the pipes and into metal holding boxes. The flexible joint on the pipe was necessary for the adjustment of the screens as water conditions changed. Because the pipe extended into the trap box approximately 10 inches, the flexible joint was also necessary to allow the pipe to be backed out during fish removal. Occasionally a pipe would become plugged with a bark chip, pine cone or other debris, but generally the system functioned satisfactorily. The bottom of the trap boxes were painted white to facilitate location of the fish during their removal.

A half-ton differential chain hoist on each trap was used to suspend and adjust the angles. Because the traps were unattended for one or two days during the latter part of the migration, it was necessary to remove the hoists. A pair of hanger bars and adjusting chains were installed for each trap for permanent operation.

As the stream diminished it became difficult to maintain an adequate flow across the screens into the holding pans. Plastic sheeting was used to cover part of the perforated area. The end of the plastic was tucked under the upstream end of the screens. Water flowing over the plastic held it in place against the plate.

The major problem with the downstream trap was the inability to handle the water volume during peak runoff. Had adequate flow information for the stream been available the problem could have been solved by the addition of more screens.

The adult trap was of a standard picket and weir design. Several modifications to the original structure were made. At first it was possible for the adults to move up under the inclined screens where removal with a dip net was difficult. A series of pickets installed immediately behind the screens eliminated the difficulty. To prevent molesting of the trapped adults by visitors, a cover of 2- by 4-inch lumber was installed over the holding chamber. Access to the chamber for fish removal was through a locked door.

Outmigrant Trapping

Originally it was planned to obtain a total count of the outmigrants; however, during times of peak runoff in 1962 and 1963 the traps were unable to handle the volume of water. During these periods they were removed or run on a partial basis by passing a percentage of the flow. Initial trapping was started as soon as installation was completed on May 3, 1961. The runoff was moderate and the trap fished continuously until the operation was terminated on July 11, 1961. A total of 2,516 outmigrants were counted. Based on the following year's data it was estimated that approximately 500 fish left the stream prior to trapping, for a total migration of approximately 3,000 fish.

The 1962 trapping was initiated March 6 and terminated on July 5. A total of 2,216 migrants were collected in 1962. The trap was out of operation or operated on a partial basis from April 3 to April 24 due to high runoff. During the period an estimated 800 fish left the stream that were not trapped, for a calculated total of approximately 3,000 fish. The early trapping indicated that the migration does not generally start until late March or April. Temperature records kept during the trapping season indicated that when the minimum water temperatures are in the 30's few fish will leave the stream.

In 1963 trapping was started March 21 and terminated June 26. A total of 761 fish was collected. Trapping in 1964 was started on April 21 and terminated on June 26. A total of 677 migrants was collected. Even though trapping was

started later in 1964 than in previous years, it was felt that a fairly complete count of the outmigration was obtained. Weather and temperatures prior to April 21 were such that few if any fish would be moving. Table 3 summarizes the outmigration data for the four years.

Table 3

Summary of Tex Creek Outmigration Data

Year	Days Trapped	Total Counted Outmigration	Outmigrants by Size Groups 0-2	2-4	4-6	6+	Estimated Total Outmigration
1961	69	2,516	27	1424	846	219	3,020
1962	101	2,281	171	1529	379	202	3,080
1963	98	761	12	230	425	94	860
1964	67	677	54	390	205	28	677

Temperature Data

During the first two trapping seasons water temperatures were taken with a hand thermometer. During 1963 and 1964 a maximum-minimum thermometer was secured inside one of the trap boxes. Figures 1 and 2 present the daily outmigration and maximum-minimum temperature information for the 1963 and 1964 seasons. There appears to be a slight correlation between water temperature and fish movement during the first part of the migration.

Fish Loss Due to Drying

As the stream became intermittent the fish that were isolated from live water were collected, enumerated and released into Murderers Creek. A visual estimate of the remaining fish was made and by combining the counted and estimated fish a total figure was obtained.

Fish salvage was not conducted in 1962. In 1964 intermittent stream flow occurred later than in previous years due to cool temperatures during July and August. Many of the fish moved upstream as the flows became low; consequently, a lesser number remained to be salvaged. Table 4 presents the estimated outmigration

of Tex Creek and the estimated fish loss from drying. Obviously these two figures are not directly comparable; however, it is felt they tend to place the loss in perspective. Also, they indicate how production of the stream might be increased if drying could be prevented by installation of subterranean weirs.

Table 4

Estimated Juvenile Outmigration and Summer Mortality

Year	Estimated Outmigration	Number of Juveniles Lost to Drying	Percentage of Zero Age Fish Lost
1961	3,020	3,680	53
1962 1/	3,080	-	-
1963	860	750	49
1964	680	150	66

1/ No salvage.

Adult Migration

The adult steelhead trap was operated in conjunction with the outmigrant trap. In 1961 the first adults arrived on May 3 and the last on June 4. The peak of the run occurred between May 19 and 21. During that period 19 steelhead entered the stream. The total run was 46 fish, 23 of which were females. Only 36 fish returned to the trap after spawning.

After spawning was completed the lower 2.5 miles of stream were surveyed for redds. Forty-three were located in the area. Periodic observations of these redds made during June and early July indicated that all of the fry emerged from the gravel prior to the occurrence of intermittent flow.

In 1962 the total run was 14 adults. Again the run contained 50 percent females. A post-spawning survey of the lower 2.5 miles of stream located 8 redds. The reduced number of adults may have resulted from the 1958 spray treatment of the upper drainage with DDT for control of the spruce bud worm. Inspection during spraying indicated numerous fry were killed. The conclusion is further supplemented

by observations on other streams that were also sprayed. In all instances the adult numbers were down, while the unaffected streams in the drainage had an increase of adults in 1962.

In an attempt to learn as much as possible about the habits of the adult steelhead, it was decided to mark each with a colored dart tag. Because of the low number of fish in 1962 little information was obtained. The identification of individual fish enabled personnel to determine that the female spent an average of seven days in the stream.

The 1963 run showed a decline for the second year in a row. The arrival of individuals was rather erratic with fish coming and going without spawning. Again all adults were tagged but because of the nature of the run little information was gained from this effort. Of a total of 12 adults entering the stream, only two of the six females were known to have spawned and only five redds were located in the project area.

In 1964 the first adults arrived May 6 and the last on May 25. A total of 16 fish entered the stream, eight of which were females. Five redds were located during the spawning survey and observations made later indicated that all produced fry. No tagging was done in 1964. Table 5 summarizes the adult migration and spawning data of Tex Creek.

Approximately 75 redds were found in Tex Creek in the 1965 spawning ground count, the progeny of the 1961 run.

Table 5

Adult Steelhead Migration and Spawning Data

Year	Total Run	Females	Redds	Spent Fish Returned to the Trap	First Arrival	Last Arrival
1961	46	23	43	36	May 3	June 4
1962	16	8	8	11	May 7	June 6
1963	12	6	5	10	May 20	May 27
1964	16	8	5	10	May 6	May 25

Conclusions

It is possible to raise ground water in some streams by the installation of subterranean weirs.

The most practical material for weir construction is 10 mil plastic sheeting. The plastic needs rigid backing where it crosses the stream channel to prevent tearing by water action.

Weirs traversing the valley floor are most effective.

Weirs need to be approximately 100 yards apart to maintain a flow in Tex Creek. The distance, however, depends on the gradient of the stream.

The inclined screen fitted with holding boxes was an effective trapping device for handling both juvenile and adult steelhead.

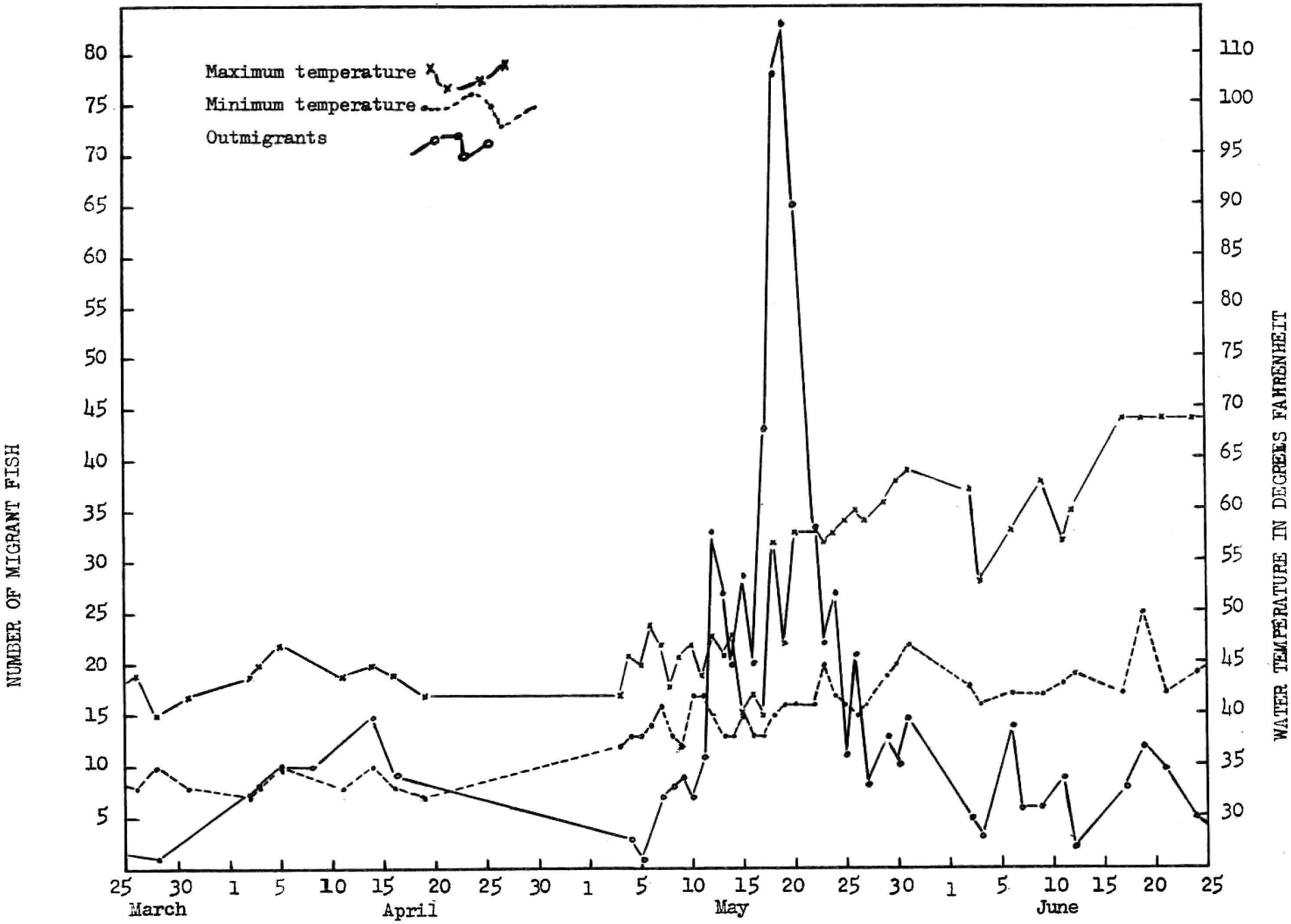


Figure 1. Daily outmigration and temperature data, 1963.

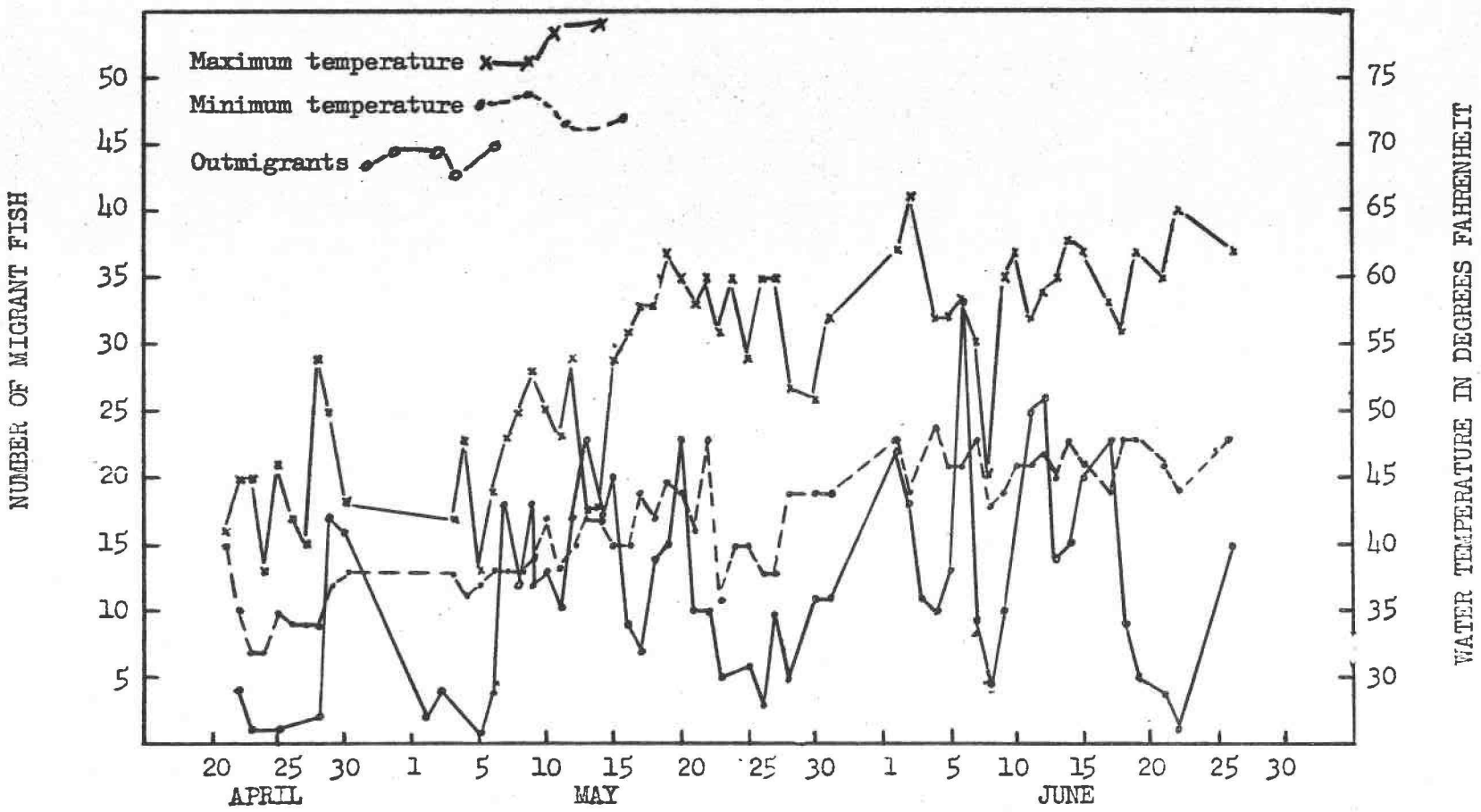


Figure 2. Daily outmigration and temperature data, 1964.

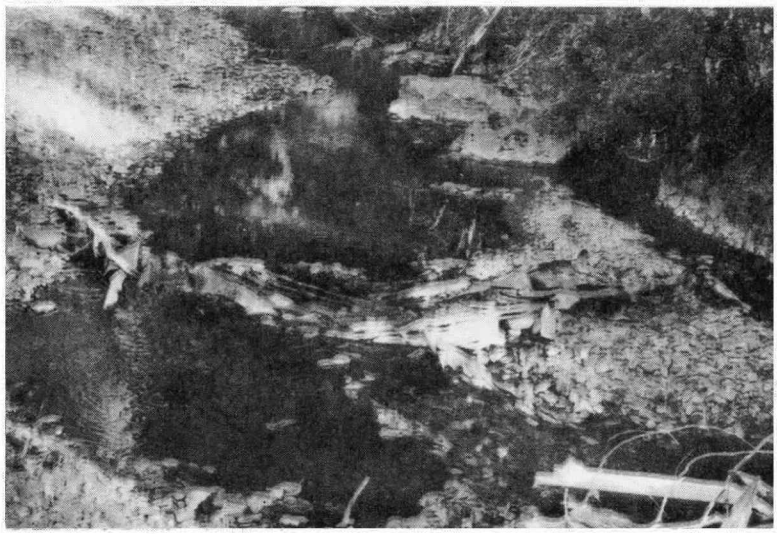
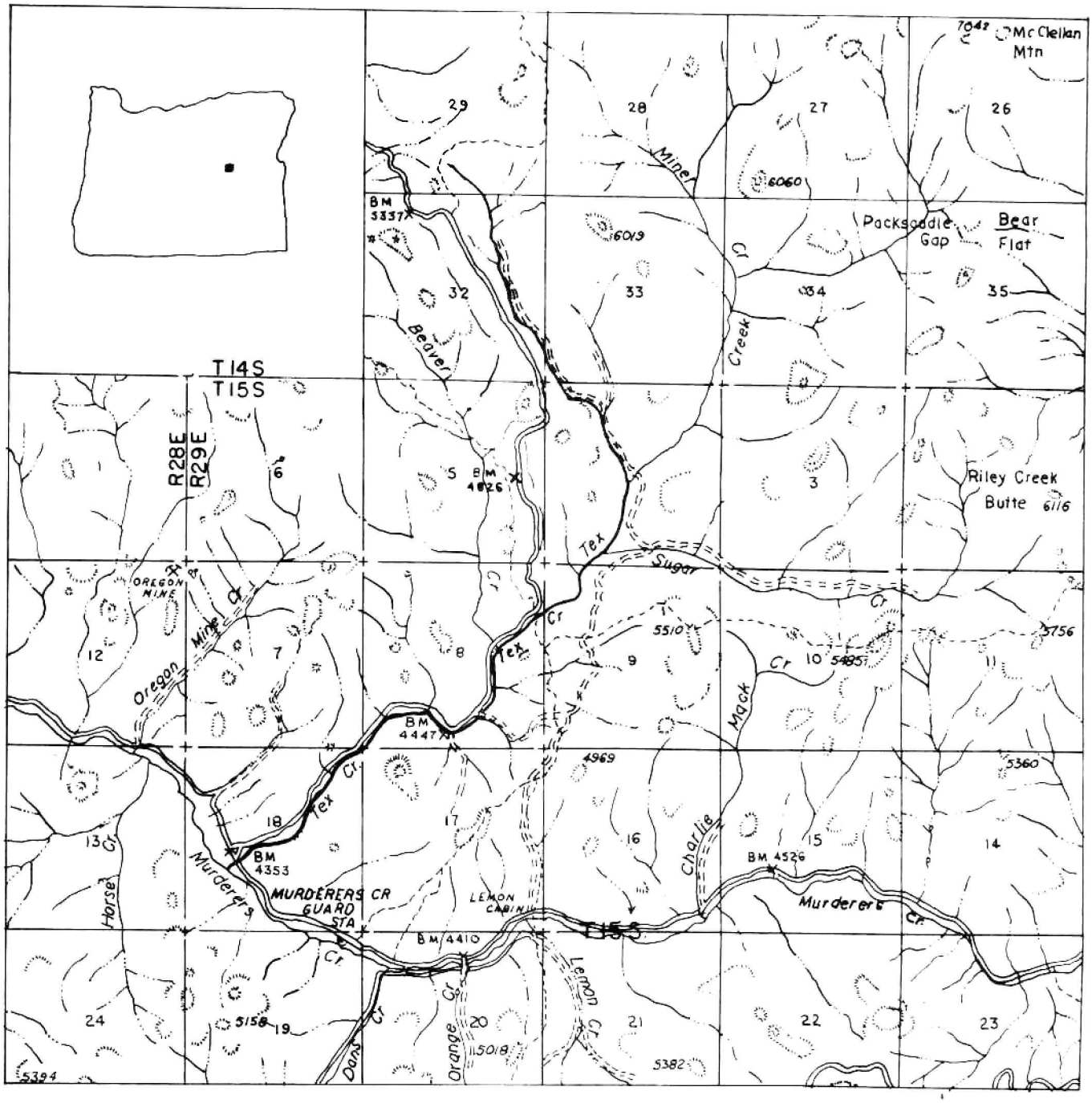


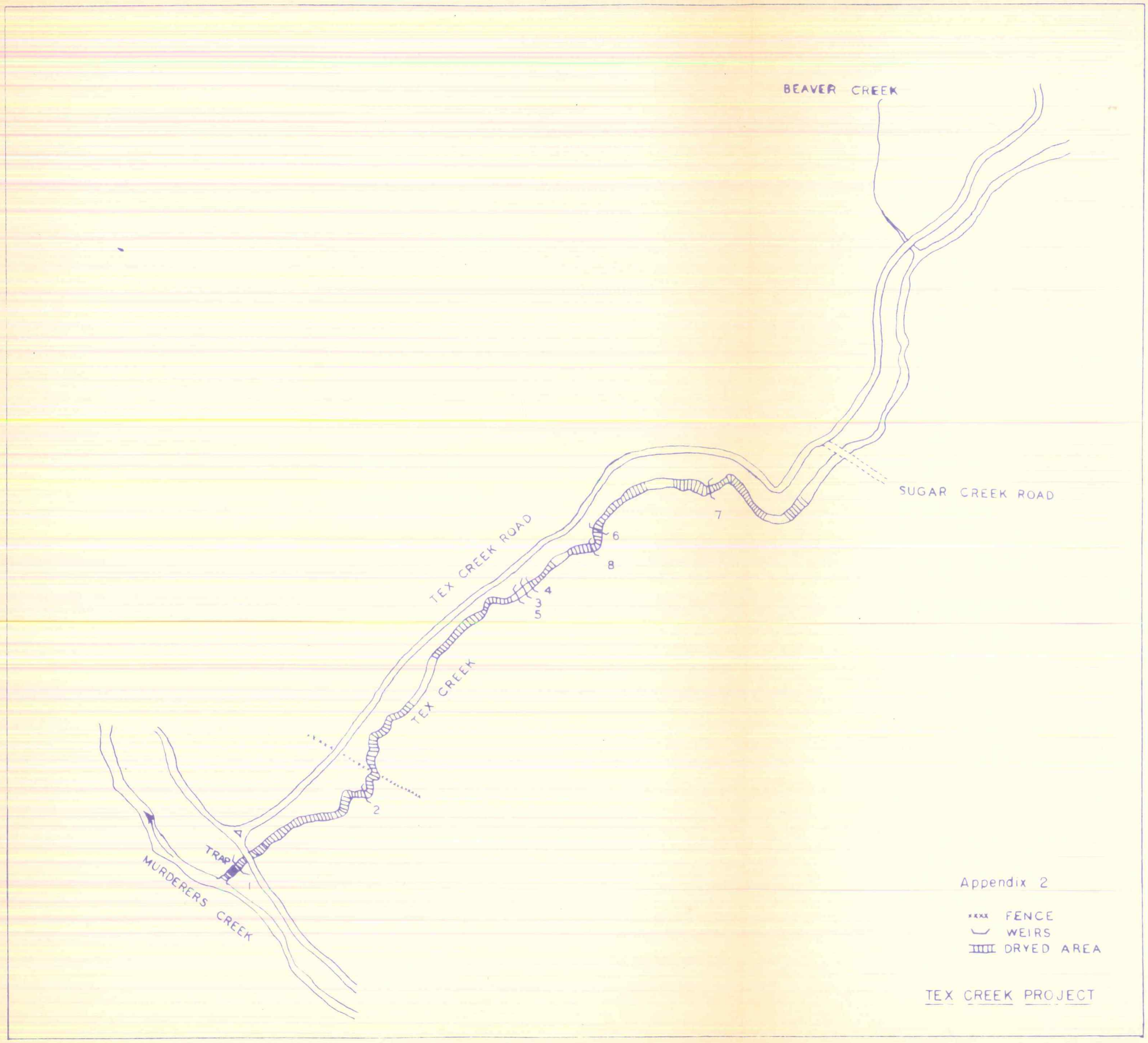
Figure 1. Weir No. 6 showing effects of spring runoff on plastic sheeting barrier.

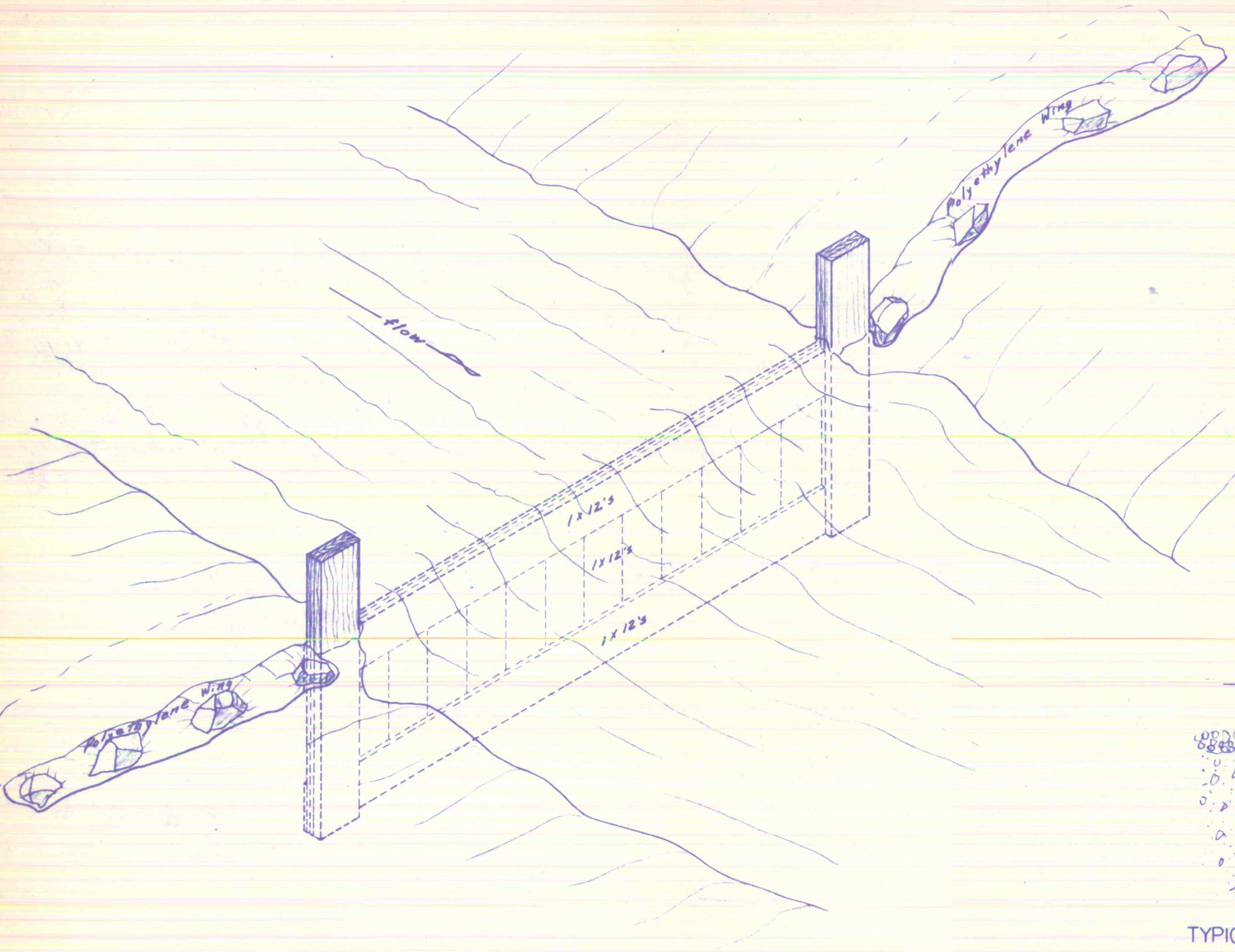
Figure 2. Weir No. 7 maintaining a summer flow above and below itself in 1964.



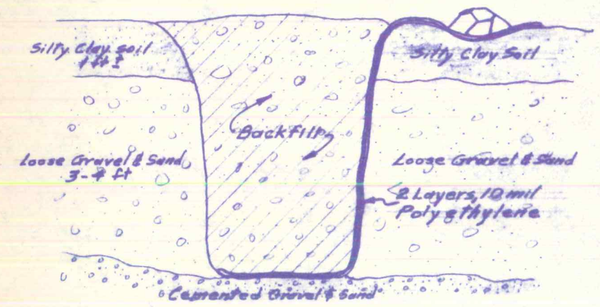
Appendix I

LOCATION MAP TEX CREEK PROJECT

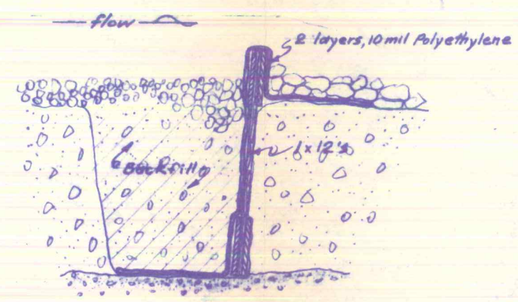

BEAVER CREEK
SUGAR CREEK ROAD
TEX CREEK ROAD
TEX CREEK
MURDERERS CREEK
TRAP
1
2
3
4
5
6
7
8
Appendix 2
FENCE
WEIRS
DRYED AREA
TEX CREEK PROJECT



DOWNSTREAM VIEW



TYPICAL WING CROSS-SECTION



TYPICAL WEIR CROSS-SECTION

Appendix 3

OREGON STATE GAME COMMISSION
PORTLAND, OREGON

TEX CREEK WEIR

DESIGNED BY	APPROVED BY CHIEF ENGINEER	DATE	REVISION BY
DRAWN BY 2-18-65 K.S.L.	APPROVED BY DIRECTOR		
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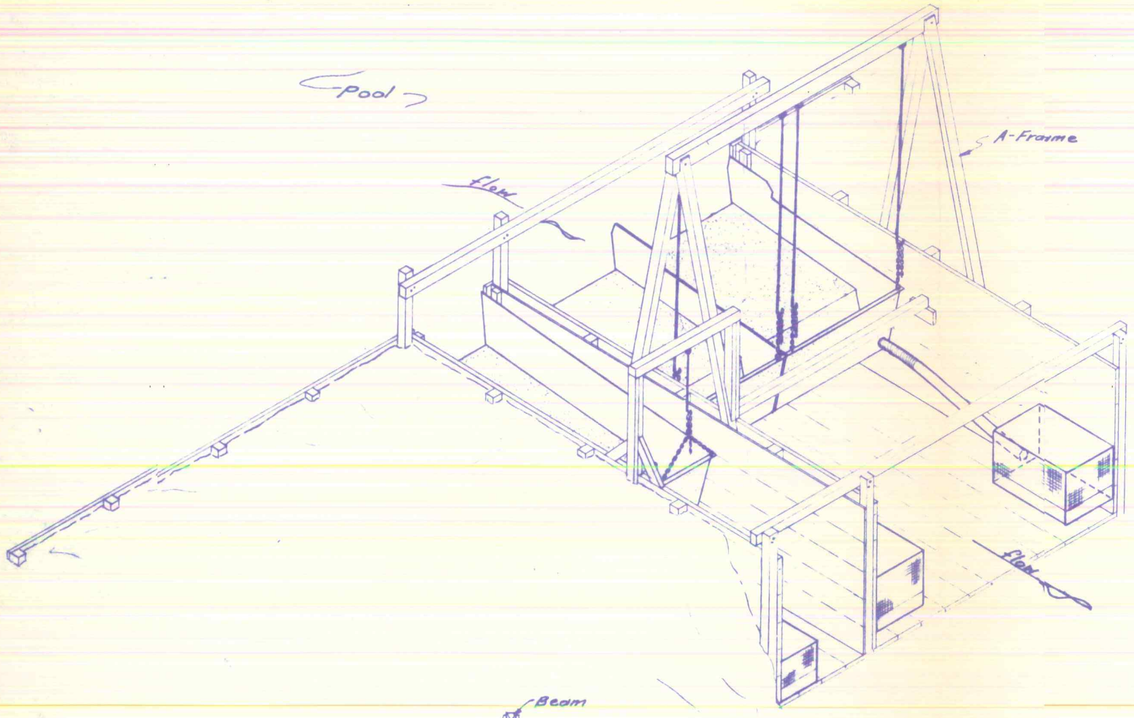
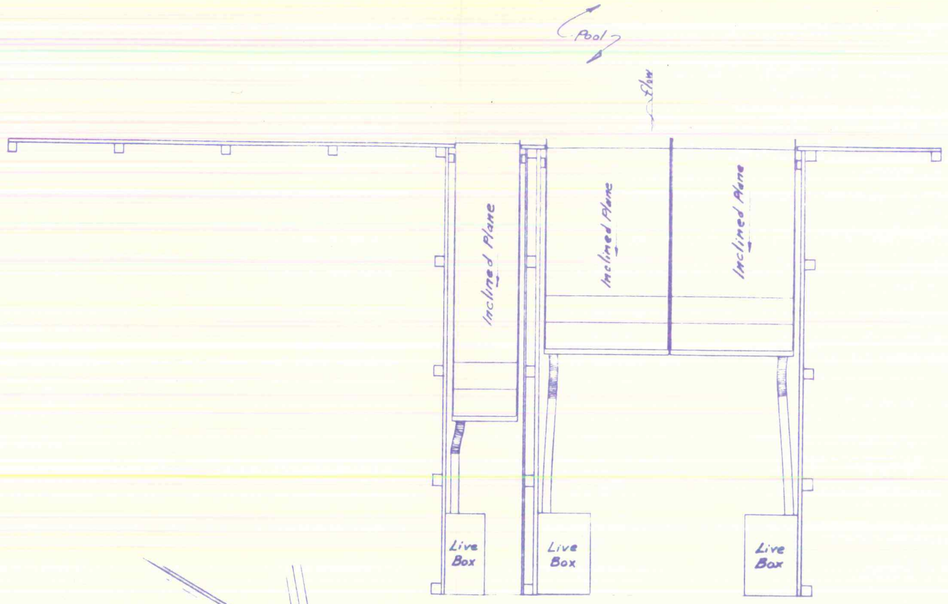
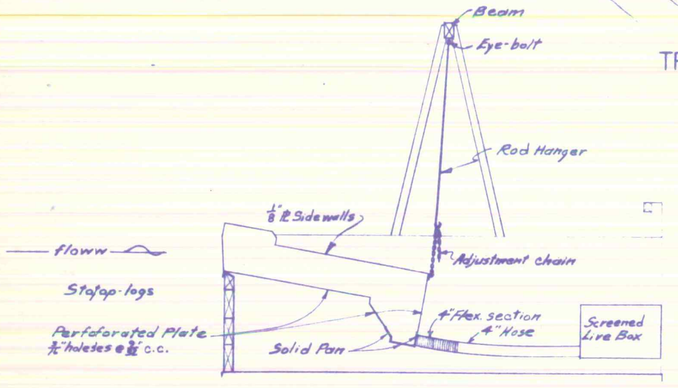
SCALE	SHEETS	1284	



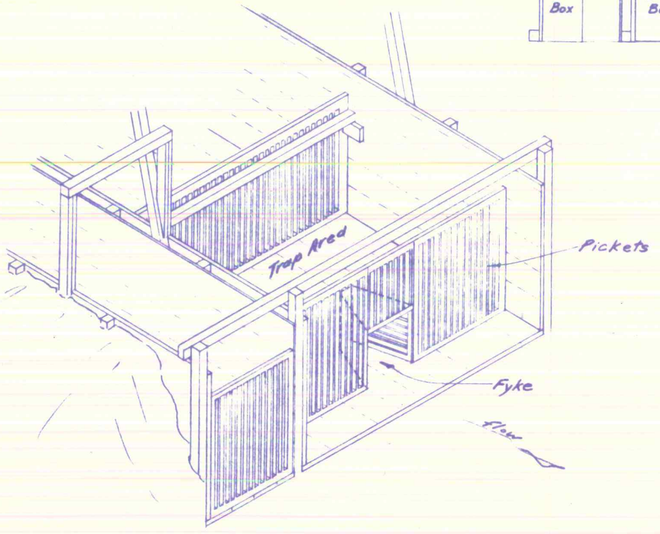
TRAPPING DOWNSTREAM MIGRANTS



PLAN



TYPICAL SECTION



TRAPPING UPSTREAM MIGRANTS

Appendix 4

OREGON STATE GAME COMMISSION
PORTLAND, OREGON

TEX CREEK
TRAPPING FACILITY

DESIGNED BY	APPROVED BY CHIEF ENGINEER	DATE	REVISION BY
DRAWN BY 2-17-65 K.S.L	APPROVED BY DIRECTOR		
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SCALE 1/8" = 1'-0"	SHEETS	1284	