

EXPLORATORY TESTS OF VELOCITY SELECTION
AS A MEANS OF GUIDING JUVENILE FISH

by

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INTRODUCTION

In the imaginative process of creating new methods to deflect juvenile migrants from rivers and streams, the use of a system of contrasting velocities was proposed. It was suggested that juvenile migrants would be uncomfortable within a high velocity and would seek areas of reduced velocity. The purpose, therefore, of this study was to determine if there were any basis for this conjecture. The plan was to provide a high velocity flow ranging from 5 to 15 feet per second through the central portion of a behavioral flume with a relatively low velocity of 1 to 2 feet per second along either wall.

If such a plan were found practical, it would allow for a structural design in which debris would readily sweep through the open central canal while the migrants would move out of the high central velocity and into the reduced velocity existing along the walls and ultimately into a bypass. The study was conducted during the summer of 1964 within an 8-foot canal of the Troy Laboratory, located in the Grande Ronde River, Oregon.

MATERIALS AND METHOD

Experimental Apparatus

There were no design precedents to follow. To provide the requisite refuge of low velocities along the walls, three designs were conceived and installed at the lower end of the flume. The first structure consisted of 18 vertical two-by-fours spaced on 2-foot centers in a line 2 inches off each flume wall. Fish selecting the slower velocities along the two-by-fours were collected in 6-inch wide bypasses set adjacent to each flume wall (fig. 1).

The second structure was a modification of the first. The vertical two-by-fours were installed on 1-foot centers and moved away from each wall by 6 inches. Each bypass was 20 inches wide (fig. 2).

In the third installation, only the bypass structure was left in the canal to determine fish response to the canal walls and bypasses only (fig. 3).

Test Procedure

Water velocities through both the flume and bypasses were controlled with stoplogs at the downstream end of the individual canals.

Fish used during the tests were wild downstream migrants collected from the inclined screen traps. Approximately 15 minutes prior to each test, the fish were placed in a container positioned against the trashrack at the upstream end of the flume. At the time of testing, the fish were released from the container and allowed to travel downstream through the flume. In the first and second series, fish were released in the center; in the third series the release position was varied from side to center.

Guiding efficiencies are expressed as the percent of all fish migrating through the flume that entered the bypasses.

RESULTS AND DISCUSSION

Results of the tests using the three designs are shown in tables 1, 2, and 3. It should be noted that the test fish, with the exception of three chinooks, were all non-salmonid. Therefore, the interpretations that follow are not intended at this time to apply to salmon and steelhead trout.

Collections in the 6-inch bypasses were negligible. When the bypass was widened and flow arresters changed, the slight bias to south bypass was altered but collection was still negligible. Total removal of the flow arresters did not change distribution in the north bypass, but a much larger collection in the south bypass resulted. The results of moving the release point indicate a strong bias toward the south bypass. When designs 2 and 3 are

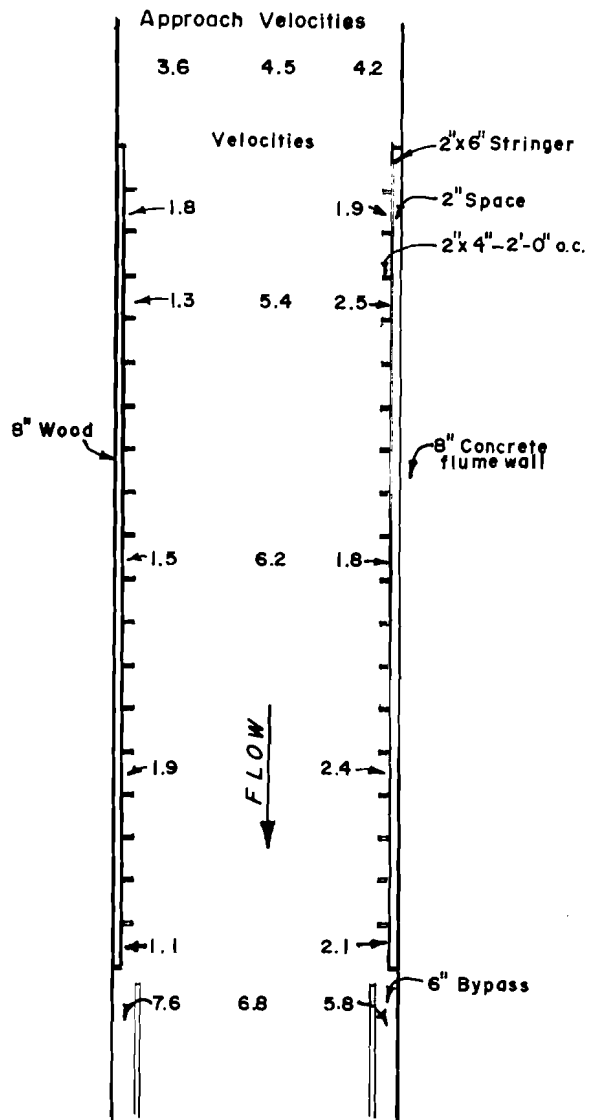


Figure 1.--Plan view showing velocity baffle arrangement in a portion of the 8-foot wide canal at the Troy Laboratory. High velocity section was 36 feet long.

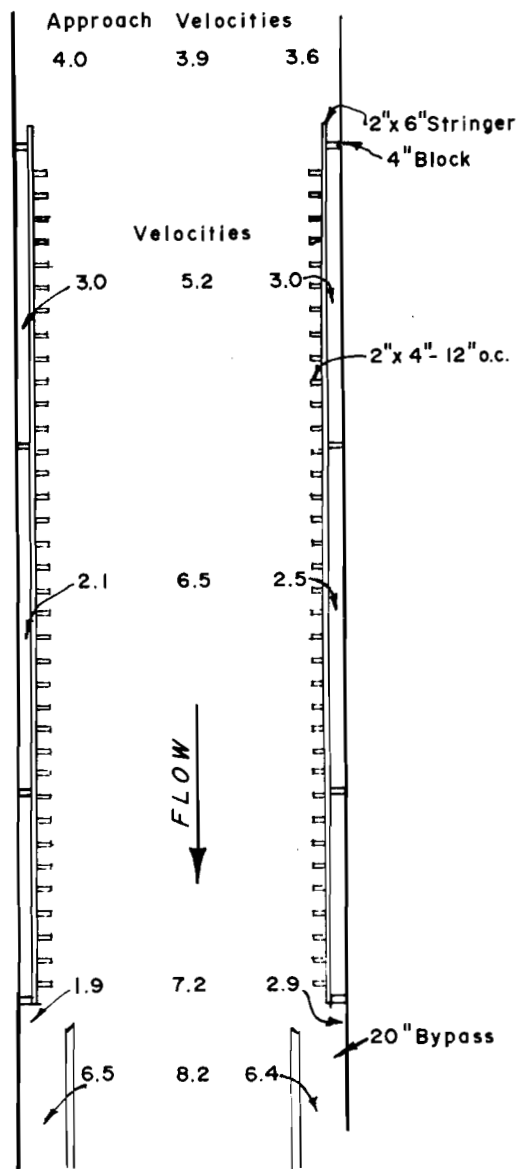


Figure 2.--Plan view showing modified velocity baffle arrangement in a portion of the 8-foot wide canal at the Troy Laboratory. High velocity section was 36 feet long.

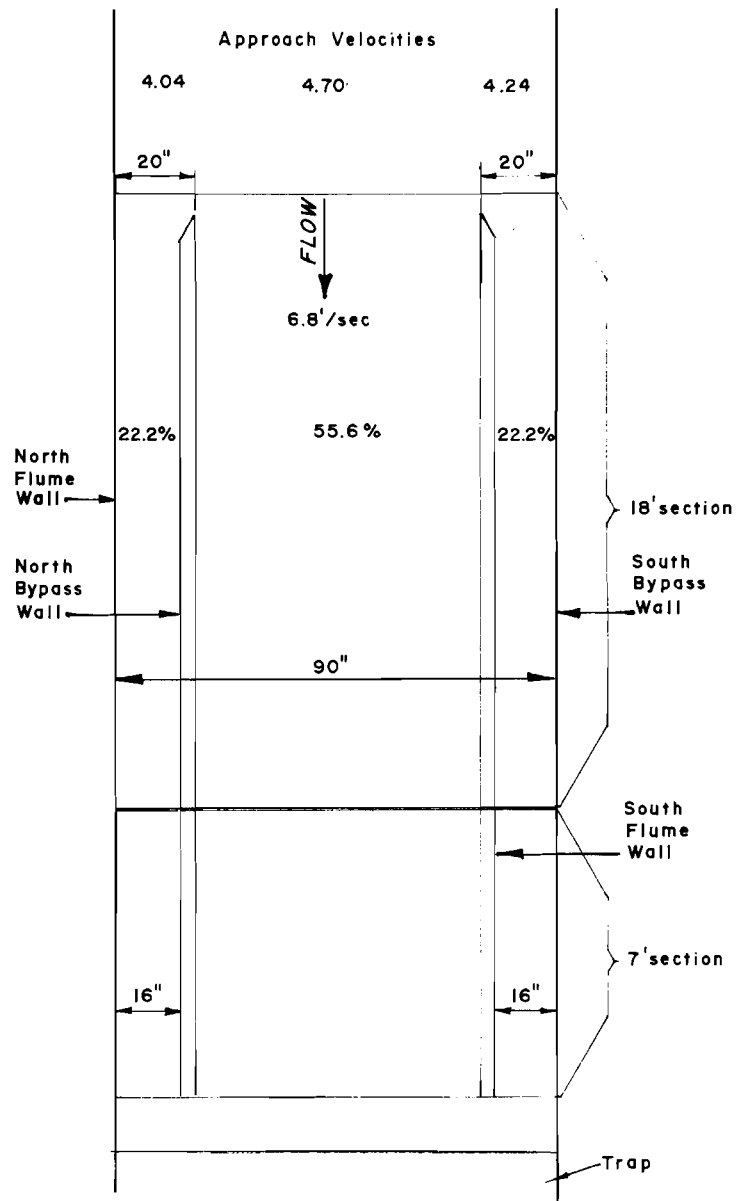


Figure 3.--Plan view showing a further modification of the velocity baffle arrangement in a portion of the 8-foot wide canal at the Troy Laboratory. High velocity section was 72 feet long.

Table 1. --Percent of juvenile fish guided into 6-inch bypass by vertical two-by-four flow arresters on 2-foot centers in a line 2 inches from each flume wall.

Test No.	Fish composition	Lateral distribution		
		North bypass	Center of channel	South bypass
		6.7% of flow	86.6% of flow	6.7% of flow
	<u>Species and Number</u>	<u>Percent</u>	<u>Percent</u>	<u>Percent</u>
1	Chinook-3 Whitefish-45	0.0	100.0	0.0
2	Chiselmouth-3 Dace-1 Red-sided shiner-11 Bluegill-1 sucker-10	0.0	96.2	3.8
3	Whitefish-20	0.0	100.0	0.0
4	Whitefish-20	0.0	82.5	17.5
5	Whitefish-20	0.0	100.0	0.0
6	Red-sided shiner-16	0.0	100.0	0.0
7	Chiselmouth-11 sucker-5	0.0	100.0	0.0

Table 2. --Percent of juvenile fish guided into 20-inch bypass by vertical two-by-four flow arresters on 1-foot centers in a line 6 inches from each flume wall.

Test No.	Fish composition	Lateral distribution		
		North bypass	Center of channel	South bypass
		22.2% of flow	55.6% of flow	22.2% of flow
	<u>Species and Number</u>	<u>Percent</u>	<u>Percent</u>	<u>Percent</u>
1	Red-sided shiners-20	0.0	100.0	0.0
2	Whitefish-19	0.0	100.0	0.0
3	Whitefish-18	0.0	100.0	0.0
4	Chiselmouth-18	5.6	83.3	11.1
5	Whitefish-19	0.0	100.0	0.0
6	Chiselmouth-19	15.7	68.6	15.7

Table 3. --Percent of whitefish accepting two 20-inch bypasses installed on the inclined screen in the 8-foot test flume. Fish were released on the north, center, and south side of flume entrance.

Test No.	Number tested	Release site	Lateral distribution		
			North bypass 22.2% of flow	Center of channel 55.6% of flow	South bypass 22.2% of flow
			Percent	Percent	Percent
1	18	North side	0.0	72.2	27.8
2	20	North side	0.0	94.8	5.2
3	18	Center	0.0	83.3	16.7
4	19	Center	10.5	63.2	26.3
5	19	South side	10.5	68.4	21.1
6	20	South side	0.0	80.0	20.0

compared, no contribution can be assigned to the use of the arresters.

Since the major portion of the test fish remained within the center of the flume, this may indicate that (1) they did not find the high velocities objectionable; (2) they may not have had sufficient length of structure (time) to allow their moving out of the center; or (3) the velocity-reducing baffles along each wall may have repelled rather than attracted the fish.

These tests were suspended to permit installation of a test design of higher priority.