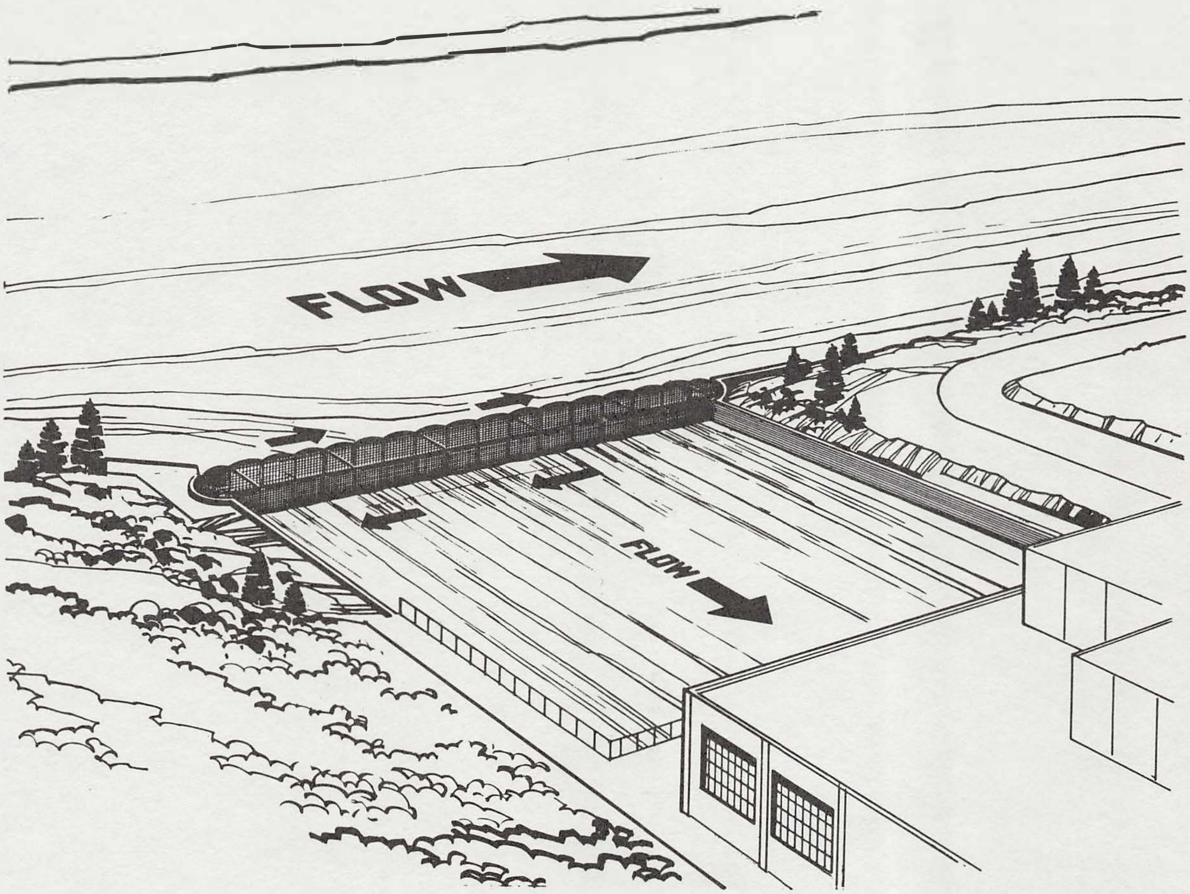
# Diversion and Collection of Juvenile Fish with Traveling Screens




UNITED STATES DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE
BUREAU OF COMMERCIAL FISHERIES

Fishery Leaflet 633

Cover photo—Artist's concept of traveling screen, model VII, as it might appear at the entrance to a power-plant intake canal.

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By

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# Diversion and Collection of Juvenile Fish with Traveling Screens

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## ABSTRACT

A horizontal traveling screen, suitable for screening fish or debris from powerplant water intakes or irrigation diversions, was designed and operated by the Bureau of Commercial Fisheries during 1965-69. The structure consisted of a vertically hung, endless belt of wire-cloth screen panels, flush with the face of the water intake structure or at an angle to the direction of flow.

Field tests in different water approach velocities, with the screen traveling at various rates, proved that such a facility can be operated efficiently. The horizontal traveling screen, as described here, should contribute materially to the development of an efficient, relatively low-cost diversion facility for fish and debris.

## BACKGROUND ON PROBLEMS IN SCREENING FISH

For many years biologists and engineers have been trying to develop an efficient method to safeguard juvenile fish exposed to hydroelectric or irrigation developments in rivers. They studied the possibility of deflecting migrants from their normal paths, causing them to take alternate routes. Numerous methods of deflecting fish have been examined, such as bands of rising bubbles, curtains of hanging chains, electrical stimuli, lights, louvers, sound, and water jets (fig. 1). These methods functioned satisfactorily under certain conditions, but were never completely reliable.

Notwithstanding the extensive and imaginative research, all fish-guiding or deflection devices in use today are burdened with one or more of the following disadvantages: (1) high cost, (2) insufficient guiding efficiency, (3) mechanical limitations where water depth is great or volume of flow large, (4) excessive head loss, (5) limited capacity for safely guiding or collecting fry and eggs of striped bass, shad, and smelt, (6) need for frequent adjustments to compensate for changes in flow volume, (7) and excessive maintenance.

In 1965 a new approach was conceived which promises to overcome these disadvantages. Development of the horizontal traveling screen (fig. 2) provided many practical solutions to problems of fish diversion. Among its advantages are the following:

1. Reduction of cost appears probable, due to simplicity of design.

2. Maintenance costs are low because all major operating parts are out of the water.

3. Previous problems of impingement of fish on screens are far less serious. Formerly many fish carried onto vertically traveling screens (such as the drum screen, fig. 3) were either carried over the screen and lost or sustained injuries in their efforts to free themselves. This latter problem also applies to

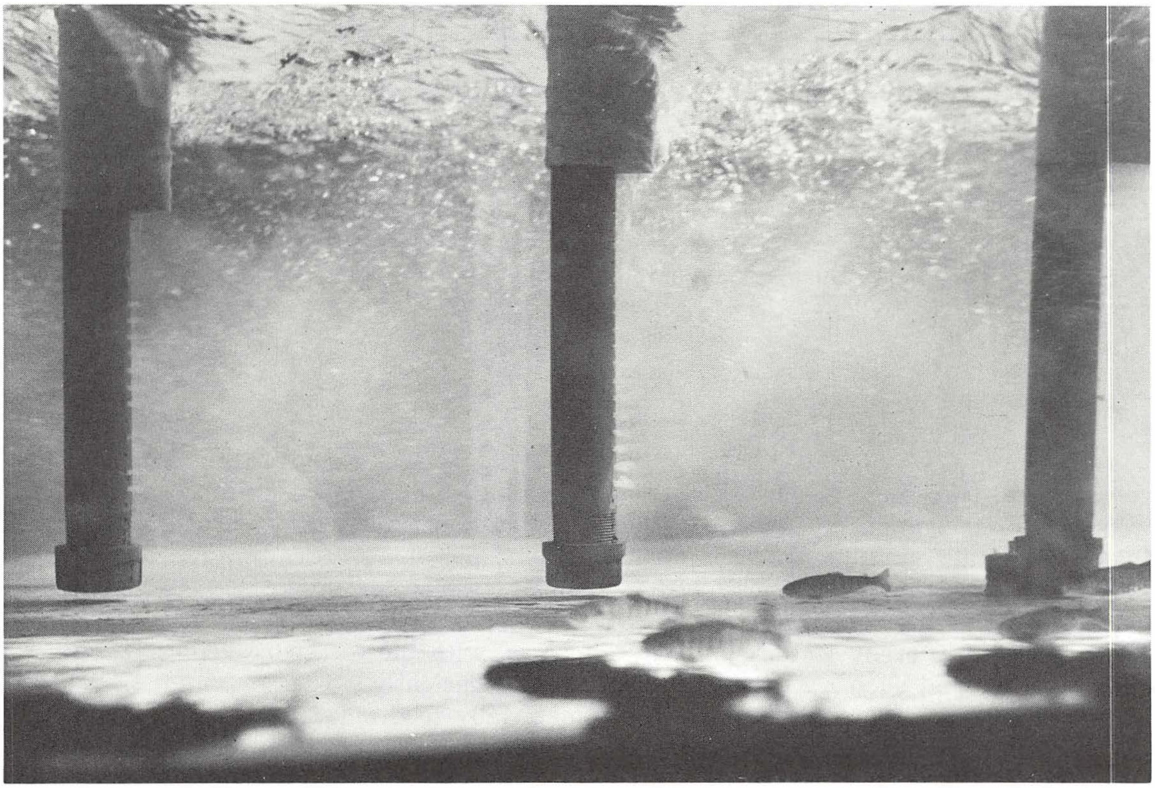

Figure 1.—Water deflection array in operation. Fish in foreground are avoiding jet streams emerging from right side of pipes.

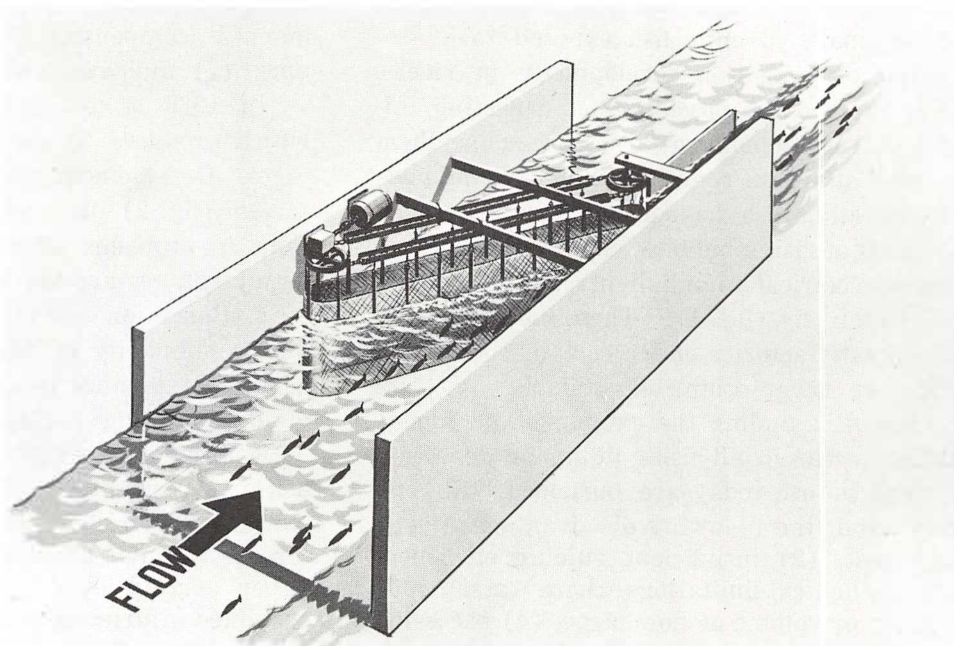


Figure 2.—Artist's view from upstream of traveling screen (model 1), 17 feet long and 4 feet high. This screen represents the first of six experimental models.

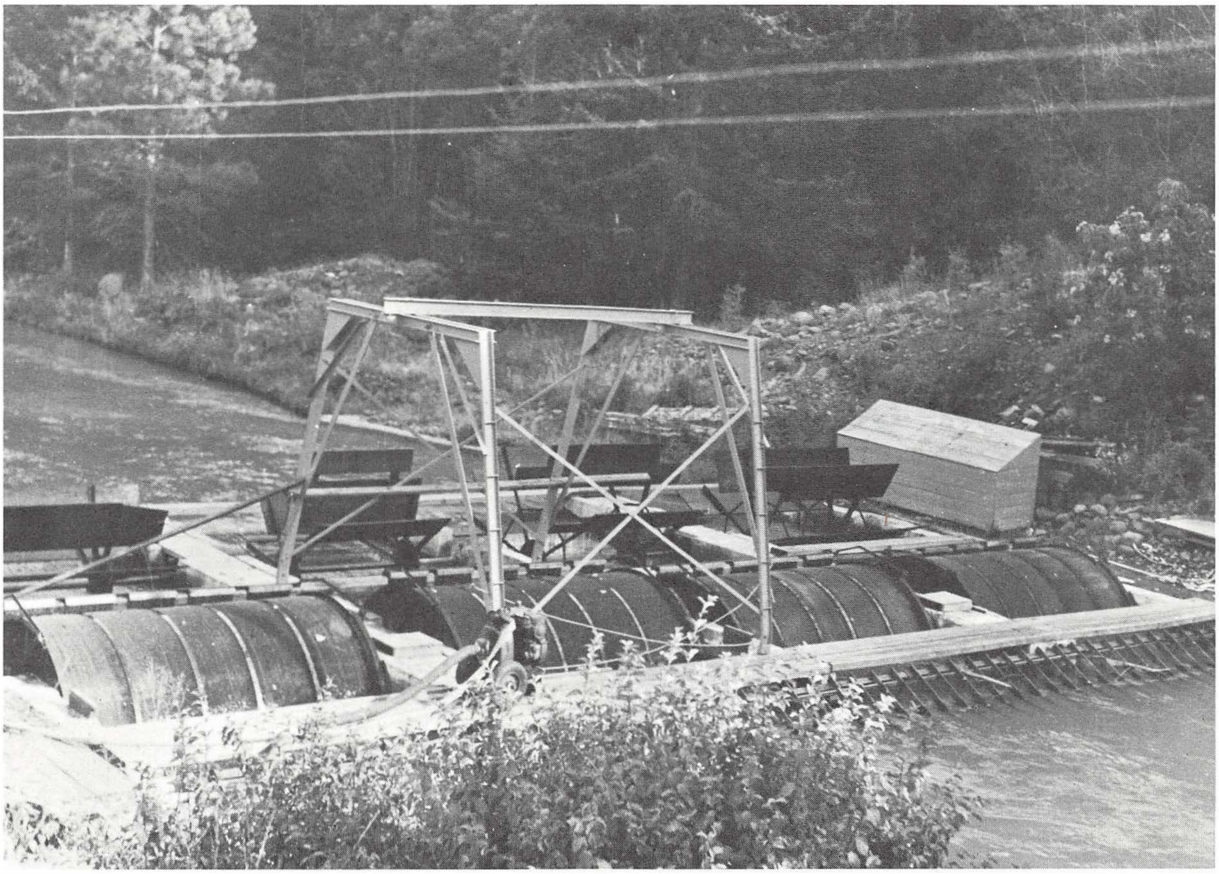

**Figure 3.—View from upstream of series of rotary drum screens placed 90° to direction of flow.**

the industrial water screen. Conversely, if fish are carried onto the horizontal traveling screen their impingement is gentle since travel of the screen can be matched to the velocity of the water; the fish remain in the water as they are carried into the bypass. Because of the gentle impingement, higher approach velocities and reduced canal widths can be considered.

4. Nonswimming forms, such as eggs of striped bass and shad, can be collected on the screen and safely carried for release into the bypass.

5. To provide for inspection or maintenance, the interlocking screen panels can be readily lifted out and returned to their original positions.

6. Screens can be easily changed if a different mesh size is required.

7. High efficiency in fish deflection can be anticipated on the basis of successful tests during 1967 in the 500 second-foot Stanfield Irrigation Canal, a diversion of the Umatilla River, Oreg. When model V (fig. 4) was tested with a natural run of juvenile steelhead trout and coho salmon, efficiencies ranged between 97 and 100 percent. Even greater efficiency can be expected from the newer designs.

8. Efficiency of operation remains high irrespective of fluctuations in water surface elevation.

9. As a safety measure, a pressure-release mechanism allows the panels to swing open if the water pressure becomes excessive.

10. The total velocity of bypass flow is minimal compared to total canal flow since fewer bypasses are required for the traveling screen. With other systems the number of bypasses must be considerably greater to avoid the possibility of fish becoming tired and impinging on the screens.

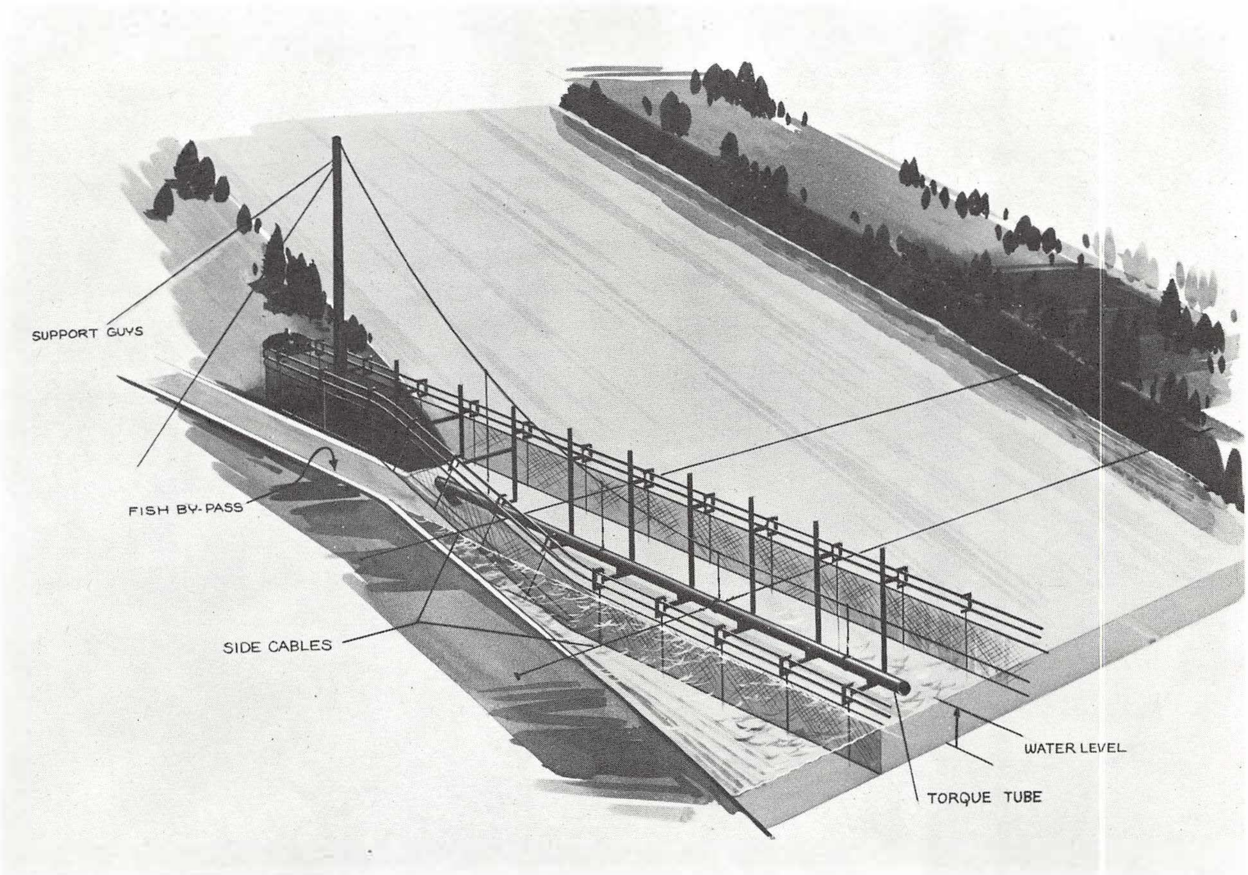


**Figure 4.—Sectional view of model V, installed and tested during 1967 in the Stanfield Irrigation Canal, a diversion of the Umatilla River near Echo, Oreg.**

## CONTINUING IMPROVEMENTS IN DESIGN

Since its conception, the plan has undergone extensive development. The latest prototype (model VI, 85 feet long) screens over 1,000 second-feet of water at a 6-foot depth at velocities up to 3 feet per second. It is now being operated in the Bureau of Commercial Fisheries' test flume on the Grande Ronde River near Troy, Oreg. A bypass installed at the downstream end of the traveling screen serves as an exit for fish deflected by the screen.

## FUTURE APPLICATION

Wherever a problem of fish screening exists, the horizontal traveling screen could be the answer. The State of California, collaborating with the U.S. Bureau of Reclamation, is studying its application in the Central Valley of California to divert fish eggs and juvenile fish. The State estimates annual diversion at over 250 million small striped bass, one-eighth to several inches long. This project would require the screening of about 30,000 second-feet of water (13.5 million gallons per minute). The Bureau of Reclamation regards this new concept as the most promising development to date in high-efficiency fish screening.

An ideal application of the horizontal traveling screen would be its placement in front of a powerplant intake. The figure on the cover illustrates one possible method of installation. This layout allows river flows to circulate freely past the screen face and eliminates the need for a bypass.

## PROPOSAL TO INDUSTRY

The Bureau of Commercial Fisheries is now proposing the design of a larger and improved model (fig. 5) for the 2,500 second-foot Leaburg powerplant intake canal at Eugene, Oreg. The canal is 17 feet deep and 70 feet wide; maximum water velocity is 3.6 feet per second (fig. 6). The City of Eugene (through its powerplant division, the Eugene Water and Electric Board) has approved use of the canal for installation of a traveling screen and has provided $7,500 to cover preliminary engineering design costs.

Thus far, each model has been somewhat larger than the previous one, and each design has been considerably modified and improved. The Bureau of Reclamation is planning a study of the traveling screen at its Denver hydraulic laboratory. A test stand will be constructed, consisting of a section of straight track, one complete end-turn, and two panels with carriages. This stand will serve as a check of operation and fabrication problems.

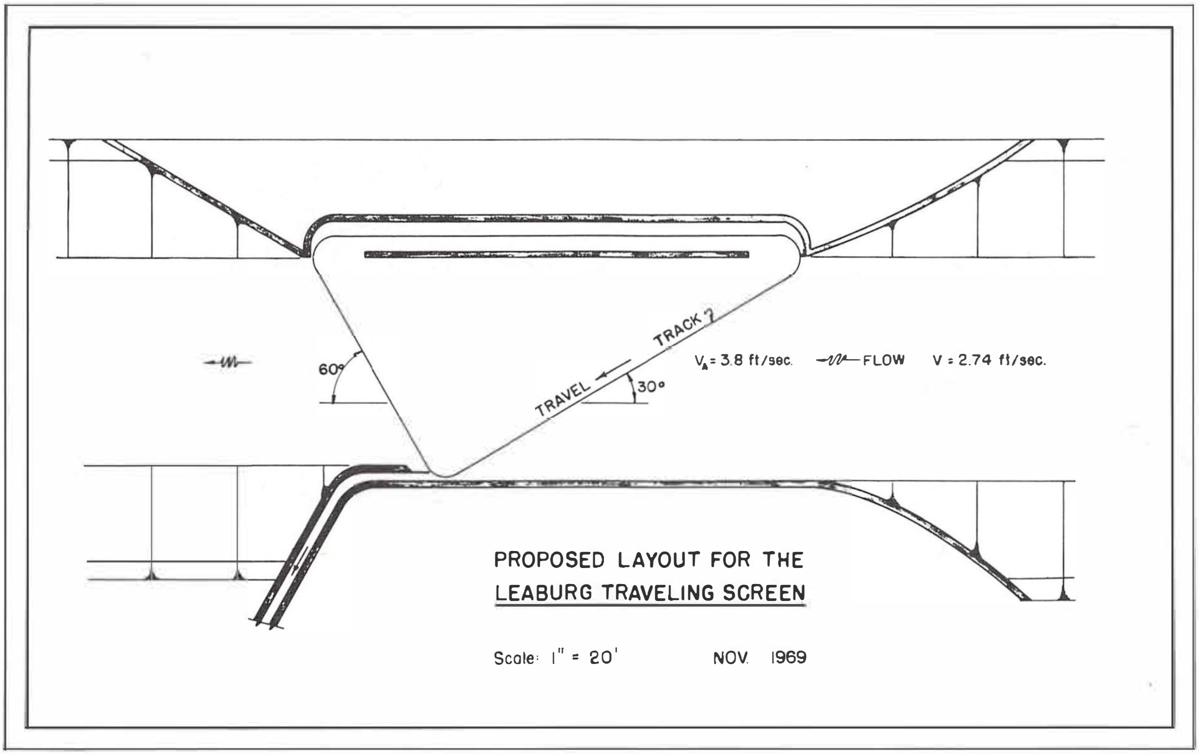


**Figure 5.—Artist's concept of model VII, as it might appear within a canal or river.**

Although the Bureau of Commercial Fisheries has independently developed the design of horizontal traveling screens since 1965, a cooperative effort by the government and private industry is an appropriate means of pursuing final design, construction, and testing of a prototype (model VII) structure. Sufficient adaptability to meet a wide variety of screening requirements is anticipated.

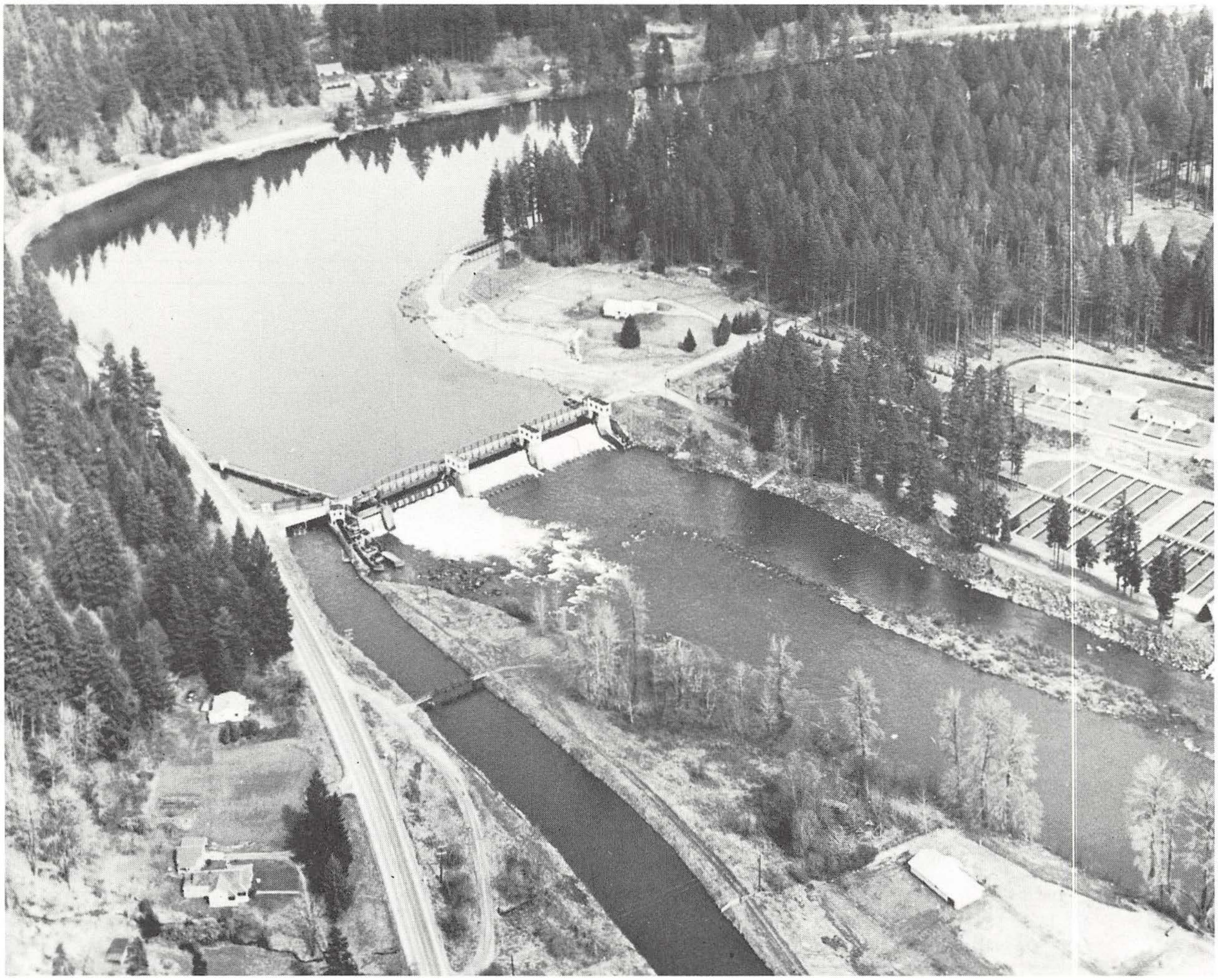

Figure 6.—Upstream view of the McKenzie River, showing the Leaburg diversion dam and canal.

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