ANNUAL REPORT

WHITE RIVER FALLS
FISH PASSAGE PROJECT

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CHAPTER 1
SUMMARY

White River Falls are located in north central Oregon approximately 25 miles south of the City of The Dalles, The project site is characterized by a series of three natural waterfalls with a combined fall of 180 ft, In the watershed above the falls are some 120 miles of mainstem habitat and an undetermined amount of tributary stream habitat that could be opened to anadromous fish, if passage is provided around the falls, The purpose of this project is to determine feasibility of passage, select a passage scheme, and design and construct passage facilities,

This annual report was prepared for the Bonneville Power Administration and prvoides them with information on possible facilities that would pass adult anadromous fish over the White River Falls. The report is organized into twelve chapters; the first six chapters provide background information on project scope, site characteristics, hydrology and hydraulics, and fisheries. Chapters 7, 8 and 9 discuss alternative passage schemes and the costs of four final alternatives. Chapters 10, 11 and 12 provide preliminary information on benefits of the project, environmental review and NEPA compliance, and the potential problem of introducing infectious disease into the watershed with anadromous fish,

SUMMARY OF FINDINGS

At the beginning of this study, twelve alternative passage schemes were considered. Those schemes consisted of various arrangements of conventional fishways, Denil fishways, locks, cableways, tunnels and traps, The field of twelve alternatives was narrowed to four which include two fish ladder schemes and two trap and haul schemes. Any of these four alternatives will adequately provide passage for adult anadromous fish over White River Falls,

The feasibility process has been complicated by proposed development of hydropower at the site by the Northern Wasco County People's Utility District, These development plans include diverting water from the head of the falls through a tunnel to a powerhouse located approximately 1,000 ft downstream of the lower falls.

The first fish ladder alternative involves a ladder entrance at the base of the lower falls with an 1,800-ft ladder continuing upstream and exiting above the falls. If this alternative is selected and hydropower is developed at the site, it would require Northern Wasco County People's Utility District to provide 25 cfs of flow for ladder operation in excess of the minimum instream flow, Also, measures must be taken to prevent fish from entering the powerhouse tailrace,

The second fish ladder alternative involves a tailrace ladder entrance at the proposed powerhouse and a barrier dam placed just upstream of the tailrace to prevent fish from passing the ladder entrance . The 3,000-ft ladder would continue upstream from the powerhouse and barrier dam and exit above the falls, This passage alternative would also require the Northern Wasco County People's Utility District to provide 25 cfs of flow for ladder operation in excess of the minimum instream flow.

The first trap and haul alternative is located at the base of the lower falls, Fish collected at that natural barrier would be transported by truck to the watershed above the upper falls, If this alternative is selected and hydropower is developed at the site, it would. also require Northern Wasco County People's Utility District to prevent fish from entering their powerhouse tailrace, However, no additional flow above the minimum instream flow would be required.

The second trap and haul alternative is' located at the proposed powerhouse. Fish would be collected at the powerhouse tailrace and transported by truck to the watershed above the upper falls. Like the ladder alternative from the proposed powerhouse, a barrier dam would be required to prevent fish from passing the trap facilities.

The cost of each alternative was determined from feasibility level drawings and estimates of operation and maintenance needs. The present value of capital, annual and replacement costs for each alternative is as follows:

Alternative 1 - Fishway from Falls Three	$4,038,000
Alternative 2 - Fishway from Proposed Powerhouse	$5,400,000
Alternative 3 - Trap & Haul at Falls Three	$3,827,000
Alternative 4 - Trap & Haul at Proposed Powerhouse	$3,909,000

CHAPTER 2
INTRODUCTION

PURPOSE OF PROJECT

The White River Falls Fish Passage Project is included in the Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program (1982) Section 704(e)(l), Table 5(u). The project is an enhancement measure that would provide passage for adult anadromous fish over a 180-ft series of natural water falls on the White River in north central Oregon, thus opening new habitat in the upper White River and its tributaries, This phase of the project involves feasibility of passage.

AUTHORITY

In compliance with the Pacific Northwest Electric Power Planning and Conservation Act of 1980, Public Law 96-501, the Northwest Power Planning Council (Council) adopted a number of enhancement measures, including the White River Falls Project. The Council's Fish and Wildlife Program states, in effect, that "upon Council approval Bonneville Power Administration shall fund a feasibility study to open passage at White River Falls", In satisfying this measure, BPA contracted with Ott Water Engineers, Inc. on July 28, 1983 to conduct the necessary engineering feasibility study. This annual report is submitted as partial fulfillment of OTT's contract with BPA,

SCOPE OF STUDY

The White River Falls Fish Passage Project is divided into three phases outlined as:

Phase 1: Passage alternative formulation and evaluation, information for NEPA compliance and fisheries benefits analysis.

Phase 2: Permit applications, final design and environmental assessment (NEPA compliance).

Phase 3: Services during construction.

OTT's current contract with BPA covers Phase 1 and is scheduled for BPA's fiscal years 1983 and 1984. Phase 1 is accomplished through a series of seven tasks which include:

- Field Investigation
- Alternative Formulation
- Alternative Evaluation
- Plan Selection, Predesign and Consultation
- Benefits Analysis
- Evaluation of Clear Creek Irrigation System
- Environmental Assessment (NEPA Compliance)

This annual report focuses principally on the first four tasks. Although the latter three tasks have not been completed at this time, information that has been collected to date is presented.

SUBCONTRACTORS

The OTT project team is complimented by six subcontractors including Milo C. Bell, James W. Buell Ph.D., Kim de Rubertis, Robert L. Rulifson, Kenneth S. Bierly and P. Lynn Sharp. Mr. Bell, a fish facilities engineer, is leading the passage alternatives analysis. Dr. Buell, a fish biologist, is leading the benefits analysis, related fisheries issues and is maintaining active liaison with BPA. Mr. de Rubertis, a geotechnical engineer is providing guidance on geotechnical issues relating to construction. Mr. Rulifson, a fish biologist, is aiding in NEPA compliance related to fisheries. Mr. Bierly, an environmental specialist, is participating in the NEPA compliance. Ms. Sharp, a wildlife biologist, is also participating in the NEPA compliance.

CHAPTER 3
SITE CHARACTERISTICS AND EXISTING CONDITIONS

GENERAL

The White River Falls Project site is located in north central Oregon approximately 25 miles south of the City of The Dalles, Oregon, Figure 1. The White River is tributary to the Deschutes River at river mile (RM) 46.4, approximately 4 miles north of the town of Maupin, Oregon. A series of three natural waterfalls characterize the site, and are numbered upstream to downstream with falls one being the highest. As seen in Figure 2, falls one and two are within 300 ft and have a total fall of approximately 140 ft. Figure 3 is a photograph showing falls one and two. Falls three is approximately 1,100 ft downstream of falls two and has a fall of approximately 15 ft. Figure 4 is a photograph of falls three looking upstream. The total fall between the headwater of falls one and the tailwater of falls three is 180 ft. The distance between falls is approximately 0.26 river miles (1,400 ft).

At the head of falls one is an old concrete diversion weir. The diversion weir was used to divert water for hydropower from above the falls through a penstock to a powerhouse between falls two and three. Though no longer in operation, much of the old equipment is still in the powerhouse. Photographs of the diversion weir and powerhouse are given in Figures 5 and 6, respectively. The diversion weir is approximately 200 ft in length and has a crest elevation of 1018.75 ft (Northern Wasco County PUD 1982). At the left abutment of the weir is a sediment trap, shown also in Figure 2. (Throughout this report the right and left banks are referred to from the downstream perspective.) The old 60-in. penstock began at the sediment trap and followed the left bank to the powerhouse. Only a few steel sections of the penstock remain; the wood stave portions have been burned. The powerhouse structure, which houses four horizontal axis Francis turbines, is still intact.

HISTORY

Hydroelectric development at White River Falls began in 1901. The site was originally developed by the Wasco Warehouse Milling Company. From 1910 to 1963 the project was owned and operated by the Pacific Power and Light Company (PP&L). After 1963, PP&L abandoned the project and donated the property and facilities to the State of Oregon. The land and facilities are now an Oregon state park known as Tygh Valley Wayside. Information reported here was taken from FERC application number 3139 (Northern Wasco County PUD 1983).

EXISTING FACILITIES USE

As mentioned in the previous section, the White River Falls site is not used for hydropower production, and its primary use is recreation associated with the State Park. There are, however, plans for redevelopment of hydropower. The local public utility, Northern Wasco County People's Utility District (NWCPUD), applied for a FERC License in 1983.

The NWCPUD's redevelopment plans include the construction of an ogee-type diversion weir in approximately the same location as the existing weir; intake and sluiceway at the right bank; 2,320 ft of 9 ft diameter low-pressure concrete lined water conduit and 245 ft of 9 ft diameter concrete lined pressure conduit; a powerhouse structure enclosing three turbines, generators and appurtenances with installed capacity of 8.50-MW. The turbines are horizontal Francis-type, two 3.25-MW units and one 2.0-MW unit. The discharge capacity of the power plant is

700 cfs (Northern Wasco County PUD 1982). Figure 7 shows NWCPUD's redevelopment plans for the White River Project.

During FERC License Application preparation, NWCPUD was aware that passage for adult anadromous fish may be provided around White River Falls. Though construction of the hydropower project is not certain at the writing of this report, it does appear to be compatible with alternative passage schemes.

CHAPTER 4
GEOTECHNICAL ASPECTS

This section of the study is not yet completed and will be submitted to BPA as part of the final report.

CHAPTER 5
HYDROLOGY AND HYDRAULICS

HYDROLOGY

The White River flows from the south slopes of Mt. Hood to its confluence with the Deschutes River approximately 32 miles to the east. The stream has been gaged by the USGS, gage 14101500 White River below Tygh Valley, Oregon, from 1917 to present. The mean annual flow over the period 1918 to 1982 is 427 cfs. The drainage area, as noted by the USGS (1972), is 368 square miles.

A mean monthly flow hydrograph and flow duration curve, Figures 8 and 9 respectively, were produced from the 63 years of USGS record between 1917 and 1980. The data was obtained from the USGS via magnetic tape and processed, using a computer program, FLODUR, developed by OTT. It is apparent from Figure 8 that the White River has two periods of peak flow, peak flow in the winter from storm runoff and again in the spring from snowmelt in the upper watershed. These two peak flow periods are also shown in Figure 10; Figure 10 is a typical water year, 1962. In general, flows do not occur in excess of 1,500 cfs or below 100 cfs for more than one week total each year. The flood of record is 13,300 cfs which occurred on January 6, 1923. A flood frequency curve for the White River near Tygh Valley was generated by NWCPUD (1982) and is included in Figure 11. From Figure 11, the flood of record is between a 50 and 100-year event.

Instantaneous data by the USGS shows a minimum flow on August 31, 1961 Of 7.5 cfs; the mean flow for that day was 126 cfs. This wide variation of flow is not characteristic of unregulated streams like the White River and is probably attributable to diversion for irrigation flow upstream. The exact cause of this low flow and a means of avoiding it must be addressed before anadromous fish are introduced into the watershed above White River Falls. A pragmatic solution may be gate openings, at irrigation diversions, that are not simultaneous at critical low flows in the stream.

The minimum instream flows determined for the White River in the reach affected by NWCPUD's power project are given in Table 1.

Table 1. -- Minimum Instream Flows for the White River Between Falls One and NWCPUD's Powerhouse. After NWCPUD (1982)

Month	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Flow (cfs)	60	60	60	60	60-100	145	145	145	100	60	60	60

The range of flow is between 60 and 145 cfs. This flow would serve to provide: habitat for fish and wildlife within and near the river, an attractive flow over the falls, and attraction and "operation" flow for fish facilities. It is possible to have concurrent operation of fish facilities and hydropower generation, though some discussion will be required with NWCPUD about specific fish facility flows and minimum instream flows.

HYDRAULICS

The fluctuation of water surfaces, at fish facility entrances and headworks, control the hydraulic operation of facilities. There are three or perhaps four water surfaces that are of interest, they include the water surface above falls one, below falls three, tailwater of NWCPUD's powerhouse and some point downstream of NWCPUD's powerhouse location. The three latter areas are possible entrance locations for either trap and haul or fishway alternatives. The area upstream of 'falls one is the only reasonable location for a fish ladder exit.

The water surface upstream of falls one is controlled by the existing weir. The proposed weir with NWCPUD's development would also serve as the hydraulic control. Stage-discharge curves for the present and proposed designs were determined by NWCPUD (1982) and are included in Figure 12. The stage-discharge curve for the powerplant tailwater was also determined by NWCPUD and is included in Figure 13. The hydraulic control for this water surface is the tailrace at lower flows and backwater from the stream at higher flows. A stage-discharge curve for the water surface downstream of falls three will be determined from channel geometry and physical measurement.

Figures 12 and 13 show fluctuations in water surfaces of no more than 2 ft between flows of 100 and 1,500 cfs; these flows correspond to exceedences of 98 percent and 2 percent respectively. A design range of 2 ft of water surface fluctuation is not difficult to meet, and provides a conservative estimate satisfactory for this level of analysis.

CHAPTER 6
FISHERIES

The entire White River basin with the exception of the lower two miles of the mainstem is presently closed to access by anadromous fish. Since the White River is tributary to the Deschutes River at RM 46.4, much of the information on fish stocks and fisheries of the Deschutes is germane to the consideration of anadromous fish passage at White River Falls. This is especially true if a fish ladder is selected over a trap and haul system, since species other than the target species could gain access to the White River drainage. In any event, anadromous fish stocks presently existent in the Deschutes system are certainly candidates for introduction into the White River drainage, hence a consideration of the characteristics of these stocks is in order.

The Deschutes River below Pelton Dam, RM 100, and its tributaries support a variety of fish populations. Fish residing in these waters include a number of different species of salmonids, some introduced warm-water game fish, and many species of native non-game fish. A list of the common and scientific names of fish known to reside in the Lower Deschutes or its tributaries is given in Table 2.

Salmonids are the most highly valued fish in the Lower Deschutes Basin. Resident rainbow trout in the Lower Deschutes and a number of lower river tributaries, including White River, provide recreational opportunities for many sport fishermen each year. The mainstem is particularly productive and, at times, has supported as many as 3,000 resident rainbow trout per mile (Fesslero 1972). There are three major stocks of anadromous salmonids in the river. Summer steelhead, spring chinook and fall chinook salmon provide angling opportunities for sportsmen

Table 2. -- Fish Known to Inhabit the Lower Deschutes Basin

Rainbow Trout	Salmo gairdneri
Cutthroat Trout	Salmo Clarki
Brown Trout	Salmo trutta
Dolly Varden Char	Salvelinus malma
Eastern Brook Trout	Salvelinus fontinalis
Chinook Salmon	Oncorhynchus tschawytscha
Coho Salmon	Oncorhynchus kisatch
Sockeye Salmon	Oncorhynchus nerka
Mountain Whitefish	Prosopium williamsoni
Pacific Lamprey	Entosphenus tridentatus
Largemouth Bass	Micropterus salmoides
Black Crappie	Pomokis nigromaculatus
Bluegill	Lepomis Macrochirus
Pumpkinseed Sunfish	Lepomis gibbosus
Largescale Sucker	Catostomus macrocheilus
Bridgelip Sucker	Catostomus columbianus
Northern Squawfish	Ptychocheilus oregonensis
Chiselmouth	Acrocheilus alutaceus
Peamouth	Mylocheilus caurinus
Redside Shiner	Richardsonius balteatus
Dace	Rhinichthys spp.
Sculpin	Cottus spp.

in addition to supporting or contributing to Indian subsistence and commercial fisheries. Coho and sockeye salmon, eastern brook, cutthroat and brown trout, Dolly Varden char, and mountain whitefish are of less overall significance in the Lower Deschutes and its tributaries than rainbow trout and chinook salmon. This is because of either low population levels or a general lack of angler interest in pursuing these stocks. Spawning and rearing areas for salmon and steelhead in the upper Deschutes drainage became inaccessible to anadromous fish when the Pelton/Round Butte hydroproject was constructed in the early 1960%. Table 3 lists the Deschutes tributaries known to support at least small numbers of salmon or steelhead. Only tributaries having suitable spawning and rearing habitat which is accessible to these fish are utilized.

FALL CHINOOK

Adult fall chinook begin arriving at Sherar's Falls, RM 44, in mid-June and continue to pass the falls on their way to up-river spawning grounds into November. Scale analysis indicates that most of these fish migrate to the ocean as sub-yearlings and return to the Deschutes after two to four years at sea. Peak passage at the falls typically occurs in late September or early October (Aho, et al. 1979). Not all of the fall chinook run is bound for spawning areas above the falls, however, and an estimated 20% of these fish spawn in areas along the mainstem Deschutes below Sherar's Falls (Aho, et al. 1979). Nearly all spawning by fall chinook in the Deschutes Basin takes place in the mainstem Deschutes River from late September through November.

Emergence of fry from fall chinook redds occurs from late March through May, varying with the water temperature regimes in different reaches of the Deschutes (Aho 1979). Because of cooler water temperatures, the fall chinook fry at the upper end of

Table 3. -- Tributaries to the Lower Deschutes River (below Pelton Dam) Known to Support Salmon or Steelhead

Stream	River Mile	Salmon	Steelhead
Buck Hollow Creek	43	No	Yes
White River (below falls)	46	Possibly fall chinook	Yes
Bakeoven Creek	52	No	Yes
Wapinitia Creek	55	No	Yes
Neua Creek	58	No	Yes
Eagle Creek	64	No	Yes
Warm Springs River	84	Spring and occasionally fall chinook: coho salmon	Yes
Trout Creek	87	No	Yes
Shitike Creek	97	Spring chinook	Yes

their distribution in the river tend to emerge later in the spring. Juvenile fall chinook rear for two to three months in the mainstem Deschutes before smolting and migrating toward the ocean in June and early July. Juveniles that have reared in the lower river seem to move downstream earlier than those rearing up river (Aho, et al. 1979).

The annual run size, harvest, escapement, and exploitation rates for fall chinook in the Deschutes River for 1977 through 1982 are given in Table 4. The fall chinook run into the Deschutes River averaged 10,029 fish between 1977 and 1982 (Lindsay, et al. 1982). The annual combined sport and Indian harvest averaged 3,479 fall chinook over the same time period, ranging from a high of 3,647 in 1979, to a low of 3,139 fish in 1981 (Lindsay, et al. 1982). This harvest amounts to an average annual in-river exploitation rate of 35% for fall chinook stocks in the Deschutes.

Most of the sport and Indian angling effort for fall chinook is concentrated at Sherar's Falls, as it is for spring chinook. The sport fishing effort for fall chinook salmon at the falls has exceeded 4,000 angler days every year since 1973, with the exception of 1978 (Lindsay, et al. 1982). An average of 701 angler days have been spent each year by Indian fishermen dip-netting for fall chinook salmon at the falls (Lindsay, et al. 1982).

SPRING CHINOOK

Figures compiled by the ODFW on the annual run size harvest and exploitation rate of wild spring chinook salmon in the Deschutes River are given in Table 5. From 1977 through 1982, the annual run of spring chinook in the Deschutes River has averaged 2,614 fish. Sport fishermen and Indian dip netters at Sherar's Falls have harvested these fish at a combined rate of approximately 26% over these years of record. The average annual exploitation

Table 4. -- Exploitation Rates of Returning Fall Chinook in the Deschutes River, 1977-1982[1]

Year	Run Size	Harvest	Escapement	In-River Exploitation Rate (%)
1977	11,530	3,617	7,913	31
1978	10,538	3,529	7,009	33
1979	11,461	3,647	7,814	32
1980	7,856	3,334	4,522	42
1981	10,265	3,139	7,126	31
1982	8,525	3,607	4,918	42
Avg.	10,029	3,479.	6,550	35%

1 Derived from figures in Lindsay, et al. 1982.

Table 5. -- Exploitation Rates of Returning Wild Spring Chinook in the Deschutes River, 1977-1982[1]

Year	Run Size	Harvest	In-River Exploitation Rate (%)
1977	3,946	1,685	43
1978	3,368	725	22
1979	2,056	585	28
1980	1,551	490	32
1981	1,579	0[2]	--
1982	2,183	729	33
Avg.	2,447	702	26%

1 From Lindsay, et al. 1982.

2 No sport or Indian fishery at Sherar's Falls.

rate would have been higher, but no spring chinook harvest was allowed in 1981 because an extremely small run was expected to return that year.

Adult spring chinook first arrive at Sherar's Falls about mid-April each year. Scale analysis has shown that about two-thirds of these fish are four years old, nearly one-third are five years old, and the rest are three years old (Lindsay, et al. 1980). The number of spring chinook passing over the falls reaches a peak in late April or early May, and gradually declines until migration past the falls is completed in mid-June (Aho, et al. 1979). Essentially all spring chinook in the Deschutes system spawn in the Warm Springs River. They generally move past the Warm Springs National Fish Hatchery in May and June, then over summer in the upper watershed before spawning there in the late summer or fall (Aho, et al. 1979).

After emerging from the gravel the following winter and spring, juvenile spring chinook spend a varying length of time in their natal streams before migrating downstream to the Deschutes River. Most of these juveniles migrate out of the Warm Springs Basin as sub-yearlings in October and November. The rest outmigrate as yearling fish from March through May of the following spring (Fessler and Aho 1977). The outmigration of sub-yearlings from the Warm Springs River is apparently related to rearing densities in natal streams. Sub-yearling migrants appear to delay their downstream movement once in the Deschutes River until the following spring, at which time they continue to migrate toward the ocean with those residual yearling spring chinook which have just moved out of the Warm Springs drainage (Lindsay, et al. 1980). ODFW has estimated that egg-to-smolt survival for spring chinook from the Warm Springs drainage is about 2% (Lindsay, et al. 1981). Smolt-to-adult survival estimates made by ODFW for these fish have ranged from 2.0 to 2.6 percent (Lindsay, et al. 1981).

The wild spring chinook run in the Deschutes is supplemented by returns of hatchery fish. ODFW makes yearly releases of spring chinook smolts reared at Round Butte Hatchery into the Deschutes to compensate for habitat lost when the Pelton Round Butte hydro-project was completed. The U.S. Fish and Wildlife Service, in a joint effort with the Warm Springs Indians, releases juvenile spring chinook into the Warm Springs River from the Warm Springs National Fish Hatchery.

If fish passage is provided at White River Falls, the timing of spring chinook use of the White River drainage will likely be simlar to that for the Warm Springs Basin. Observed seasonal patterns of spring chinook use of the Warm Springs drainage are depicted for different life stages in Figure 14.

SUMMER STEELHEAD

The Lower Deschutes River, its tributaries and the Round Butte Hatchery support a substantial run of summer steelhead. The annual escapements of both wild and hatchery summer steelhead over Sherar's Falls are given for 1977 through 1982 in Table 6. From 1977 through 1982, the run of wild adult steelhead passing Sherar's Falls averaged 5,200 fish. Over the same period of time, an average of 5,380 adult hatchery-reared steelhead passed over Sherar's Falls yearly.

Many of the hatchery steelhead passing Sherar's Falls do not find their way to the fish collection facility at Pelton Dam because of varied smolt release sites and adult straying. These fish, along with wild steelhead passing Sherar's Falls, are available to spawn naturally in accessible portions of the Deschutes drainage above Sherar's Falls. The estimated numbers of summer steelhead available to spawn naturally above the falls for each year from 1977 through 1981, are given in Table 7.

Table 6. -- Escapement of Wild and Hatchery Steelhead Over Sherar's Falls, 1977-1982[1]
Confidence Limits (95%) are in Parentheses

Year	Wild (no fin mark)	Hatchery (fin clipped)
1977	6,600 (5,100-.8,000)	7,000 (6,300-7,700)
1978[2]	2,800 (2,300-3,200)	3,500 (3,300-3,700)
1979[3]	4,200 (3,200.5,300)	6,000 (5,700-6,400)
1980[3]	4,100 (3,200.5,000)	6,000 (5,600-6,400)
1981[3]	6,900 (5,600-8,300)	5,000 (4,500-5,400)
1982[3]	6,600	4,800

1 From Lindsay, et al. 1982.
2 Sport fishery closed August 20.
3 Sport harvest of unmarked steelhead prohibited.

Table 7. -- Number of Steelhead Available to Spawn Naturally above Sherar's Falls, 1977-1981[1]

Run Year	Spawners[2] Wild	Hatchery[3]	Total	Return Year
1977	6,600	4,800	11,400	1981-1982
1978	2,800	1,600	4,400	1982-1983
1979	4,200	3,400	7,600	1983-1984
1980	4,100	3,800	7,900	1984-1985
1981	6,800	3,000	9,800	1985-1986

1 From Lindsay, et al. 1981.

2 Overestimates spawners because some fish are caught above Sherar's Falls.

3 Escapement over Sherar's Falls minus Pelton trap count. Underestimates spawners available by 400-900 because it does not account for fish trucked downstream from trap.

Summer steelhead in the Deschutes River support a very large and famous sport fishery. During the last three years for which catch statistics have been calculated, 1980 through 1982, fishermen have caught over 11,000 steelhead in the Deschutes (Johnason, pers. comm.). Angler effort and catch of summer steelhead are concentrated in the Deschutes below Sherar's Falls and are particularly heavy below Mack's Canyon (tindsay, et al. 1981). A major reason for this is high fish densities which result from extensive straying of Upper Columbia and Snake River steelhead stocks into the Lower Deschutes River. For example, ODFW has estimated that nearly 80% of the 59,000 summer steelhead thought to have entered the Deschutes River in 1981 were stray fish (Lindsay, et al. 1981).

Because of angling regulations which require that all wild summer steelhead caught in the river be released by sport fishermen, only wild fish caught incidentally by Indian dip netters at Sherar's Falls are harvested. The annual exploitation rate of adult summer steelhead from Round Butte Hatchery has ranged from 23 to 33 percent during years for which accurate harvest estimates are possible (Lindsay, et al. 1981). This rate is similar to that which might be expected for wild steelhead if the progressive regulations now enforced on the Deschutes were changed to allow the harvest of wild fish.

Adult steelhead generally pass Sherar's Falls from July through October, with peak movement over the falls occurring sometime in late September or early October (Williams, pers. comm.). Fish which spawn in the Deschutes mainstem or in large tributaries draining lands west of the river, do so from March through May (Fessler 1974). Based on data for the run timing of steelhead past Warm Springs National Fish Hatchery on the Warm Springs River (Cates 1980), it appears that fish which spawn in large westside Deschutes tributaries move to their spawning grounds in pulses during March, April and early May. These pulses may be associated with storm events. Steelhead which spawn in smaller Deschutes tributaries like those draining lands east of the river, move out of the mainstem during periods of high winter streamflow and spawn from mid-January 'through April (Fessler 1974).

Steelhead fry emerge from redds in the spring or early summer (Aney, et al. 1967). The time of emergence is dependent upon when spawning occurred and the temperature regime of the natal stream over the incubation period. After a one to three-year period of stream residency, juvenile steelhead in both eastside (Fessler 1974) and westside (Aho, et al. 1979) tributaries as well as those in the mainstem Deschutes, smolt and begin their seaward migration in March, April and May. Time of greatest smolt movement varies between different Deschutes River tributaries. Outmigration of wild steelhead smolts in the Warm springs River typically peaks in early May, as opposed to earlier March and April peaks in downstream movement of smolts from smaller eastside tributaries like Bakeoven and Buck Hollow creeks (Fessler 1974).

Analyses performed on the scales of wild adult steelhead captured at Sherar's Falls from 1971 through 1980, 8,808 fish, indicate that the run is composed of approximately equal numbers of one-salt and two-salt fish (Lindsay, et al. 1980). A careful examination of scales from 100 of these wild fish showed that Deschutes summer steelhead experience a number of different life histories (Fessler, et al. 1976). Fessler found that the most common steelhead life history was 2/l (two years in fresh water and one year in salt water) (35%), followed by l/2 (22%), 2/2 (20%) , 3/l and l/l (10%).

It is anticipated that if fish passage is provided at White River Falls, the timing of summer steelhead use of the White River

Basin will be similar to that for steelhead in the Warm Springs drainage. The timing of use of the Warm Springs drainage by different steelhead life phases is given in Figure 15.

WHITE RIVER

Fishing pressure on the White River and its tributaries is generally light. Most angling in basin streams is concentrated on rainbow trout that ODFW plants each spring in the White River near a campground at upper Smocks Crossing and at Tygh Valley (Williams, pers. comm.). Angler use of these areas is usually heaviest when the trout season opens in late April, and drops off considerably after ODFW stops planting catchable trout in the White River sometime in late June. Angler use of the White River near upper Smocks Crossing or Tygh Valley amounts to about 35 or 40 anglers per day (Williams, pers. comm.). ODFW has estimated that about 1,500 angler days are expended annually fishing for resident rainbow trout between Tygh Valley and White River Falls (Lichens 1981).

Streams in the White River drainage above White River Falls are known to support rainbow, eastern brook, brown and cutthroat trout, mountain whitefish, and a few species of rough fish having no commercial or recreational value. Rainbow trout are distributed throughout the basin, while brook trout are apparently confined to the upper reaches of the White River and some of its tributaries (Schroeder, pers. comm.). Brown and cutthroat trout are uncommon in the watershed. The distribution of mountain whitefish in the basin appears to be limited to lower White River. The only non-salmonid fish known to inhabit streams in the drainage above the falls are prickly sculpin and long-nosed dace. Although present below White River Falls, northern squawfish and suckers have not been found in' streams above the falls during electroshocking surveys recently conducted by ODFW. More information on the distribution and abundance of fish populations native to the White River Basin, and their habitats will be available as the ODFW and the U.S. Forest Service continue inventory work in the basin.

There is considerable evidence suggesting that the White River watershed above White River Falls is capable of supporting substantial self-sustaining runs of anadromous fish. For example, in a recent report to the U.S. Bureau of Reclamation, the U.S. Fish and Wildlife Service at the National Marine Fisheries Service estimated that from 500 to 1,600 steelhead and 400 fall chinook adults could migrate to and spawn in the Upper White River drainage, if passage were provided (USFWS and NMFS 1981). Earlier benefit estimates made by the Bureau in 1974 were considerably higher and based in part on a proposed flow augmentation scheme. Differences between the new and old estimates point to a clear need to obtain more accurate estimates of the potential for anadromous fish production in the White River drainage.

MONITORING FACILITIES

It is important that some features be incorporated into any fish passage facility which will enable an evaluation of its success. In the case of White River Falls, monitoring of the progress of invasion of a newly accessible watershed is important for several reasons. First, as pointed out by Heller (1984), a substantial portion of the upper White River watershed would remain inaccessible to anadromous fish even if passage were provided at White River Falls, but could be opened with a modest level of effort in removing minor passage obstacles. Monitoring the progress of successful invasion would provide very valuable information on when, where and how fast to open additional stream miles, some containing excellent anadromous fish habitat.

Second, although Withler (1983) and others have demonstrated more or less conclusively that removing natural barriers to anadromous fish is the approach with the most promise of increasing production in Pacific Northwest river systems, and although this approach has been successfully implemented in the past, no careful systematic monitoring program at the point of barrier removal and within a target watershed has ever been carried out. Monitoring success at White River Falls presents an extremely valuable opportunity to implement such a program with a very modest commitment of resources. Third, information gained through monitoring will enable fisheries agencies throughout the Pacific Northwest to make compelling arguments based on solid scientific information for the opening. of appropriate watersheds elsewhere in the region, thereby efficiently enhancing natural production of anadromous fish. These benefits may be difficult to realize without the incorporation of appropriate design features, however. The Oregon Department of Fish and Wildlife has expressed a similar philosophy and a strong desire to incorporate appropriate features into design alternatives which would permit monitoring of the success of the facility.

With these objectives in mind, OTT contacted ODFW and jointly developed a conceptual layout for evaluation and monitoring features. This layout can be adapted to the range of alternatives for fish passage with only minor modification. The evaluation features conceived would allow for counting, sorting, and conveying fish, with rejection of undesirable species or individuals (all necessary components of a trap and haul facility, in any case) as well as for anesthetizing, tagging, innoculation against certain disease (e.g., BKD) and other handling procedures. Regardless of which facility alternative is selected, the inclusion of elements which will allow for fish handling will add to the overall value of the project.

If a ladder alternative is selected, a counting station with fish handling capability would allow monitoring of run size and timing, stock vigor, disease and injury rates, etc. Adult fish could be selectively removed from the facility, tagged and released or transported to selective points in the watershed for release. Eggs could be taken and incubated for later fingerling release as part of a strategy to accelerate the invasion of the drainage. If a trap and haul alternative is selected, fish handling capability would greatly expand the flexibility and usefulness of the facility to include egg taking, tagging, innoculation, etc. In either case, the facility would be enhanced.

CHAPTER 7
ALTERNATIVES CONSIDERED

GENERAL

Twelve alternative passage schemes have been considered since the beginning of this study. These schemes include:

- Denil Fishway
- Lock System
- Waterfall Modification
- Tunnel
- Fishway with Bridge
- Trap and Cable Car (with and without power project)
- Fishway (with and without power project)
- Trap and Haul (with and without power project)
- Trap and Haul Downstream of Powerhouse Site

Each alternative was evaluated considering its applicability, economic feasibility, constructability and operation. As a result of the initial evaluation, the first seven of the twelve alternatives were eliminated and the latter five were considered for further study. A report was submitted to BPA in the fall of 1983 that explained the various alternatives in some detail; that report is summarized in the following sections.

DENIL FISHWAY

The Denil or Denil-type ladders (including Alaska Steep Pass) are an open channel with baffled walls and floor. The baffles are arranged in such a way to create return flow at the walls and floor which slows the core flow. The ladder can then be set on a relatively steep slope, six horizontal to one vertical (6H:lV), and maintain a core velocity of no more than 4 fps. In general, fishway slopes are set at 10H:lV. There are no resting areas in Denil sections, and designs must provide resting areas after approximately 30 ft of run. The salient features of the Denil are its relatively steep slope and availability of prefabricated sections.

The Denil Fishway alternative involves providing passage around falls three with a Denil Fishway. Falls three is approximately 15 ft high and would require three 30-ft sections of Denil run and two resting pools. Passage around falls one and two would then be provided by a conventional ladder.

There are two key difficulties that caused this alternative to be eliminated. When fish enter a ladder there is an associated delay and fallback. If fish are required to enter two ladders, these problems would be compounded. Finally, construction of a fishway beginning at the base of falls two would be difficult at best. The area is virtually inaccessible with nearly vertical canyon walls. The costs of construction alone eliminate this alternative.

LOCK SYSTEM

Lock systems operate by trapping fish at the base of a barrier in a chamber, closing the chamber and filling it to a level sufficient to pass the barrier. One lock design, the Borland lock, is essentially a large diameter pipe with a trap and valving system at the lower end and an exit gate at the upper end. A typical one hour cycle begins with the lock empty. Approximately 10 cfs pass through the conduit and trap at the bottom. The water flowing through the trap provides attraction for fish. At the end of 25 minutes the trap is closed and the lock is allowed to fill. Once the lock is filled, water is passed through it for approximately 25 minutes to prompt fish to leave the system. Finally, the lower gate is opened, the lock empties and the cycle is repeated. The entire cycle time is one hour.

The alternative would involve a Denil or conventional type passage facility around falls three, since it would be placed at the base of falls two and transport fish to an elevation just below the existing diversion weir crest. An open channel would pass fish from the lock to a point just beyond the diversion weir. This system would require two locks to be side by side; while one lock was filling the other would attract fish, keeping them continually motivated and not interrupt their migration.

The advantage of this alternative is that fish need not expend the energy in ascent, as in a conventional fishway. The difficulty in construction at falls two and possible fallback at both falls two and three facilities make this alternative unattractive. Problems also exist with clearing fish from the locks; Clay (1961) considers this the most apparent weakness of Columbia River fish locks. These disadvantages, along with high operation and maintenance costs, have led to the. elimination of this alternative.

WATERFALL MODIFICATION

For some low obstructions such as waterfalls, it is more economical to remove or modify the obstruction than construct conventional passage facilities. In the case of a waterfall, explosives may be used to reduce the gradient or steps may be blasted into the fall.

The waterfall modification alternative involves blasting 15 pools into the left bank of falls three. Each pool would be 10 ft wide by 5 ft long and approximately 2 ft in depth. This would provide passage around falls three; passage around falls one and two could be provided with a conventional fishway or a lock system as described in the previous alternative.

Like the two earlier alternatives, waterfall modification has the advantage of a shorter ladder and reduced construction costs for passage around falls three. The principal disadvantage, however is the removal of a waterfall within the State Park. Additionally, the construction problems at falls two would still exist and the pools would likely fill with sediment. In light of the aesthetic damage to the waterfall, construction costs and operation difficulties, this alternative has been eliminated.

TUNNEL

Contrary to intuition, fish will swim through darkened passages if the flow is attractive, on the order of 2 fps (U.S. Fish and Wildlife Service 1959). Tunnel fishways have been successfully operated in the Northwest including Castille Falls on the Klickitat River, Ice Harbor on the Snake River, Selway Falls on the Selway River and Granite Falls on the Stillaguamish.

The tunnel alternative would be used to extend the forebay of NWCPUD's power project. A conventional fish ladder would be constructed from the proposed location of NWCPUD's powerhouse and proceed up Devil's Half Acre Creek Canyon to the tunnel portal. The tunnel portal would be located at elevation 1,025 ft. A 7-ft diameter tunnel would be driven approximately 1,200 ft to the power project intake structure. A second run of conventional fishway would be constructed above ground from the tunnel entrance to a point upstream of the intake and diversion weir.

The advantage of this scheme is that the fishway would not have to cross the White River to proceed upstream to the head of falls one. Further, a fishway out of the park area may have less pressure from vandals and poachers. The apparent disadvantage is added expense; the conventional fishway sections in this alternative would be approximately 3,000 feet long, slightly less than a left bank fishway, but require a 1,200-ft tunnel at roughly $1,200 per foot. This alternative is obviously not cost effective.

FISHWAY WITH BRIDGE

In conjunction with NWCPUD's powerhouse on the right bank as shown in Figure 7, a conventional fish ladder would be constructed from the powerhouse tailrace up the right bank to approximately elevation 875, just below falls three. From this point, a 17-ft span bridge would convey the fishway to the left bank. The ladder would then continue up the left bank to exit just beyond the diversion weir above falls one.

This alternative was dismissed as the added expense of a bridge could be avoided by crossing from the right bank to the left bank of the White River at a barrier dam just upstream of NWCPUD's powerhouse. The barrier dam is necessary'to prevent fish from moving upstream and passing the ladder entrances in the tailrace. Further, the canyon on the right bank downstream of the proposed bridge is steep and construction in this area would be difficult.

TRAP AND CABLE CAR

The trap and cable car alternative would operate with a trap located at NWCPUD's powerhouse or falls three. Fish attracted to and collected at the trap would be transported around the barriers, along the west bank, in a cable car (much like a ski lift operation). Fish would be off-loaded upstream of the diversion weirs in a holding pool. Fish would remain in the holding pool until they regained their propensity to further migrate. Similar systems were successfully used at lower Baker and Ice Harbor Dams.

Advantages of a trap and cable car include a minimum of water loss for the purpose of hydropower generation; fully automated, the system could function as required by fish and not operator schedules. The disadvantages of high capital and maintenance costs, and perhaps aesthetics, have led us to dismiss this alternative.

FISHWAY

Conventional fishways operate as a series of pools with water flowing from Pool to Pool over weirs or through vertical slots. The objective of the fishway is to create an artificial stream gradient, around barriers, which fish are capable of negotiating. The series of pools provide adequate volume for energy dissipation and areas for fish to rest while swimming.

One of the most effective fishway designs is the vertical slotted type. The slotted fishway is fashioned with vertical openings or slots, usually 12 inches wide, that will pass debris, bed load and fish, as well as regulate flow over a wide range of tail and headwater fluctuations. The slope of the slotted fishway is set such that the maximum head loss between pools is 1 ft. Performance characteristics of the vertical slotted ladder make it the appropriate choice for the White River Falls site.

There are two reasonable fishway alternatives for the site. The first is without a consideration for Power production that has the fishway entrance at the base of falls three. The fishway continues from falls three up the left bank and exits at the left abutment of the existing diversion weir. The fishway route is shown in Figure 16.

The second fishway alternative favors hydropower development by NWCPUD. The fishway would originate at NWCPUD's tailrace, cross the White River at a barrier dam just upstream from the tailrace and continue up the left stream bank to the diversion weir. This route is also shown on Figure 16.

Both fishway alternatives have the advantage of simple operation, relatively low operation and maintenance costs and the ability of adequately passing adult anadromous fish. The principle disadvantage, common to both, is high capital cost. These alternatives have been selected for further study and a detailed discussion of each is provided in Chapter 8 along with scale drawings of main features. Preliminary estimates of construction costs are provided in Chapter 9.

TRAP AND HAUL

Trap and haul is perhaps the most successful technique for transporting fish around extremely high barriers or to areas otherwise inaccessible by fish. The system operates by attracting fish (at a natural or manmade barrier) to a holding pool, collecting or crowding the fish into an elevator or hopper, raising the fish to a level that they can be loaded into a tank truck and hauling the fish in the truck to a desired off-load area in the watershed. Fish trucks are generally fitted with cooling and aeration systems to insure fish safety during hauling.

There are three trap and haul alternatives considered at White River Falls. The first alternative is a trap located at falls three. The falls would serve as a natural barrier. The haul road out of the canyon, as seen on Figure 16, traverses up the north slope and meets State Highway 216 approximately 1,000 ft east of the state park entrance.

The second trap and haul alternative is compatible with NWCFUD's hydropower development. A barrier dam would be placed just upstream of the powerhouse tailrace forcing fish to move into the tailrace. Trap entrances would then be placed in the tailrace; the trap facility would be adjacent to the powerhouse. Fish trucks would use the powerhouse access road.

The third trap and haul alternative is unique in that it would be compatible with or without hydropower development and could be constructed immediately. This alternative requires a barrier dam and trap be constructed at or below (downstream) the proposed powerhouse. If the dam were placed downstream of the power plant, it should be placed far enough downstream to insure the backwater does not cause NWCPUD to lose head for power generation. Unfortunately, there does not appear to be any exceptional sites downstream of the proposed powerhouse to construct a barrier dam and trap and have relatively easy access for construction and fish hauling. The site of the proposed powerhouse, however, is a natural candidate. The barrier dam, trap and appurtenances could also be constructed in such a way to be adaptable to latter construction of a powerhouse and truck access is possible through Devil's Half Acre Creek Canyon.

Trap and haul alternatives have the advantage of relatively low capital costs and a well understood operation that will effectively pass fish around White River Falls. The principal disadvantage of trap and haul, however, is operation and maintenance costs required for operators, trucks and trap equipment. The first two trap and haul alternatives discussed above clearly depend upon a decision by NWCPUD to develop or not develop the hydropower potential of White River Falls. Though much like the second al ternat ive, the third alternative is not burdened by this dilemma. Since the latter trap and haul alternative is, in effect, the same as the second trap and haul alternative, only the first two alternatives will be discussed in greater detail.

The two final trap and haul alternatives have been selected for further study and a detailed discussion is presented in Chapter 8 along with scale drawings of main features. Preliminary estimates of construction costs are provided in Chapter 9.

Of the twelve initial alternatives, four were selected for further study which is presented in Chapters 8 and 9. Those alternatives are referred to in the remainder of this report as Alternative 1 - Fishway from Falls Three, Alternative 2 - Fishway from Proposed Powerhouse, Alternative 3 - Trap and Haul at Falls Three and Alternative 4 - Trap and Haul at Proposed Powerhouse.

CHAPTER 8

PROJECT ALTERNATIVE DESCRIPTIONS AND CONSIDERATIONS

ALTERNATIVE 1 -- FISHWAY FROM FALLS THREE'

Alternative 1 is a fishway from falls three as shown in Figures 17, 18, 19 and 20. The 1,800-ft long fishway would be constructed along the left bank of the White River. Fish would enter the fishway at falls three and exit from the headworks adjacent to the existing diversion weir. The vertical drop between entrance and exit of the fishway is approximately 180 ft.

The fishway would be the vertical slot type with 10-ft long by 6-ft wide pools. Maximum water surface drop between pools would be one foot. The total depth of flow would vary between 4 ft, at 25 cfs and 6 ft at 42 cfs. The jet velocity at the fishway entrance and pool slots would be between 4 and 8 fps. Average velocity in the fishway pool would be approximately 1 fps. The vertical slots would self-regulate flow under the fluctuating head of 2 ft.

The fish ladder entrance would be placed adjacent to the lower falls which creates a natural barrier to fish. To help fish find the ladder entrance, approximately 25 cfs of attraction flow would be added to the fishway flow through a diffusion chamber at the entrance. Vertical vanes would guide the flow and prevent fish from entering the diffusion chamber. The attraction flow would be gravity fed from an auxiliary water intake above the falls through a 24-in. steel pipe. Flow rate would be controlled by a 24-in. valve.

Terrain at three locations would require special switchback fishway structures to maintain the uniform hydraulic gradient. The first of these, as shown in Figure 17, is at falls three near the fishway entrance. It would contain twenty four pools in three rows and would be covered by a wooden deck. The wooden deck keeps debris and bed load out of the structure which is flooded yearly during high flows. The remaining two switchback structures are located above the old powerhouse.

The fishway exit would be located upstream of falls one, just above the existing settling basin and diversion weir. Any planned evaluation facilities would also be located there.

The fishway would be constructed entirely of reinforced concrete including cast-in-place slabs and precast slotted baffled walls. The side walls would be cast-in-place concrete.

ALTERNATIVE 2 -- FISHWAY FROM PROPOSED POWERHOUSE

Alternative 2 is a fishway from the proposed powerhouse as shown in Figures 21, 22, 23 and 24. The 3,000-ft long fishway would be constructed along the left bank of the White River. The fishway entrance would be in the tailrace of the proposed powerhouse below a concrete barrier dam crossing the river. The exit would be above falls one at the left abutment of the proposed hydropower diversion weir. The vertical drop between entrance and exit of the fishway is approximately 187 ft.

A concrete barrier dam would be constructed in the river upstream of the proposed powerhouse tailrace. The barrier would be designed to prevent fish from passing upstream while directing them to enter the fishway. The central 80-ft long spillway would be an ogee-type with a swimming barrier on the downstream face. The adjacent right and left bank sections of the dam are 119 and 30-ft long, respectively, and are buttressed reinforced concrete retaining walls. The downstream face of the retaining walls are protected with grouted riprap. The walls vary uniformly in height with sloping footings and top. The 80-ft long central spillway is designed to pass the lo-year flood while the right and left bank sections will contain the 100-year flood.

The intake structure located in the barrier wall would provide up to 65 cfs of auxiliary water to the fishway intake by gravity flow through a 36-in. steel pipe. The flow rate, controlled by a valve, would enter the fishway through a diffusion chamber at the fishway entrance pool. The auxiliary water will help to create adequate momentum to attract fish to the two fi.shway entrances. As seen in Figure 23, the entrance at the powerhouse face will pass fish when the adjacent unit is not operating. The second entrance, placed below the boil from turbine units, will pass fish when all units are operating.

Due to the site restrictions and steep terrain on the right bank of the White River, the fish ladder would cross to the left bank of the river inside a concrete conduit within the barrier dam. The conduit would be 4 ft wide by 7 ft high and be hydraulically designed to flow partially full at less than 2 fps. After crossing the river, the fishway would follow the left bank until it intersected the same route as the fishway from falls three (Alternative 1).

The fishway would be a vertical slot type with the same characteristics as the Alternative 1 fishway. The fishway exit would be located at the left abutment of the proposed hydropower diversion weir above falls one. Fish evaluation facilities could be located near the fishway exit on the left bank upstream of falls one. Access to the fishway, from the exit to the barrier dam, could be provided by a pathway adjacent to the fishway. The fishway entrance adjacent to the powerhouse on the south side of the river could be reached using the powerhouse access road.

ALTERNATIVE 3 -- TRAP AND HAUL AT FALLS THREE

Alternative 3 is a trap and haul system as shown in Figures 25, 26 and 27 located at the left bank of falls three. A switch-backed ladder would be required to transport the fish 32 vertical feet from the base of the falls to the trap facility above the falls.

The trap entrance, as seen in Figure 25, would be similar in appearance to the switchback entrance used for the Alternative 1 fishway. In this case, however, the baffles between pools would be half Ice Harbor weirs. The half Ice Harbor weirs would maintain a relatively constant water surface elevation at the trap facility regardless of the water surface fluctuations in the river at the trap entrance. The pools would be 10 ft long and 6 ft wide with a depth of apprdximately 6 ft at 25 cfs. The half Ice Harbor weir is fashioned with a bottom orifice, 18 in. high by 15 in. wide, that passes both fish and bed load; fish generally prefer the orifice to jumping over the weir. Maximum water surface drop between pools would be 1 ft. Flow velocity through the orifices and the ladder entrance slot would be between 4 and 8 fps.

As in the Alternative 1 fishway, the lower falls will serve as a natural barrier to prevent migrating fish from moving beyond the ladder entrance. Approximately 20 cfs of auxiliary water will be diverted at the intake above falls three and flow through a 24-inch steel pipe to a diffusion chamber at the ladder entrance. As discussed earlier, the auxiliary water will help attract fish away from the falls and to the ladder through more attractive momentum.

The fish trapping facility would be located above the falls at the end of the thirty-two pool fishway. The trapping facility consists of a VEE trap, a holding pool, fish crowder and a fish elevator with loading chutes. A pump station would provide flow to the holding pool and elevator shaft. The pump station would contain two gravity fed propeller pumps; each capable of pumping 25 cfs. One pump would serve as backup in case of mechanical failure.

The trap and holding pool would be 10 ft wide and 27 ft long. The vee trap funnels fish into the holding pool while 25 cfs of upwelling flow keeps the holding pool water fresh and aerated. This flow exits through the trap and continues down the ladder. An elevator type hoisting structure at the end of the holding tank would contain a 5-ft square punched aluminum fish hoisting brail.

The fish trap facility would have a capacity of up to thirty fish per loading cycle. When the desired number of fish have moved through the vee trap into the holding tank, the operator turns a valve to divert part of the the 25 cfs of upwelling flow into the fish elevator shaft. This new flow pattern attracts fish "upstream" into the elevator. The operator then activates the crowder to force the fish to the elevator. The crowder is a vertical punched aluminum plate which extends from side to side and top to bottom of the holding tank. The crowder plate moves on rails from the vee trap toward the elevator. After fish are in the elevator, the operator closes a slide gate at the side of the elevator, the water level rises and the brail is winched up to the truck loading chute. When the brail reaches the loading chute the fish exit through an opening in the side of the elevator and slide down the chute into a fish hauling truck parked below. The operator would return rough fish not wanted in the load to the river through a pipe from the loading chute. Once the truck is loaded, the driver would haul fish on a gravel surfaced access road and off-load them in the river upstream of the existing diversion weir or further upstream in the watershed.

The 12-ft wide gravel surfaced access road would traverse the north side of the canyon adjacent to the trap facility. From there, the road would continue north to State Highway 216. The minimum length of the fish haul would be approximately one mile. The fish could also be hauled further upstream on existing public roads.

The trap and haul system would require electrical power at the trap facility to operate the pumps, crowder and winch. This power could be supplied from the existing Tygh Valley substation, less than one-eighth of a mile away. Fish elevation facilities, should they be included, would be located adjacent to the trap holding tank.

ALTERNATIVE 4 -- TRAP AND HAUL AT PROPOSED POWERHOUSE

Alternative 4 is a trap and haul system at the proposed powerhouse as shown in Figures 28 and 29. The trap facilities would be located adjacent to the proposed powerhouse below a concrete barrier dam crossing the river. A four pool half Ice Harbor ladder would be required to pass fish from the tailrace entrances to the trap facility. The concrete barrier dam would be the same as described in Alternative 2 though there would be no need to cross the river with a fishway. The dam would again be located just upstream of the proposed powerhouse tailrace to prevent fish from passing upstream and missing the trap facility entrance.

As discussed in Alternative 2, two entrances would provide a flexible operation of the trap. Attraction and operation flow to both entrances would be gravity fed from an intake at the dam through a 36-in. pipe. Part of this flow would be distributed into the fishway through vertical vanes from the diffusion chamber. Flow would also be routed through branch pipes and valves to the holding pool, fish elevator pump, and fish elevation facilities as required.

Though oriented differently, the general- physical and operation characteristics of the fish trap would be the same as those described for Alternative 3. Fish tank truck access to the loading chute would be across the lower powerhouse deck. The proposed transformer, at NWCPUD's powerhouse, would have to be relocated to provide truck access to the loading chute.

The powerhouse access road would be used in hauling the fish upstream of the proposed diversion weir and intake structure. The minimum one-way haul distance to the river, just above the intake structure, is approximately l-1/2 miles. Fish could also be hauled further upstream.

Fish evaluation facilities, if included, would again be located adjacent to the fish trap holding tank as shown in Figure 29. Electrical power to run the trap facility is available through NWCPUD's distribution system.

GENERAL PROJECT CONSIDERATIONS

UPSTREAM EFFECTS OF PASSAGE

Introducing anadromous fish into the watershed above White River Falls creates four distinct problems: screening, introduction of unwanted fish, altered land use and introduction of IHN and IPN viruses. The first three of these topics are discussed in the following subsections; the latter topic is discussed in Chapter 12.

Screening

Water for irrigation is diverted from both the White River and its tributaries above White River Falls. If anadromous fish are introduced into the watershed, these irrigation diversions should be screened to prevent juvenile salmonids from entering canals, conduits, etc. The number of diversions and individual or combined capacities is not known at this time, however, the costs of this work could be substantial. The unit cost of screening small diversions may run in excess of $2,000 per cfs of capacity. Additionally, each screen would require regular maintenance during the irrigation season. The screening needs in the White River Basin are beyond the scope of this study, however, the problem must be quantitatively addressed at some point in the future.

Introduction of Unwanted Fish

Sampling studies in the White river by the Oregon Department of Fish and Wildlife have yet to identify the presence of squawfish and suckers. This is a concern since both species are present in the Deschutes River and may be introduced into the White River above falls one with anadromous fish. These species are competitive with both anadromous and resident fish. In particular, suckers and small squawfish compete for productivity with all other fish and large squawfish prey upon resident and anadromous juveniles.

This problem can be addressed in one of two ways. All fish entering the upper watershed can be handled or screened and rough species returned to the mainstem of the White River below falls three. Alternately, the problem can be ignored and rough fish can be allowed to compete with other anadromous and resident species.

Land Use

Introducing anadromous fish in the area above White River Falls will undoubtedly alter land use. After runs are sustained, there will be considerable sport fishing which may not be looked favorably upon by farmers adjacent to the streams. The burden of this management will fall upon private, state and federal land owners. This facet should be fully addressed later.

ABILITY TO PASS FISH

Various passage alternatives must be capable of effectively passing all expected runs. Though natural systems do not lend themselves to precise quantification, reasonable estimates of capacity can be made. There are three basic criteria used to evaluate fishway capacity. They include time spent in each fishway pool, holding requirements for fish and dissolved oxygen requirement for fish. The specific criteria were taken from Bell (1980) and repeated here as follows:

- Fish spend between 2.5 and 4.0 minutes in each pool of a conventional fishway (other than Denil-type).

- Pool volumes should allow, at a minimum, 0.2 ft^3 per pound of fish. The requirement for a 15 pound adult fish is then 3.0 ft^3.

- Adult fish dissolved oxygen requirement during active swimming is approximately 40 x 10^{-4} oz/hr/pound of fish. During normal activity, this drops to 24 x 10^{-4}. The saturated dissolved oxygen concentration of fresh water at 50°F is approximately 0.012 oz/ft^3 at mean sea level. Conservatively, 50% of the available dissolved oxygen is useful to fish.

Using the above criteria, the four final alternatives were evaluated as to their ability to pass fish. This analysis showed that proposed facilities would not limit any realistic run sizes that may be established in the White River.

CAPITAL, ANNUAL AND REPLACEMENT COSTS

The capital costs of each alternative are listed by major item and provided in Chapter 9. The annual costs of each alternative were estimated based on requirements for labor and maintenance. The trap and haul alternatives are the most labor intensive and it is estimated that the operations would require one and one-half full-time employees to properly man the trap, and haul fish. Since fish will arrive between dawn and dusk each day over the period of upstream migration, likely six months in duration for both steelhead trout and chinook salmon, this is not an unrealistic estimate. Fish ladder alternatives are assumed to require one-half time employee for regular maintenance of the facilities. Annual costs are also expected to be incurred in excess of labor for all alternatives. This would include power costs, repairs and like items. The annual costs expected for each alternative are listed in Chapter 9.

During normal operation of trap and haul facilities, some equipment items must be replaced. These items include trucks, pumps and winches. The assumed replacement times and costs are included in Chapter 9. Fish ladder alternatives do not have equipment that is expected to require replacement; therefore, no replacement costs are included in project costs.

COMPETITIVE USES FOR WATER

Water of the White River is currently used by resident fish and wildlife and irrigators. These uses have priority over either of the proposed developments, power or fish facilities, but do not preclude either. Since irrigation diversions are upstream of the proposed power and fish facilities sites, there should be no substantial difficulties. The problem discussed in Chapter 5 with irrigation withdrawals in low flow periods must, however, be addressed. The needs for resident fish and wildlife within the reach affected by the power project have been addressed through minimum flow requirements.

The principal concern remaining is the competitive use of water between passage alternatives and NWCPUD's power project. If either of the ladder alternatives are selected, they would require a flow of 25 cfs to be diverted from above the falls for ladder operation flow. This flow is in excess of the minimum instream flows already negotiated. The auxiliary attraction flows required for fishway entrances are within the minimum instream flows and are not expected to effect NWCPUD's operations.

Since the trap and haul alternative at the proposed powerhouse would require approximately 90 cfs for both entrances, additional instream flow may be required when both entrances are in operation. This would not occur for the entire trap operation season, however, as the minimum instream flows are above 90 cfs between February 16 and June 30. The minimum instream flow between July 1 and February 15 is 60 cfs. The additional 30 cfs required during some periods may be pumped from the tailrace with a net savings of power.

CHAPTER 9 ·

CONSTRUCTION PLAN AND COSTS

The objective of this chapter is to provide BPA with possible construction plans and cost estimates for the four alternatives to aid in the selection of a predesign. Once predesign selection is made, a more detailed study will be required in both the areas of construction plan and perhaps cost estimates. The information reported here is based on experience of OTT staff and consultation with ODFW staff and other relevant agencies.

CONSTRUCTION PLAN

Construction schedules in or near streams are usually controlled by fluctuating stream flows. Significant savings in construction costs can be made if the activities in or near the stream are planned for the low flow period. The low flow period for the White River occurs between July and October with mean monthly flows below 200 cfs; this is seen in Figure 8. As noted in the layouts presented in Chapter 8, all four alternatives require some construction within the river. Clearly, this will require significant effort to dewater those reaches of the river.

DEWATERING

One of two methods of dewatering will be required depending upon the alternative selected. The first method is embankment fill cofferdams. This type of cofferdam is simply a fill composed of coarse and fine materials standing on slopes of approximately 2H:lV. The fill material should contain sufficient coarse material for strength while having a sufficient fraction of fines to lessen seepage through the structure. Synthetic membranes may also be required to protect the stream side of the embankments from scour. These membranes further reduce seepage through and beneath the cofferdams.

The second method of dewatering that may be required for the White River Falls is a diaphragm wall. The diaphragm wall consists of two rows of sheet piling with fill placed between the rows of piling. Piling would be placed far enough apart to withstand the hydrostatic force of the water. Since piling cannot be driven into the basalts of the White River Canyon, this method would require "z" piling to be placed in a steel template on the river bottom. This method of dewatering is expensive, however, it will perform in areas of high stream velocity where embankment fill structures would fail.

The fishway from falls three, Alternative 1, would likely require dewatering with a diaphragm wall at the base of the falls. The intake and diversion weir just above falls three could be dewatered with a combination of embankment fills and perhaps sandbags. The fish ladder exit above falls one could be dewatered with embankment fills as well. The trap and haul facility, Alternative 3, at falls three would require the same dewatering measures as discussed for Alternative 1, however, no dewatering would be required above falls one.

The fishway alternative from the proposed powerhouse, Alternative 2, would require dewatering the area of the barrier dam with a series of embankment fills. The operation would involve dewatering the right half of the stream and constructing the right half of the swimming barrier in the dry. The entire flow could then be diverted upstream with an embankment fill through a closed conduit and through the sluiceway at the right abutment of the swimming barrier. The ladder exit above falls one could be dewatered with an embankment fill. The trap and haul facility at the proposed powerhouse, Alternative 4, would be dewatered in the same way as discussed for the fish ladder alternative.

ACCESS DURING CONSTRUCTION

Relatively steep canyon walls of the White River within the project site provide challenging construction problems. The ladder sections between falls three or the proposed powerhouse must be "pioneered". This would involve blasting and excavating ladder routes from the exit to the entrance, and then placing concrete from the entrance to the exit. This practice would eliminate the need and cost of an access road adjacent to the fishways over the entire routes. Access to the ladder entrance at falls three would, however, be necessary for heavy equipment required in construction of the diaphragm wall cofferdam. Access to the barrier dam and ladder entrance at the proposed powerhouse site would be available through NWCPUD's powerhouse access road.

As mentioned in Chapter 8, the trap and haul alternatives require hauling roads from the trap facility. These hauling roads would be constructed at the beginning of construction activities and serve as access during construction.

CONSTRUCTION TIMING

There are three key elements to construction of either of the four alternatives. They include access, dewatering and excavation and concrete placement. As discussed earlier, dewatering should be planned for the low flow period, July through October. Hence, the activities may run as follows:

- Construction access provided by early July and may begin as early as desired by the contractor.

- Dewatering should begin by early July and allow for excavation and concrete placement in dry areas during the period July through October.

- Excavation and concrete placement in areas not requiring dewatering can parallel or follow the activities in dewatered areas.

This brief discussion of activities would likely be similar to that followed by a contractor, however, the actual sequence and staging of construction is generally the responsibility of the contractor.

If NWCPUD's power project is built, considerable attention should be paid to coordination of efforts between projects. Considerable savings in construction costs would undoubtedly be made.

PRESENT VALUE OF COSTS

Since the four final alternatives will accomplish the goal of passing any realistic run sites of anadromous fish over the falls, much of the predesign selection will be based on econanics (the cost of various alternatives). Three items make up the total cost of various alternatives and include:

- **Capital Costs**
- Annual Costs
- Replacement Costs

Capital costs include those costs that are realized initially in the project (i.e., construction, engineering and equipment costs). Annual costs are those costs which occur every year the project is in operation and include labor and maintenance of facilities. Replacement costs are incurred periodically when equipment must be replaced (e.g., trucks, pumps and winches).

In an effort to place all costs on a consistent basis, a present value analysis was performed for each alternative. The analysis used is similar to that used by BPA to determine levelized costs for alternative power production schemes. The assumptions in the analysis were:

- SO-year project life
- 11% interest rate
- 7% inflation rate
- 3% discount rate

The latter assumption of a 3% discount rate deserves some explanation. The discount rate is the long-term cost of money and not the borrowing rate. In effect, the discount rate has the risk associated with borrowed money removed from it. The 3% discount rate used in these analysis is the same rate used by BPA.

Determination of the present value of each alternative involves a five step process outlined as follows:

1) Capital costs of construction, equipment and engineering services are converted to a stream of uniform capital cost payments. This is a capital recovery factor for 50 years at 11% interest.

2) Capital cost payments are then deflated at 7% and discounted at 3%. This is a combined operation at a composite rate of 10.21% (i.e., [(1.07 * 1.03) - 1] x 100% = 10.21%). The present value of capital cost payments are then determined at the composite rate of 10.21%.

3) Present value of annual labor and maintenance costs are determined using the 3% discount rate.

4) Present value of replacement costs at the year they are incurred are determined usig the 3% discount rate.

5) The total present value of project costs is then the sum of present values determined in steps 2, 3 and 4.

The costs of the four passage alternatives are listed by major item and included in Tables 8, 9, 10 and 11 for Alternatives 1, 2, 3 and 4, respectively. This cost information is a best estimate based on the level of analysis completed to date.

Table 8. -- Capital and Annual Costs for Construction, Engineering, Operation and Maintenance for Alternative 1, Fishway from Falls Three

ITEM	UNIT	QUANTITY	UNIT COST	TOTAL COST
MOBILIZATION & DEMOBILIZATION	LS	a--	$ 25,000	$ 25,000
DEWATERING				$ 171,000
Falls Three	LS --	---	150,000	150,000
Headworks	LS	---	6,000	6,000
Pumps & Maint.	LS	---	15,000	15,000
EARTHWORK				$ 206,000
Excavation, Rock	CY	7,230	25	181,000
Backfill	CY	600	15	9,000
Riprap	CY	80	25	2,000
Hauling	CY	2,000	7	14,000
REINFORCED CONCRETE				$1,261,000
Slabs	CY	2,050	250	512,000
Walls	CY	2,140	350	749,000
DRAINS				$ 41,000
Perforated Pipe	LF	1,800	17	31,000
Drains	LS	---	10,000	10,000
METALS				$ 44,000
Trashracks	LS	---	3,000	3,000
Diffusers	LS	---	4,000	4,000
Piping	LS	---	17,000	17,000
Valves & Gates	LS	---	20,000	20,000
ACCESS ROAD	LS	---	230,000	$ 230,000
WOOD DECK	LS	---	24,000	$ 24,000
CIVIL SITE WORK	LS	---	50,000	$ 50,000
Subtotal				$2,052,000
10% Contractor O&P				205,000
20% Contingency				451,000
TOTAL				$2,708,000

Table 8. -- Continued

ITEM	UNIT	QUANTITY	UNIT COST	TOTAL COST
ENGINEERING SERVICES				
Permits				35,000
Design				
Basic Services				270,000
Surveying				40,000
Geotechnical Investigation				80,000
Testing				25,000
Inspection				120,000
TOTAL				$ 570,000
TOTAL CAPITAL COSTS				$3,278,000
ANNUAL COSTS				
l/2 FTE @ $30,000/yr.				$ 15,000
Maintenance, Yearly				5,000
TOTAL ANNUAL COSTS				$ 20,000
PRESENT VALUE				
11% Money, 7% Inflation, 3% Discount Rate				
PV of Capital Costs				$3,523,000
PV of Annual Costs				515,000
TOTAL PROJECT COST				$4,038,000

Table 9. -- Capital and Annual Costs for Construction, Engineering, Operation and Maintenance for Alternative 2, Fishway from Powerhouse

ITEM	UNIT	QUANTITY	UNIT COST	TOTAL COST
MOBILIZATION & DEMOBILIZATION	LS	---	$ 25,000	$ 25,000
DEWATERING				$ 110,000
Barrier Dam	LS	---	94,000	94,000
Headworks	LS	---	6,000	6,000
Pumps & Maint.	LS	---	10,000	10,000
EARTHWORK				$ 391,000
Excavation, Common	CY	1,060	15	16,000
Excavation, Rock	CY	10,700	25	267,500
Backfill	CY	1,030	15	15,500
Riprap, Grouted	CY	900	70	63,000
Riprap	CY	305	25	8,000
Hauling	CY	3,000	7	21,000
REINFORCED CONCRETE				$2,122,000
Slabs	CY	4,120	250	1,030,000
Walls	CY	3,120	350	1,092,000
DRAINS				$ 71,000
Perforated Pipe	LF	3,100	17	53,000
Drains	LS	---	18,000	18,000
METALS				$ 46,000
Trashracks	LS	---	3,000	3,000
Diffusers	LS	---	4,500	4,500
Piping	LS	---	13,500	13,500
Valve	LS	1	10,000	10,000
Sluice Gate	LS	1	15,000	15,000
CIVIL SITE WORK	LS	---	60,000	$ 60,000
Subtotal				$2,825,000
10% Contractor O&P				282,000
20 % Contingency				621,000
TOTAL				$3,728,000

Table 9. -- Continued

ITEM	UNIT	QUANTITY	UNIT COST	TOTAL COST
ENGINEERING SERVICES				
Permits				35,000
Design				
Basic Services				385,000
Surveying				50,000
Geotechnical Investigation				100,000
Testing				25,000
Inspection				150,000
TOTAL				$ 745,000
TOTAL CAPITAL COSTS				$4,473,000
ANNUAL COSTS				
l/2 FTE @ $30,000/yr.				$ 15,000
Maintenance, Yearly				8,000
TOTAL ANNUAL COSTS				$ 23,000
PRESENT VALUE				
11% Money, 7% Inflation, 3% Discount Rate				
PV of Capital Costs				$4,808,000
PV of Annual Costs				592,000
TOTAL PROJECT COST				$5,400,000

Table 10. -- Capital and Annual Costs for Construction, Engineering, Operation and Maintenance for Alternative 3, Fish Trap at Falls Three

ITEM	UNIT	QUANTITY	UNIT COST	TOTAL COST
MOBILIZATION & DEMOBILIZATION	LS	---	$ 25,000	$ 25,000
DEWATERING				$ 160,000
Cofferdams	LS	-0-	150,000	150,000
Pumps & Maint.	LS	-0-	10,000	10,000
EARTHWORK				$ 61,000
Excavation, Rock	CY	2,000	25	50,000
Backfill	CY	250	15	4,000
Hauling	CY	1,000	7	7,000
REINFORCED CONCRETE				$ 260,000
Slabs	CY	370	250	92,000
Walls	CY	480	350	168,000
METALS				$ 124,000
Trashracks	LS	---	2,000	2,000
Diffusers	LS	-0-	6,000	6,000
Piping	LS	---	45,000	45,000
Valves & Gates	LS	---	41,000	41,000
Vee Trap	LS	---	5,000	5,000
Crowder	LS	---	10,000	10,000
Elevator	LS	---	15,000	15,000
EQUIPMENT				$ 221,000
Generator	LS	1	15,000	15,000
Winches	LS	2	5,000	10,000
Truck	LS	1	136,000	136,000
Pumps	LS	2	30,000	60,000
ACCESS ROAD	LS	---	230,000	$ 230,000
WOOD DECK	LS	---	24,000	$ 24,000
CIVIL SITE WORK	LS	-0-	25,000	$ 25,000
Subtotal				$1,130,000
10% Contractor O&P				113,000
20% Contingency				249,000
TOTAL				$1,492,000

Table 10. -- Continued

ITEM	UNIT	QUANTITY	UNIT COST	TOTAL COST
ENGINEERING SERVICES				
Permits				35,000
Design				
Basic Services				155,000
Surveying				40,000
Geotechnical Investigation				60,000
Testing				20,000
Inspection				75,000
TOTAL				$ 385,000
TOTAL CAPITAL COSTS				$1,877,000
REPLACEMENT COSTS				
Tractor - Replace @ Year 10, 20, 30 & 40				$ 80,000
Winches - Replace @ Year 10, 20, 30 40				10,000
Pumps - Replace 1 @ Year 25				30,000
ANNUAL COSTS				
Truck Maintenance/Year				$ 9,700
Labor, 1.5 FTE's @ $30,000/Year				45,000
Maintenance/Year				8,000
TOTAL ANNUAL COSTS				$ 62,700
PRESENT VALUE				
11% Money, 7% Inflation, 3% Discount Rate				
PV of Capital Costs				$2,018,000
PV of Replacement Costs				196,000
PV of Annual Costs				1,613,000
TOTAL PROJECT COST				$3,827,000

Table 11. -- Capital and Annual Costs for Construction, Engineering, Operation and Maintenance for Alternative 4, Fish Trap at Powerhouse

ITEM	UNIT	QUANTITY'	UNIT COST	TOTAL COST
MOBILIZATION & DEMOBILIZATION	LS	---	$ 25,000	$ 25,000
DEWATERING				$ 99,000
Cofferdams	LS	---	89,000	89,000
Pumps & Maint.	LS	---	10,000	10,000
EARTHWORK				$ 177,000
Excavation, Common	CY	1,060	15	16,000
Excavation, Rock	CY	3,300	25	82,000
Backfill	CY	600	15	9,000
Riprap, Grouted	CY	900	70	63,000
Riprap	CY	260	25	6,500
REINFORCED CONCRETE				$ 543,000
Slabs	CY	370	250	382,000
Walls	CY	480	350	161,000
METALS				$ 151,000
Trashracks	LS	---	2,000	2,000
Diffusers	LS	---	7,000	7,000
Piping	LS	---	32,000	32,000
Valves & Gates	LS	---	56,000	56,000
Vee Trap	LS	---	5,000	5,000
Crowder	LS	---	10,000	10,000
Elevator	LS	---	25,000	25,000
Stairway	LS	---	14,000	14,000
EQUIPMENT				$ 191,000
Generator	LS	1	15,000	15,000
Winches	LS	2	5,000	10,000
Truck	LS	1	136,000	136,000
Pumps	LS	2	15,000	30,000
CIVIL SITE WORK	LS	---	25,000	$ 25,000
Subtotal				$1,211,000
10% Contractor O&P				121,000
20% Contingency				266,000
TOTAL				$1,598,000

Table 11. -- Continued

ITEM	UNIT	QUANTITY	UNIT COST	TOTAL COST
ENGINEERING SERVICES				
Permits				35,000
Design				
Basic Services				155,000
Surveying				20,000
Geotechnical Investigation				60,000
Testing				20,000
Inspection				75,000
TOTAL				$ 365,000
TOTAL CAPITAL COSTS				$1,963,000
REPLACEMENT COSTS				
Tractor - Replace @ Year 10, 20, 30 & 40				$ 80,000
Winches - Replace @ Year 10, 20, 30 & 40				10,000
Pumps - Replace 1 @ Year 25				7,500
ANNUAL COSTS				
Truck Maintenance/Year				$ 9,700
Labor, 1.5 FTE's @ $30,000/Year				45,000
Maintenance/Year				8,000
TOTAL ANNUAL COSTS				$ 62,700
PRESENT VALUE				
11% Money, 7% Inflation, 3% Discount Rate				
PV of Capital Costs				$2,110,000
PV of Replacement Costs				186,000
PV of Annual Costs				1,613,000
TOTAL PROJECT COST				$3,909,000

CHAPTER 10
BENEFITS

An analysis of expected benefits of providing anadromous fish passage over White River Falls awaits completion of contract work by the U.S. Forest Service and ODFW. Several work products are pending which will feed directly into the analysis. These are a fish habitat inventory of streams within the Mt. Hood National Forest by the U.S. Forest Service, a similar survey of streams on private land by ODFW, a study of fish injury and mortality associated with passage of juvenile salmonids over White River Falls by ODFW, a study to determine if IHN or PHN virus is present in the watershed by ODFW, and qualitative electrofishing of selected streams in the White River watershed by ODFW. To date, preliminary and tentative findings have been incorporated in the following discussion where appropriate.

Many miles of streams with the potential for producing salmon and steelhead will become accessible to anadromous fish if passage around White River Falls is provided. Considerably more quality habitat for andromous fish would become available for salmon and steelhead production with minor passage improvement at additional barriers to fish migration within the basin. Most of the high quality stream habitat, about 124 stream miles, is situated in the upper watershed, within the boundaries of Mt. Hood National Forest (Heller, et al. 1984). Another 40 to 60 stream miles of less productive habitat are also located inside the National Forest boundary (Heller et al. 1984). About half of the mainstem White River lies outside the National Forest boundary. Of this, approximately 50% is on USDI Bureau of Land Management land, the remainder is outside federal control. In addition, about 35 to 40 miles of perennial streams with potential for anadromous fish production lie in the lower basin outside the National Forest and BLM land.

The fishery benefits derived from fish passage at White River Falls will be proportional to both the quantity and quality of spawning and rearing habitat to which anadromous fish will gain access. Benefits will be dependent on the ability of the habitat to produce juvenile fish of outmigrant size. Data collected by ODFW and the U.S. Forest Service on the quality and quantity of habitat for anadromous fish above the falls as part of project feasibility studies is being compiled at this time. Once the information has been compiled and analyzed, the potential of the White River drainage to produce anadromous fish will be estimated.

All information available at this time indicates that many streams in the White River Basin have good spawning and rearing habitat for anadromous fish. However, four factors have been identified which may limit the production of anadromous salmonids in some lower quality habitat within the drainage. These habitat limitations are: 1) the high sediment load in the glacier-fed mainstem *White River, 2) diminshed flows in some stream channels during the low-flow period due in part to water appropriations, 3) relatively high water temperatures in some tributary streams in the summer and fall, 4) potential downstream passage problems for migratory fish at unscreened water diversions and at White River Falls.

The mainstem White River's potential for supporting juvenile anadromous salmonids has significant implications for this project, since it accounts for a significant portion of the anadromous fish habitat available above the falls. The White River is a glacial stream. Poor water clarity during low-flow periods in the late summer and early fall and a heavy load of fine sediment in the mainstem may limit the ability of the river to produce fish. The deleterious effects of fine sediment upon fish and other aquatic life can be considerable and were reviewed by Gibbons and Salo (1973) and Iwamoto, et al. (1978).

The extent of sedimentation in the mainstem White River and its influence on the ability of anadromous salmonids to spawn, incubate and rear needs further examination. Although the glacier-fed nature of White River may limit aquatic productivity during certain seasons, it certainly does not preclude salmonid production. Electrofishing surveys conducted by ODFW have shown that a substantial population of large and healthy rainbow trout currently resides in the mainstem (Schroeder, pers. comm.). Also, vigorous anadromous salmonid populations are found in a number of glacial river systems elsewhere in the Pacific Northwest, Canada and Alaska. Data on resident fish populations in the White River being collected by ODFW should help to determine the capacity of mainstem White River to produce juvenile anadromous salmonids. The chronically turbid flows prevalent in White River during the late summer and fall may, in fact, have a beneficial effect on introduced anadromous fish. The mainstem would be an effective staging area for adult fish prior to spawning in tributary streams, particularly in the lower drainage. Limited water clarity may make it difficult for predators to locate large adult fish holding in White River during periods of low flow.

Fish production in a number of lower elevation tributaries to the White River appears to be limited by low natural flows in the summer and fall. This problem is compounded by irrigation withdrawals. Irrigation withdrawals are the largest consumptive use of water in the White River Basin. Irrigation water rights allow the legal withdrawal of 42.6 thousand acre feet of water within the drainage in 1961 (Oregon Water Resources Board, 1961). Water for irrigation is usually appropriated from smaller tributary streams within the basin as opposed to being taken directly out of the White River. This pattern of water diversion is reflected by the fact that only 460 of a total of 11,000 acres irrigated in the basin during 1959 received water directly from the White River (Oregon Water Resources Board, 1961). Low flows in a number of White River tributaries during the summer and fall limit fish production by leading to high water temperatures in addition to reduced rearing space. Although resident rainbow trout are found in all of these streams, their population density is probably lower than it would be if stream temperatures were cooler.

Although problems of reduced streamflow due to irrigation diversion are generally greatest in certain 'White River tributaries, particularly lower Clear and Frog Creeks, low minimum flows also affect fish production in the mainstem itself. The Oregon State Game Commission recommended minimum flows for the maintenance of fish production levels in the White River to the Oregon Water Resources Board in 1961. The recommended minimum flow for the mouth of the White River was 150 cfs (Oregon Water Resources Board, 1961). This flow is higher than the average monthly flows for August (135 cfs) and September (127 cfs) recorded at RM 2.0 of the White River for the period 1918 through 1980.

Chinook salmon and steelhead are cold water fish which prefer a rather narrow range of water temperatures, between 7.3 and 14.6°C (Bell, 1980). They can survive in water as warm as 24°C but generally cease growing when temperatures reach 20.3°C. Laboratory studies have shown that water temperature affects the activities of juvenile salmonids to such an extent that the rearing densities of fry can be regulated. Hahn (1977) has shown that the rearing densities of steelhead fry decline with increasing water temperature. He also found that diurnal fluctuations in water temperature can partially offset the adverse effect of high water temperature on steelhead fry densities. The fact that a daily respite from maximum water temperatures in streams can provide thermal relief to juvenile salmonids is of major significance to this project. Schoder (pers. comm.) has postulated that the deleterious effects of warm maximum water temperatures in some lower White River tributaries may be partially offset by considerable nighttime cooling of stream temperatures.

Considerable analysis must be completed to adequately describe the water temperature regimes of White River and its tributaries. ODFW is presently monitoring water temperatures in a number of streams within the basin through the use of recording thermographs and maximum/minimum thermometers. Results of these temperature studies should give a reasonable indication of the limitations that water temperatures in the basin may place upon the distribution and abundance of juvenile anadromous salmonids.

Two downstream passage problems will present themselves to outmigrant salmon and trout. First, unscreened water diversions from tributary streams could be a serious problem for anadromous salmonid populations in the basin. Significant numbers of juveniles migrating downstream from rearing areas in White River tributaries could be diverted into irrigation systems and perish. A potential solution to this problem would be to screen the diversions. ODFW and the U.S. Forest Service are identifying unscreened diversions which may cause significant threats to outmigrants.

The second downstream passage problem for outmigrants is presented by White River Falls itself. Testing by ODFW has shown that high rates of mortality may be suffered by downstream migrants attempting to pass over White River Falls during periods of low flow (Schroeder, pers. comm.). Survival does not appear to be a problem for outmigrants passing White River Falls when flows are high in the spring, however. Therefore, the only anadromous stock which might suffer consistently significant losses passing the falls as juveniles would be spring chinook salmon, since this is the only anadromous salmonid stock in the Deschutes drainage with significant juvenile downstream movement when stream flows are low in the fall. In atypical years during which springtime flows in White River are low, outmigrating steelhead and spring outmigrant chinook might be subject to significant mortality.

The severity of the downstream passage problem at White River Falls during periods of low flow is presently open to speculation. Chinook used for low-flow survival tests at the falls by ODFW had only recently recovered from a bout of bacterial kidney disease (BKD) and were in poor health (Schroeder, pers. comm.). The test fish may not have been in optimum condition to survive even moderately stressful passage situations. ODFW plans additional tests on the passage mortality of chinook smolts migrating over White River Falls in 1985. These tests will hopefully use juvenile salmonids in good health and should yield results which are more definitive than those tests already completed.

POTENTIAL IMPACTS

The introduction of salmonid and steelhead trout into White River, upstream of the Falls, will have an impact on the resident fish presently found in the basin. The intensity of competition between introduced anadromous species and a particular native resident species for food and space will depend upon how similar the ecological requirements of the two species are. Introduced chinook salmon and steelhead trout will compete to some degree with the resident salmonids in the drainage.

Chinook salmon will compete with resident fish in the White River Basin only as juveniles prior to outmigration. Adult chinook will not compete with resident fish for food or spawning habitat since they do not feed while in fresh water and will select spawning areas which cannot be used by'any fish presently in the drainage. The period of stream residency by juvenile chinook in the basin and thus the length of time they will be interacting with resident fish and steelhead, will be different for spring and fall run fish. Juvenile spring chinook typically spend one year in natal streams before smolting and migrating toward the ocean, while sub-yearling fall chinook generally begin migrating to sea only two to three months after emerging from redds. The result of competitive interaction is expected to be a reduction in the populations of resident salmonids, but an increase in total salmonid production within the basin. This expectation is based on the findings of Glova (1978) and others relative to total salmonid production under sympatric and allopatric conditions. Glova's work has shown that if more than one species of salmonid is present in a system, the habitat will be partitioned between co-habiting fish in such a way that total productive capacity will be more completely realized than if only one of the species were present. Research by Everest and Chapman (1972) on the behavior of sympatric salmonid populations in Idaho streams, suggests that juvenile chinook and steelhead segregate themselves based largely on habitat preference and not as a result of competitive interactions. Similar non-competative segregation was reported for the Campbell River on Vancouver Island by Hamilton and Buell (1974). If this holds true in the White River watershed, then the production of either of these two species will not be at the expense of the other species. Not all impacts of introducing chinook salmon into the watershed will be detrimental to native fish populations. Salmon fry constitute a signif icant food source for resident rainbow trout in the main-stem Deschutes River during the winter and early spring (Fessler 1977). Fry from introduced stocks will likely be consumed to some extent by resident trout in the White River drainage. In addition, carcasses of spawned-out salmon will comprise a new source of nutrients for streams above White River Falls.

Juvenile steelhead will probably compete intensely with resident trout in the basin for rearing space and food because they have very similar ecological requirements. The cost of steelhead production in the basin will likely be significant reductions in the population levels of yearling and underyearling resident trout. However, there is no reason to doubt that healthy populations of both resident rainbow and steelhead trout can co-exist in the White River Basin as they do in many other basins in the Pacific Northwest. Angler harvest of resident trout should not be diminished substantially, since present harvest appears to be targeted primarily on stocked fish.

The upper reaches of a number of streams in the watershed will remain inaccessible to anadromous salmonids after passage is provided at White River Falls because of additional migration barriers. Trout populations residing above these barriers, in some cases genetically distict stocks, will be unaffected by a fish passage facility at the falls, unless these additional barriers are modified or removed.

The effects of competition with juvenile chinook salmon or steelhead trout on whitefish and resident non-game fish in the drainage is uncertain. It is possible that production of these species will be reduced in relation to the degree to which their ecological requirements overlap with those of the introduced species they must share habitat with. The effect is expected to be very slight, however, except in cases where total food supply is presently limiting production.

Water Quality

The water quality of the White River is considered relatively unpolluted. The White River and most of its tributaries drain sparsely populated areas on the eastern slopes of Mt. Hood. The main water quality problem in the system is high turbidity in the mainstem from glacial sediment. Quality analyses performed on water from the White River have shown that levels of pollution indicators are within ranges established by the state for clean water (Northern Wasco County PUD, 1983). Bacterial levels can be relatively high at the project site from time to time, probably due to the influence of human activities and cattleraising operations nearby (Northern Wasco County PUD, 1983).

Endangered Species

There are no threatened or endangered species of fish known to reside in the White River Basin.

CHAPTER 11
ENVIRONMENTAL CONSIDERATIONS

GENERAL

The purpose of this chapter is to present a preliminary analysis of environmental considerations for the proposed White River Falls Fish Passage Facility. As a federally chartered agency, BPA is required to comply with all relevent portions of the National Environmental Policy Act (NEPA) for all projects funded. Fish passage improvements for White River Falls are proposed for funding under the Fish and Wildlife Program for the Columbia River Basin. The project therefore requires an environmental review and documentation under NEPA procedures.

Under the guidelines of the President's Council on Environmental Quality, a first step in NEPA procedures is a scoping processing. The purpose of that process is to determine the level of potential environmental impact generated by the proposed project. Potential impact is usually evaluated for a series of subject areas or categories. These are then examined on a cumulative basis to determine if the project requires an Environmental Assessment (EA) or an Environmental Impact Statement (EIS) under NEPA.

A process for carrying out the scoping analysis has been developed by BPA. The analysis consists of two parts, corresponding to BPA's preliminary environmental guidelines. The first part is a ranking of alternatives for the facilities comparing potential environmental impacts. The second is a response to applicable threshold questions from BPA's guidelines. The purpose of the threshold questions is to elucidate potential "red flag" areas which may indicate the project requires preparation of an Environmental Impact Statement.

In this chapter, scoping analysis is developed for four possible alternative designs of the White River Falls Fish Passage Facility. This analysis expands and supplements the Preliminary Environmental Scoping Report submitted to BPA in October of 1983. The purpose of this is to evaluate impact levels which will assist BPA in its determination for requiring either an EA or an EIS on the project. Another equally important purpose is to present sufficient environmental data on each alternative to provide criteria for selection of the optimum alternative. This is particularly important since some alternatives could require EIS preparation while others may not require an EIS.

In addition to information contained here, some data analysis and draft information have been prepared on issues of particular importance including land use, fish and wildlife, and recreational aspects of the proposed project. After alternatives have been evaluated, this information will be included in a report to BPA.

ALTERNATIVES

Four alternatives have been described in Chapter 8 and are repeated here as:

1. Fishway from falls three
2. Fishway from proposed powerhouse
3. Trap and Haul at falls three
4. Trap and Haul at proposed powerhouse

Each alternative is evaluated on a relative basis considering impacts of:

- Amount and duration of construction activities
- Specific design features of the alternative
- Operation and maintenance features

These items are combined into an assessment of impacts by category.

A list of subject categories adapted from BPA's preliminary Environmental Guidelines is shown in the first column of Table 1. The table also shows a classification of impact categories for each alternative. The classification has been coded into one of four possible values for each environmental category and alternative:

1) Potential for Major Impact
2) Potential for Only Minor Impact
3) No Significant Impact
4) Delete, Not Applicable

The values of the coding applied to each category serve to determine the level of impacts anticipated for that category. The value also serves as a screening criterion to determine the detail necessary, in either an EA or EIS, for that category. A value of "4" will have no impact. Therefore, the topic can be categorically excluded from either an EA or EIS. A value of "3" indicates that the project will have no significant long-term effect, however, the reasons for the lack of effect may not be obvious. Therefore, existing conditions will need to be covered and a brief explanation given for the lack of significance of any impacts. An example of this would be the topic "Noise". Considerable noise will occur during construction, but will be temporary and restricted to an area with few residents. Values of "2" may have some minor impacts. Therefore, moderate consideration will be needed for those categories. Values of "1"

Table 12. -- Potential Levels of Impact by Category and Alternative

ALTERNATIVE: ISSUES	Alternative 1 -- Fishway from Falls Three			Alternative 2 -- Fishway from Proposed Powerhouse			Alternative 3 -- Trap and Haul at Falls Three			Alternative 4 -- Trap and Haul at Proposed Powerhouse		
	S	R	0	S	R	0	S	R	0	S	R	0
Land Use	1	2	1	1	2	1	2	2	2	2	2	2
Vegetation, Fish & Wildlife												
Vegetation	2	4	3	2	4	3	2	4	3	2	4	3
Fish	1	1	1	1	1	1	1	1	1	1	1	1
Wildlife	2	2	2	2	2	2	2	2	2	2	2	2
Hydrology	2	3	2	1	2	1	3	3	3	3	3	3
Water Quality	2	2	2	1	2	1	2	2	2	2	2	2
Air Quality	3	4	3	3	4	3	3	4	3	3	4	3
Solid & Hazardous Waste, Toxic Materials	2	4	2	2	4	2	2	4	2	2	4	2
Geology 6 Soils	1	3	2	1	3	2	1	3	2	2	3	2
Cultural	2	2	2	2	2	2	2	2	2	3	2	2
Recreational	1	1	1	1	1	1	1	1	1	2	1	1
Noise	3	4	3	3	4	3	2	4	3	2	4	3
Aesthetics	1	2	1	1	2	1	1	2	1	2	2	2
Economics	1	1	1	1	1	1	1	1	1	1	1	1

KEY: S - Site
R - Regional
O - Overall

1 - Potential For Major Impact
2 - Potential For Only Minor Impact
3 - No significant Impact
4 - Delete. Not Applicable

will have a potential for major impact in that category. In-depth research will be needed to determine the extent of those impacts.

The project will have two effects in a'geographic sense. One effect will be from activities at the site related to construction of either a ladder or trap and haul facility. While these will have some wider implications, the focus of impacts will be the canyon area at, and immediately downstream of, the Falls. The second effect is regional in nature. It deals with impacts from introducing anadromous fish into a new basin, potential use changes etc. Many of the effects (e.g., sports fishing) are anticipated to be beneficial effects and this must be emphasized in the EA or EIS.

Table 1 shows the impact values for each general environmental category for both site and regional impacts for each alternative. The third column of each set of values shows the overall weighting for each category and alternative. In general, this column represents the smallest of the two numbers (i.e., most severe or critical impact rating) for site and regional effects, based on the theory that the most critical category should determine the overall level. In borderline cases, however, the overall rating may be less than the most critical category. This occurs in the case of vegetation which is affected by the project at the site but not to any significant extent in an overall context.

LEVELS OF POTENTIAL IMPACT

Impact ratings for site, regional and overall impacts are discussed below for each alternative by category. The differences in impact ratings for each alternative will be emphasized. If the impacts are relatively the same for all alternatives, then the impacts will be discussed collectively.

This simplifies discussion, particularly for regional impacts which are virtually independent of specific alternatives.

A. Land Use

Land use at the site is expected to shift from a relatively undeveloped park to a higher visitor use area with either fishway alternative (1 and 2), especially if public viewing is established. Trap and haul alternatives (3 and 4) would involve fewer changes in use, though some visitors may make the descent to the facility. In all cases, the passage facilities will create impacts related to access, ownership, management, operations and maintenance. All alternatives will increase use by fishermen above the falls.

Regional changes in land use could include such items as 1) need for increased fishing access, 2) changes in recreational patterns causing increased recreational land use needs, 3) conflicts with current forest management uses. Also, the project may affect current irrigation operations through a need for fish screens at diversions or through competing uses for water. All alternatives have essentially the same regional effect.

B. Vegetation, Fish and Wildlife

Vegetation is sparse at the site and effects on vegetation will be minor for all alternatives. One rare plant is present in the general area but will probably not be affected by construction.

Site effects on wildlife will be limited to the removal of a small amount of habitat utilized by birds and small mammals. Construction noise and activity may also affect some nesting birds. Distribution of wildlife at the site is not yet known in enough detail to distinguish between alternatives. Fish use is naturally the largest change induced by the project. Changes at the site will be related to passage of anadromous fish and subsequent downstream passage of juveniles. Blasting and construction activities may cause impacts to fish during construction. Impacts upon fish are roughly equal for all alternatives. However, the trap and haul facility may cause more stress on fish due to timing and handling during operation.

On a regional basis, effects on vegetation will be mainly insignificant, although there may be minor effects on vegetation induced by use changes by recreational users or others. There may be potential changes in usage by wildlife species which feed on salmon or steelhead including raptors, bears and furbearers.

Regional effects on fish will be those of introducing entirely new species of fish into a basin which ahs never supported these species. There will be predation and competition effects on resident fish and questions of the suitability of habitat and water quality to sustain the new runs. Regional effects on fish will not vary between alternatives providing, that facilities are all designed to accommodate adequate run sizes.

C. Hydrology

Site hydrology will not change, however, hydraulic conditions of the river floodplain in the canyon area must be considered in terms of potential effects of construction. All alternatives have some portion of the project within a floodplain. The downstream ends of both fishways lie within the 100-year floodplain as do portions of the trap and haul facilities. Floodproofing will be necessary for all alternatives.

Alternatives 1 and 2 will withdraw some water from the reach between the upper and lower falls. This competes to some extent with aesthetics of the waterfall, however, this becomes particularly important where fishway flows will also compete with water needs for Northern Wasco County PUD's proposed hydropower facility.

Regional hydrology will not be affected by any of the alternatives; however, introduction of anadromous fish may later cause conflicts between instream flow needs for fish and water diversion for irrigation.

D. Water Quality

Site water quality could be affected during construction activities. Sediment will enter the river, particularly during construction in the river and on banks. Alternatives 2 and 4 would involve construction of an instream barrier dam. All alternatives would also have considerable construction work on the stream banks. Work on both fishways (alternatives 1 and 2) would involve construction work in steep canyon wall areas, which are subject to erosion. Alternative 3 would involve construction of an access road on these steep canyon walls. Alternative 2 has probably the highest potential for water quality impact followed by alternatives 1, 3 and 4. Use of cofferdams and other dewatering devices prior to construction and construction during dry weather periods will greatly reduce potential for water quality degradation.

Regional water quality questions include the ability of the upper watershed to sustain spawning requirements, such as clean gravels. Transmission of waterborne diseases also relates to water quality. The effects of anadromous fish carcasses on the nutrient cycle may also be considered. Regional water qua1 ity will be equally affected by all alternatives.

E. Air Quality

The project is expected to cause minimal effects on air quality. Construction activity will cause some particulate emissions. This will be minor for all alternatives. Increased vehicle use will cause increase of gaseous pollutants including sulfur and nitrogen oxides. Fishway alternatives (1 and 2) would involve vehicle use mainly during construction whereas trap and haul alternatives would involve continuous vehicle use during the life of the project. The fishways, however, have potential to increase vehicle use by park visitors. Overall, air quality effects will be roughly equivalent for all alternatives. Regional air quality will not be affected to any measurable extent.

F. Soil and Hazardous Waste and Toxics

No hazardous or toxic materials are expected to be involved in construction, although concrete and other construction materials may degrade water quality and have potentially toxic effects on fish. Additional visitor use of the park resulting from alternatives 1 and 2, and to a lesser extent alternatives 43 and 4 may create the need for additional sanitary facilities at the state park. There would be no regional effects for this category.

G. Geology and Soils

Site effects on geology and soils will involve effects of instream construction on sediments, excavation work in the canyon and spoil movement and disposal. In general, alternatives 1 and 2 involve the largest amount of rock and soil modification. Erosion may be a problem during construction on the steep canyon walls. Considerable grading will also be needed for alternatives 3 and 4 which require construction of access roads usable by trap and haul trucks.

Regional aspects involve the effect of existing soils and geology on river turbidity and, therefore, spawning success. Effects from changes in land use on soils must also be considered. Regional changes will be generally similar for all alternatives.

H. Cultural

This topic includes cultural resources in the basin, including treaty rights and uses by Indian Tribes, or effects of land use alterations on past or present uses by Tribes including archaeological resources. On-site effects will focus on the existing abandoned powerhouse which is eligible for the Historical Register nomination. While the powerhouse will not be directly affected by any construction, alternatives 1, 2 and 3 will involve construction near the powerhouse and might affect access. Other than this, all alternatives are roughly equivalent on both a site and regional basis.

I. Recreation

Site impacts to recreation mainly involve alternatives which affect the park. With alternatives 1 and 2, the fishways may attract additional visitors to view passage facilities. To a lesser extent, this applies to alternative 3 and 4. This will affect park use and access and could require expanded park facilities. For alternative 2, there is a potential for reduced flows over the waterfall. All alternatives could lead to increased sport fishing above the falls, both on the site and on a regional basis. On a secondary level, this could lead to increases in hunting and general recreation in the basin.

J. Noise

Noise effects will involve construction noise and blasting effects. During construction, impacts on the park, nearest residences and surrounding farms will be similar for all alternatives, although alternatives 1, 2 and 3 will affect more people since they are closer to park facilities. Alternatives 3 and 4 will have a long-term noise effect due to trucks used during operation. No significant regional noise effects will occur for any of the alternatives.

K. Aesthetics

This will be one of the major considerations at the site. Flow requirements of the fishway alternatives (1 and 2) may affect the amount of water passing over White River Falls. The fishways will also be large and of high visual impact. The assessment must address design mitigation of these effects. Trap and haul alternatives will be more isolated from view and somewhat smaller in scope.

The regional aesthetics may be changed to a minor amount by the introduction of fish in the upper watershed, but changes in human use and land use patterns make this an important issue. Regional effects will be identical under all alternatives.

L. Economics

Generally, economics would be deleted for an Environmental Assessment under current BPA guidelines. In this project, however, the economics of fisheries costs and benefits are a major issue. Since a separate benefit analysis is being performed on this topic, the EA will summarize benefit/cost information developed in other portions of the study. Benefits to the local economy, sport and commercial fisheries and Indian Tribes will occur. The interface with proposed hydropower projects may create problems of competition for water use. Variation in economics by alternative cannot be assessed at this time, but will be addressed in the environmental report.

THRESHOLD QUESTIONS

BPA's Preliminary Environmental Guidelines require not only determination of level of potential impact within each category, but also addressing a series of threshold questions. These questions deal mainly with compatibility of use with existing laws, ordinances and designated sensitive areas. "Red Flag" issues are brought out and specific points which might require EIS preparation are made clear. The threshold questions are organized under the same series of environmental categories as those discussed above, except that energy conservation is substituted for soils, and recreation and aesthetics are combined under land use.

- A. Existing and Planned Land Use.

1. State, Areawide and Local Plan and Program Consistency

- Description and Location of Proposal -- The proposed development site is located in section T4S R14E in Wasco County, Oregon. The White River watershed lies entirely--within Wasco County with a drainage area of 238,080 acres in Wasco and Hood River Counties.

- Project Site -- The project site is designated Exclusive Farm Use (EFU) Wheat and Range. Zoning is EFU (A-l 80). The Wasco County Comprehensive Plan has not yet been approved by the Oregon Land Conservation and Development Commission. The plan states that "Commercial utility facilities for the purpose of generating power for public use by sale. .." requires a conditional use permit under the zoning ordinance (i.e., the proposed Northern Wasco County PUD hydroelectric project). However, "Normal fish and wildlife management activities including but not limited to: fish hatcheries, public wildlife refuges, experimental areas..." are permitted outright under the zone. The zoning and plan designations either allow the proposal outright or as a conditional use. No public objection to the Wasco County Comprehensive Plan has been lodged that would affect the proposal.

- Regional -- The Wasco County Comprehensive Plan designates most of the White River watershed as EFU Wheat and Range, Forest or Reservation Lands. Zoning is dominated by EFU (A-l 80), Forest (F-2 80) or Reservation Lands.

2. Coastal Zone Management Program Consistency

- Is the project within or does it directly effect the coastal zone? NO.

  The proposed project is not within the coastal zone of Oregon. The only potential effects on the coastal zone may be an increase in salmon and steelhead stocks available to coastal fishermen.

3. Permit for Right-of-way on Public Land

- Is or does this proposal include the use of public lands not in accordance with the primary management objectives of these lands? POSSIBLY.

  The lands within U.S. National Forest boundaries are planned for multiple use under the Badger-Jordan Planning Unit Land Management Plan of the Mt. Hood National Forest. Fishery introduction is compatible with the plan and policies. The White River within the National Forest boundary has been identified by public groups as having potential for inclusion in the National Wild and Scenic Rivers System. The recommended management direction for Wildlife and Fish states "Permit structural and non-structural habitat improvement provided they do not introduce non-native species that could significantly change the natural ecosystem." Clarification of this Interim Managment Direction is necessary to determine if it conflicts with or is compatible with the proposal.

4. Farmlands

- Is or does this proposal include an action which converts farmlands to other uses or causes physical deterioration and/or reduction in productivity reducing the farmland's value for production? POSSIBLY.

  The proposal will directly affect a minimal area that is generally unsuitable for farming, grazing or fiber production. Indirect effects may include pressure for increased recreation access through farmlands (roads). Most recreational activity will be fishing and camping which would take or affect only minimal amounts of land.

5. Recreation Resources

- Does this proposal affect values for wild and scenic rivers? NO.

  Although sections of White, River are being considered for nomination as a wild and scenic river, the White River at the project location has not been identified by the Department of Interior as a study river for inclusion in the National Wild and Scenic River System. The White River in this location has not been identified by the State of Oregon for inclusion in the State Scenic Rivers program. However, public groups have identified areas in the upper watershed believed to have wild and scenic river potential.

- Is this proposal incompatible with the National Trail System? NO.

  The proposed project is not located on or near any National Recreation trails.

- Is this proposal affected by standards for Forest Service or BLM wilderness areas? NO.

  The wilderness inventory by BLM did not identify lands along White River as having wilderness value or potential. The U.S. Forest Service RARE II inventory did not identify Forest Service Lands within the White River Watershed for wilderness evaluation.

- Is this proposal affected by standards for BLM areas of critical environmental concern? NO.

  No Bureau of Land Management areas of environmental concern exist within the White River Basin, although there is considerable BLM land in the basin.

- Is this proposal affected by standards for parks or other areas of ecological, scenic, recreational, or aesthetic importance? YES.

  It is expected that because of the proximity of the State Park and because the old powerhouse is being considered as a historical monument, any construction in the canyon and the falls area will have to comply with state standards for construction in park areas.

The proposed construct ion and fishery enhancement will not adversely affect the recreational use of White River Falls State Park unless significant flow diversion occurs or access is impaired. With proper park planning, the fishway or trap and haul facility (alternatives l-4) can be used to enhance the interpretive value of the State Park.

The Oregon Natural Heritage Plan has identified riparian habitats in this area as having moderate to high priority for protection. Three riparian areas of the White River system have been identified as having Natural area value by the Nature Conservancy. Site WC-30, the White River Canyon, includes the construction site. This area is protected by an overlay zone that requires additional findings of compatibility for conditional uses.

- Does this proposal convert to other than outdoor public recreation uses property acquired or developed with assistance from land and water conservation funds? NO.

  No property will be acquired or developed with assistance from land and water conservation funds. BPA will fund the entire project.

B. Vegetation, Fish and Wildlife

1. Endangered and Threatened Species and Critical Habitat Threshold Questions

- Will this proposal affect a listed species? POSSIBLY. Minor beneficial impact. A few (l-2) wintering Bald Eagles (Haliaeetus Leucocephalus, Threatened) were observed along the White River and a tributary during 1981 and 1982 (Wasco County PUD 1983). Carrion in the form of spawned out anadromous fish, which the project will introduce to the river reach above the falls, may provide increased seasonal food supplies for Bald Eagles, as well as a variety of other brids and mammals that feed on anadromous fish. Wildlife which utilize anadromous fry and smolts may also benefit from increased food supplies in the White River above the falls. No federally listed threatened or endangered plant species are located at the site or are suspected to occupy habitats in the watershed. Six candidate plant species occupy habitats potentially affected bY the project and one species, Astragalrs tyghensis is found only in the Tygh Valley. There are no known threatened or endangered fish species in White River.

- May this proposal adversely modify a critical habitat, as listed by the Secretary of Interior? NO. Any critical habitat occurring in the White River Basin will not be adversely modified by the project. Activities during construction may temporarily disturb habitats of some species but species displacement will not occur to any significant extent.

0 Will this proposal result in construction and/or a construction contract? YES.

The proposal for a fish passage at White River Falls will result in construction of fish collection or fishway facilities. The fishway alternatives (1 and 2) will require more extensive construction activites.

2. Fish and Wildlife Conservation

0 Is or does this proposal include an action where the waters of any water body are to be impounded, diverted, deepened, or otherwise controlled or modified for any purpose whatsoever? YES.

A feasibility study to open passage through the natural rock falls of White River Falls is listed as item (U) in Table 8, Passage Development and Restoration Projects in Washington, Oregon and Idaho, page 7-12 of the Northwest Power Planning Council's (1982) Columbia River Basin Fish and Wildlife Program. Alternatives 1 and 2 create the only significant water diversion. Alternatives 2 and 4 involve creation of barrier dams which will impound and deepen the river to a minor extent at the site.

o Is or &es this proposal include a proposal for action which is consistent with the Northwest Power Planning Council's Northwest Conservation and Electric Power Plan including the Columbia River Basin Fish and Wildlife Program? YES.

The White River fish passage project is consistent with the Northwest Power Planning Council's Northwest Conservation and Electric Power Plan including the Columbia River Basin Fish and Wildlife program. Construction using federal funds will fall under Fish and Wildlife Coordination Act requirements.

C. <u>Hydrology</u>

1. Wetlands

0 Is or does this proposal include construction and/or improvements in a wetland? NO.

The only wetland that occurs is an intermittent stream located on the south side of White River located downstream from both the proposed trap and haul or fishway facilities. The proposed project will not affect this wetland area.

2. Floodplains

0 Is or does this proposal include construction and/or improvements within, or activities which take place or have impact on a 100-year floodplain? YES.

Parts of the proposed fish passage project will unavoidably be located on the floodplain. However, the facility will be designed to withstand floods. The facility will not cause additional flooding of adjacent areas.

3. Permit for Structures in Navigable Water

0 Is or does this proposal affect any navigable water of the United States? NO.

The proposed project is not located on any navigable water of the United States.

D. Water Quality

1. Permits for Discharges into Waters of the United States

- Is or does this proposal include discharge of dredged or fill material into waters of the United States? NO.

  Any excavated material will be deposited above the high water line. Therefore, it is not expected that a permit will be required for discharge of dredged or fill material.

2. Clean Water Act

- Might this proposal result in the discharge of pollutants into the waters of the United States either from point or nonpoint sources which pertain to water quality standards promulgated under National Pollution Discharge Elimination System (NPDES), State water quality requirements, and Section 208 of the Clean Water Act? NO; POSSIBLY; NO.

  The proposed fish passage project will not discharge any pollutants into White River which pertain to water quality standards promulgated under NPDES.

  Permits will most likely be required from the Corps of Engineers and the State Land Board for excavation in connection with fish collection or fish passage facilities. A permit may also be required from the State Department of Fish and Wildlife for any blasting in the stream. A temporary variance from the State Department of Environmental quality -- water quality standards will be required for excavation in the stream.

The proposed fish passage project will be in compliance with Section 208 of the Clean Water Act.

3. Safe Drinking Water

0 Is this proposal affected by drinking water standards of EPA or a State which has assumed primary enforcement authority for drinking water standards? NO.

The proposed project will not discharge any toxic pollutants into any waters. Therefore, this proposal will not be affected by EPA or State Drinking Water Standards. No drinking water sources exist in White River downstream from the proposed project.

0 Is this proposal one which affects ground water, including sole source aquifers? NO.

Ground water will not be affected from the fish passage project. During construction, excavation will not be deep enough to affect the ground water in the area. No pollutants" will be discharged which might seep into ground water aquifers.

E. <u>Clean Air Act</u>

0 Is this proposal affected by air standards promulgated under National Ambient Air Quality Standards, State Implementation Plans (SIPS), new source performance standards or prevention of significant deterioration regulations, national emission standards for hazardous pollutants and/or emission limitations in air quality control regions? NO.

No air pollutants will be emitted by the proposed fish passage project. Therefore, the project will not be affected by any air standards. Emissions from construction vehicles are temporary and minor in nature and are not covered by National or State air quality standards.

F. Solid and Hazardous Waste Management

1. Solid Waste Management

o Will this proposal result in potential procurement of recyclable products, source separation of recyclable products, solid waste storage, solid waste transport and solid waste disposal? POSSIBLY.

No recyclable products will be produced by the proposed fish passage project. Disposal of excavated materials during construction must be considered. Also additional visitor use at the State Park may create a need for additional sanitary facilities.

2. Hazardous Waste Management

0 Is this proposal affected by Environmental Protection Agency (EPA), Department of Transportation (DOT) or by State regulations on hazardous waste? NO.

No hazardous wastes will be generated by the proposed fish passage project. Therefore, EPA, DOT and State regulations on hazardous waste will not affect the project.

3. Pesticides

0 Is this proposal affected by regulations on the purchase, use, storage, or disposal of pesticides? POSSIBLY.

A fish research facility proposed by Oregon Department of Fish and Wildlife may use an anaesthetic classified as pesticide. Any discharge to the river will require a variance from Oregon Department of Environmental Quality.

4. Toxic Substance Control

- Is this proposal affected by EPA regulations on PCBs? NO.

  No PCBs will be involved in the proposed fish passage project.

G. Energy Conservation at Federal Facilities

- Is or does this proposal include the operation, maintenance, or retrofit of an existing federal building; the construction or lease of a new federal building; or federal agency operations other than building operations (such as services, operation of aircraft and land vehicles, and operation of federal facilities)? NO.

  No federal buildings will be used for the proposed fish passage project. Trucks used for a trap and haul may be purchased by BPA but will be turned over to the State Department of Fish and Wildlife for operation.

H. Heritage Conservation

- Does this proposal have an effect on access to religious sites or on ceremonial rites of the Native Americans; a property listed on the National Register of Historic Places; a property eligible for listing on the National Register of Historic Places; a property listed on the National Register of National Landmarks; or a property listed as a National Historic Landmark? NO.

No known religious sites or ceremonial rites of the Native American occur in the project vicinity.' The old powerhouse is eligible for historical register nomination which gives it the same protection as if it were listed on the register. But, the proposed project will not disturb the old powerhouse. The property is not listed on the National Register of National Landmarks nor is it listed as a National Historic Landmark.

0 Does this proposal have an effect on the excavation, removal, damage, alteration, or defacing of any archaeological resource located on public lands, Indian lands, or on lands held in fee title by the United States or BPA or_ a property listed on the World Heritage List? NO.

No known archaeological resource is located on the project vicinity and the proposed fish passage project is not listed on the World Heritage List.

I. Noise Control

0 Is this proposal affected by noise standards? NO.

Major noise emissions will not be generated by the proposed fish passage project. During construction, some noise may occur from blasting and excavation. Also, trucks used for construction and for a trap and haul facility will create noise. But, this noise will be minor and the project should not be affected by state or federal noise standards.

CHAPTER 12

POTENTIAL FOR DISEASE CONTAMINATION OF OAK SPRINGS HATCHERY

The issue of potential contamination of the Oak Springs Hatchery water supply with disease carried by anadromous fish into the White River watershed is extremely important to consider. The Oak Springs Hatchery is one of relatively few in the Pacific Northwest which has remained free of serious disease problems. It is, therefore, essential to identify the level of risk to the hatchery's water supply, presented by the introduction of potentially disease-carrying anadromous fish into the White River watershed, and to explore possible solutions to the problem.

Certain facts are known. The Oak Springs Hatchery water supply comes from springs in an aquifer which subtends Juniper Flat. These springs, and hence the hatchery% water supply, are occasionally augmented by surface flow during periods of high runoff. This surface flow, called Oak Springs Creek originates from marshy ponds in the northeast extremity of Juniper Flat on the bluff overlooking Oak Springs. Although there is no natural drainage over Juniper Flat from the watershed to which anadromous fish would gain access, the Clear Creek/Frog Creek ditch system which originates in the southwest extremity of the White River drainage, extends over the flat and one of its laterals terminates in the marshy ponds on Oak Springs Creek. Low concentrations of sulfates, chlorides and nitrates in the water of Oak Springs indicate that infiltration from the irrigation system into the aquifer does not appear to be significant (Foundation Sciences, 1981). Nevertheless, coupling cannot be ruled out with presently available information. Hence, there is some potential for contamination of the hatchery water supply if disease were introduced into upper Clear Creek or upper Frog Creek.

In order to further assess the potential for disease contamination and to identify possible methods to reduce or eliminate that potential, certain activities are being carried out. It is reasonable to expect that if viral disease is present in the White River watershed but not in the Oak Springs Hatchery water, any connection is insufficient to affect contamination. Therefore, the Oregon Department of Fish and Wildlife has begun a study to determine whether resident fish populations in the watershed carry disease of concern, especially IHN or PHN virus. Sampling of brook trout for PHN has been conducted and none was found, although some BKD (bacterial kidney disease) was identified. Sampling for IHN will be conducted this spring.

Surface flow patterns on the northeast extremity of Juniper Flat have been studied and the feasibility of diverting surface flow away from the Oak Springs was analyzed. It was found that prevention of surface flow contamination of the hatchery water supply is feasible, at least as far as water from the Clear Creek Ditch is concerned. Oak Springs Creek can be diverted either east for about l/4 mile to drain into the Deschutes River or northwest about the same distance to another small natural drainage which flows toward Devil's Halfacre and eventually into the White River about l/2 mile below the Falls.

Diversion structures on Clear Creek and Frog Creek were inspected and the feasibility of preventing access by anadromous fish into these streams above diversion points was assessed. It was found that preventing access above diversions is feasible in both cases.

Certain things are not known. It is not known whether IHN virus is present in the watershed. It is not known if water from the Clear Creek ditch system infiltrates into the Oak Springs aquifer, although water quality information indicates that if a connection exists the rate of infiltration is low. If infiltration is occurring, the infiltration route is not known and it is not known whether it is feasible to block or interrupt the connection if it exists.

Based on the foregoing, a set of possible solutions was developed. Some of these approaches were alluded to above. They include:

- Divert surface runoff away from the Oak Springs themselves, thus preventing direct contamination of the hatchery water supply from that source.

- Divert surface runoff away from the springs and interrupt surface-aquifer coupling if feasible.

- Isolate Upper Clear Creek and Upper Frog Creek from anadromous fish access, thereby preventing any disease contamination of the ditch system.

- Do nothing to reduce the risk of disease contamination of the ditch system, accept whatever risk accompanies such an approach and deal with disease problems at the hatchery if they occur.

Selection of the most appropriate approach or combination of approaches will depend upon results of the Oregon Department of Fish and Wildlife's studies and further information gathered by OTT. A separate report will be submitted to BPA with these findings.

REFERENCES

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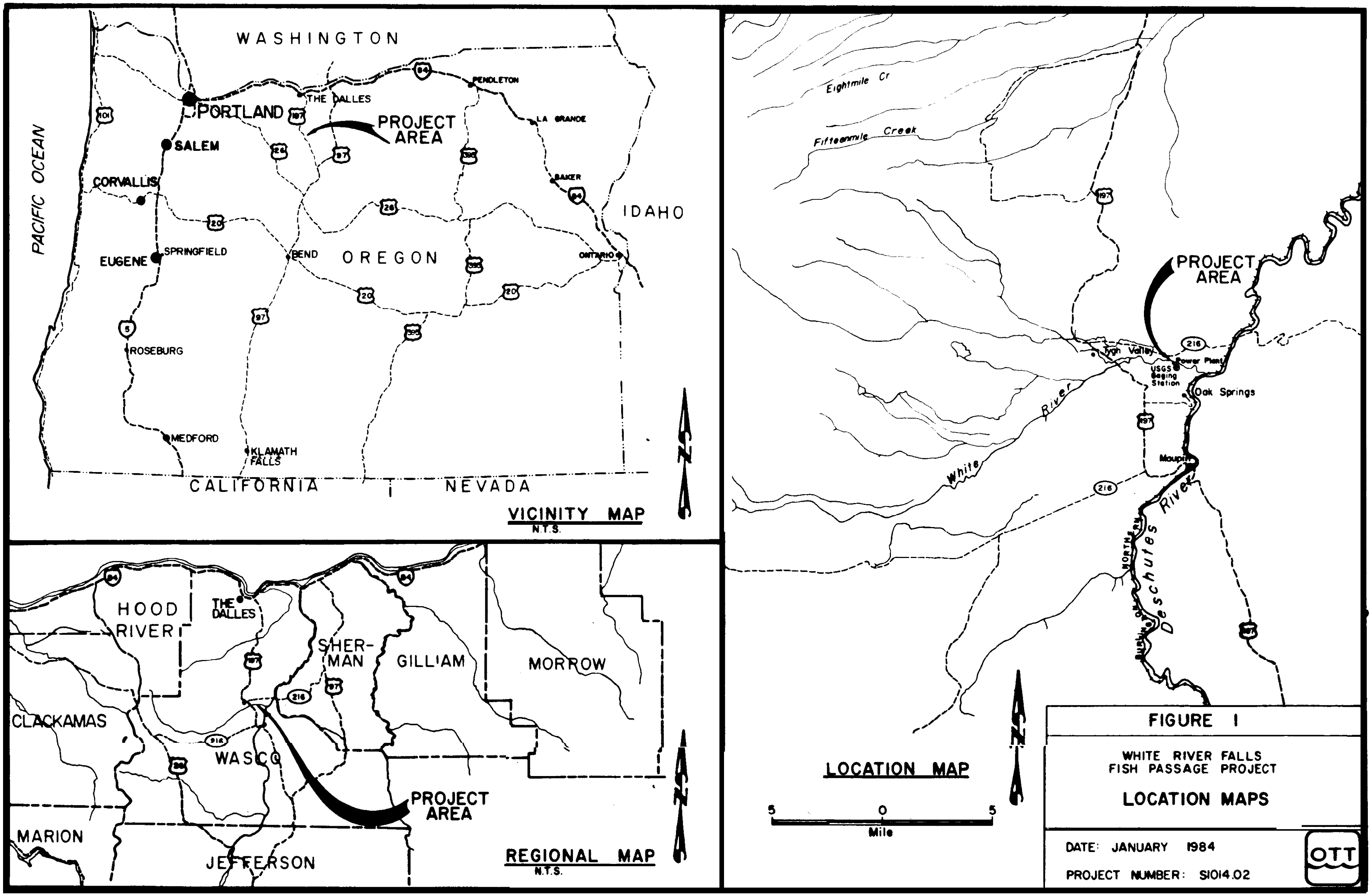
APPENDIX A

FIGURES


WASHINGTON
PACIFIC OCEAN
PORTLAND
THE DALLES
PENDLETON
LA GRANDE
PROJECT AREA
SALEM
CORVALLIS
BAKER
IDAHO
EUGENE
SPRINGFIELD
BEND
OREGON
ONTARIO
ROSEBURG
MEDFORD
KLAMATH FALLS
CALIFORNIA
NEVADA
VICINITY MAP
N.T.S.
HOOD RIVER
THE DALLES
SHERMAN
GILLIAM
MORROW
CLACKAMAS
WASCO
PROJECT AREA
MARION
JEFFERSON
REGIONAL MAP
N.T.S.
Eightmile Cr
Fifteenmile Creek
PROJECT AREA
Tygh Valley
Power Plant
USGS Gaging Station
Oak Springs
White River
Maupin
Deschutes River
LOCATION MAP
5 0 5
Mile
FIGURE I
WHITE RIVER FALLS
FISH PASSAGE PROJECT
LOCATION MAPS
DATE: JANUARY 1984
PROJECT NUMBER: S1014.02
OTT

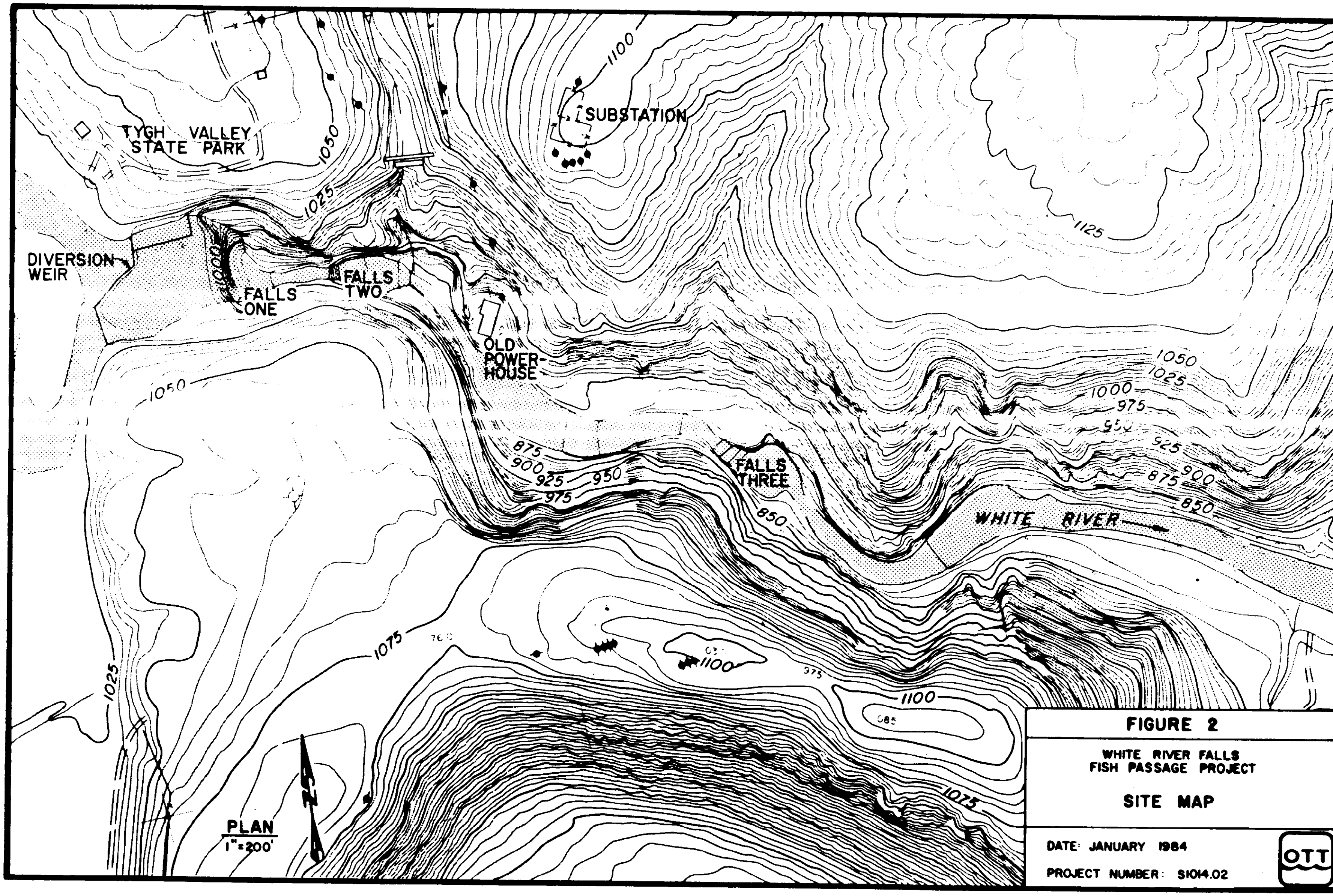


FIGURE 2

WHITE RIVER FALLS
FISH PASSAGE PROJECT

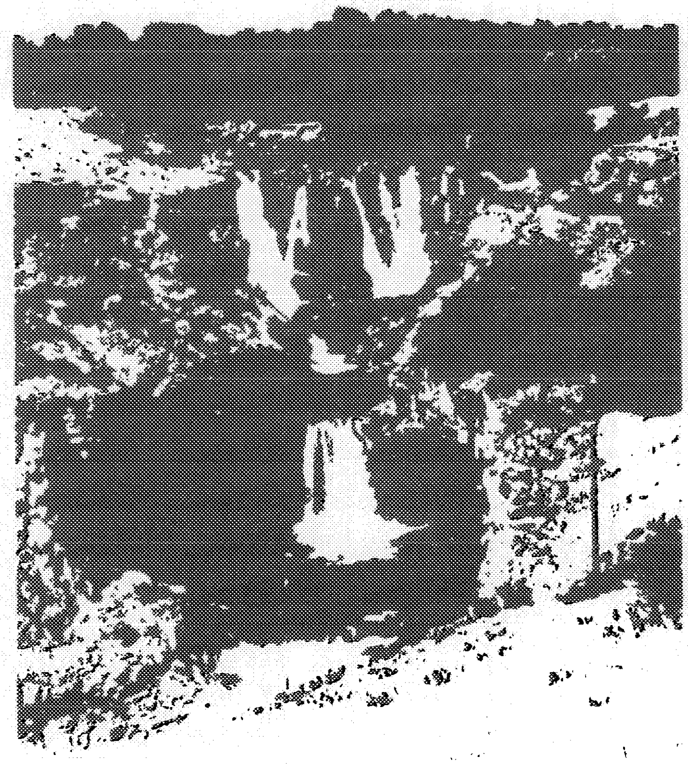
SITE MAP

DATE: JANUARY 1984

PROJECT NUMBER: S1014.02

OTT

Figure 3.--Photograph of Falls One and Two.



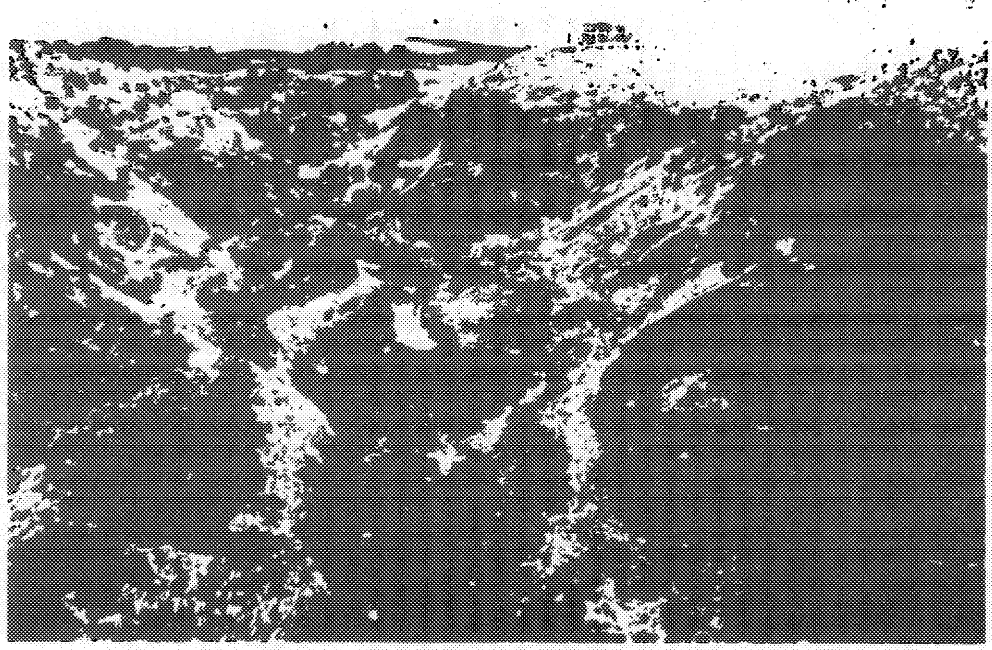


Figure 4.--Photograph of Falls Three looking upstream.

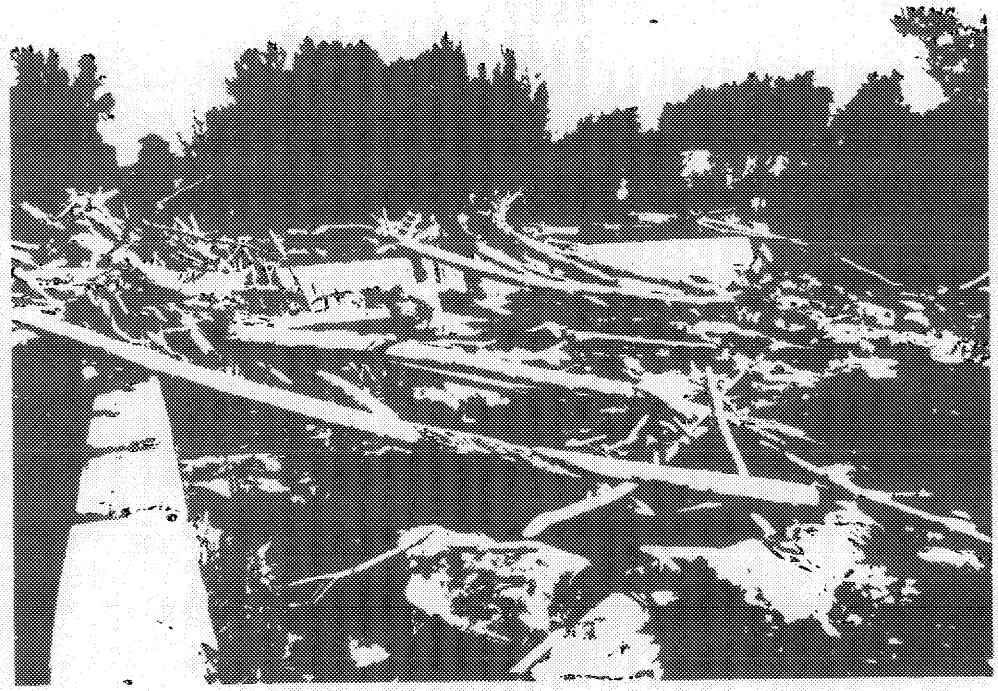


Figure 5.--Photograph of Existing Diversion Weir above Falls One.

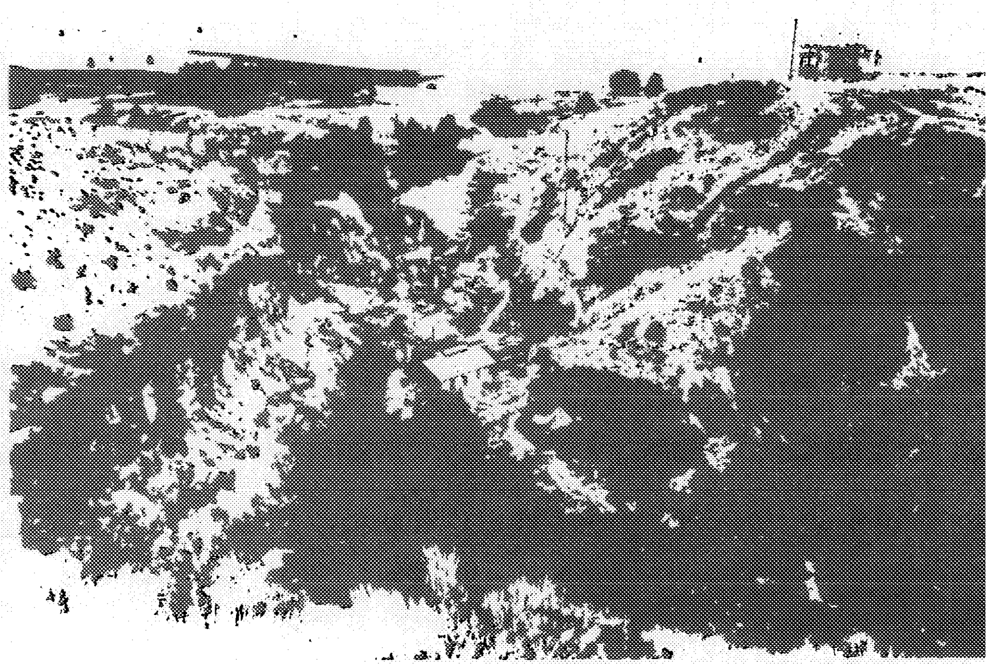


Figure 6.--Photograph of Old Powerhouse between Falls Two and Three.

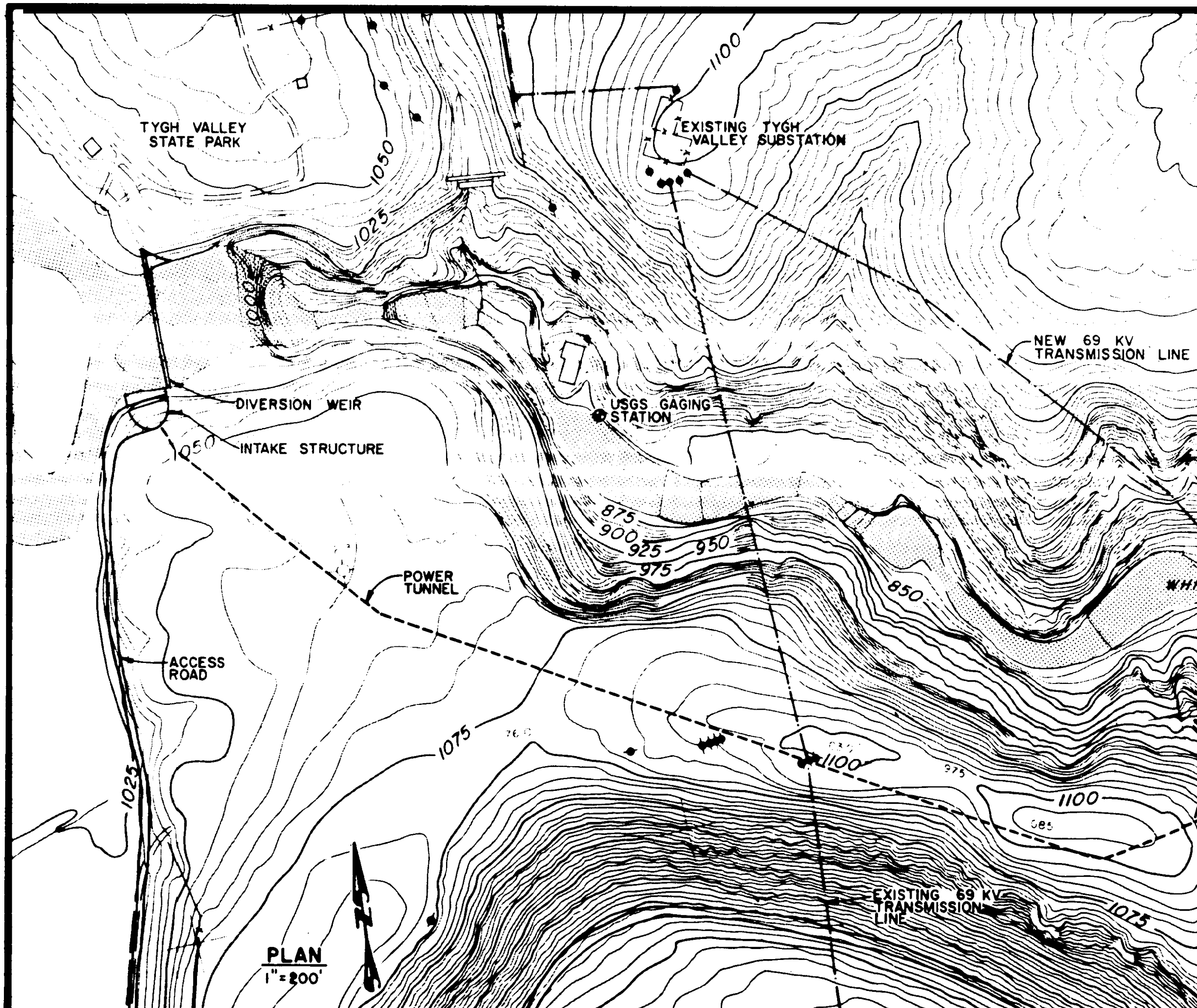


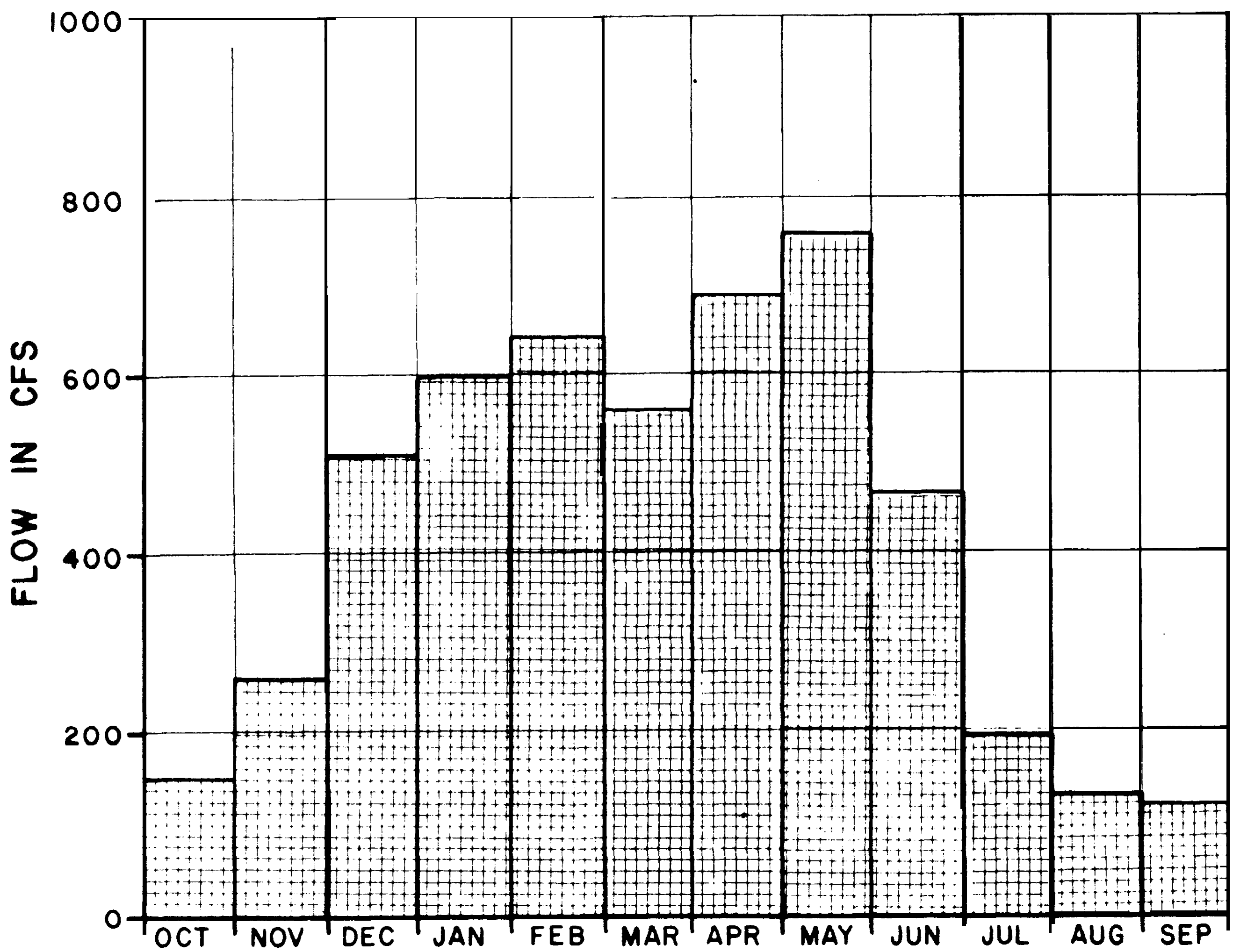
FIGURE 7

WHITE RIVER FALLS
FISH PASSAGE PROJECT

DEVELOPMENT PLAN OF
NORTHERN WASCO COUNTY PUD

DATE: JANUARY 1984

PROJECT NUMBER: S1014.02



NOTE: DATA FROM WATER YEARS 1918 TO 1982 USGS GAGE 1410150, WHITE RIVER BELOW TYGH VALLEY, OREGON.

FIGURE 8

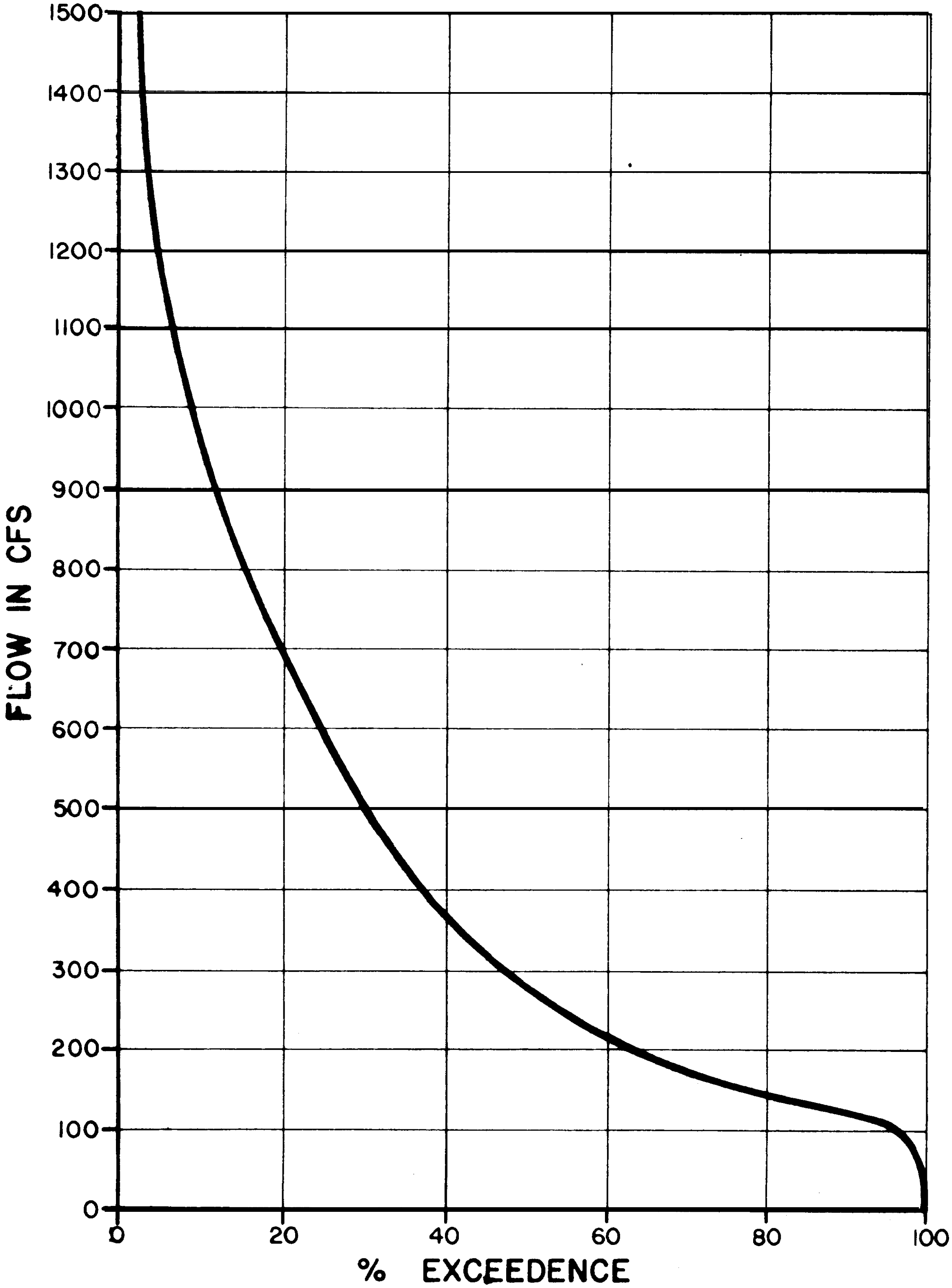
WHITE RIVER FALLS
FISH PASSAGE PROJECT

MEAN MONTHLY HYDROGRAPH

DATE: JANUARY 1984

JOB NUMBER: S1014.02

OTT



NOTE: DATA FROM WATER YEARS 1918 TO 1982 USGS GAGE 1410150, WHITE RIVER BELOW TYGH VALLEY, OREGON.

FIGURE 9

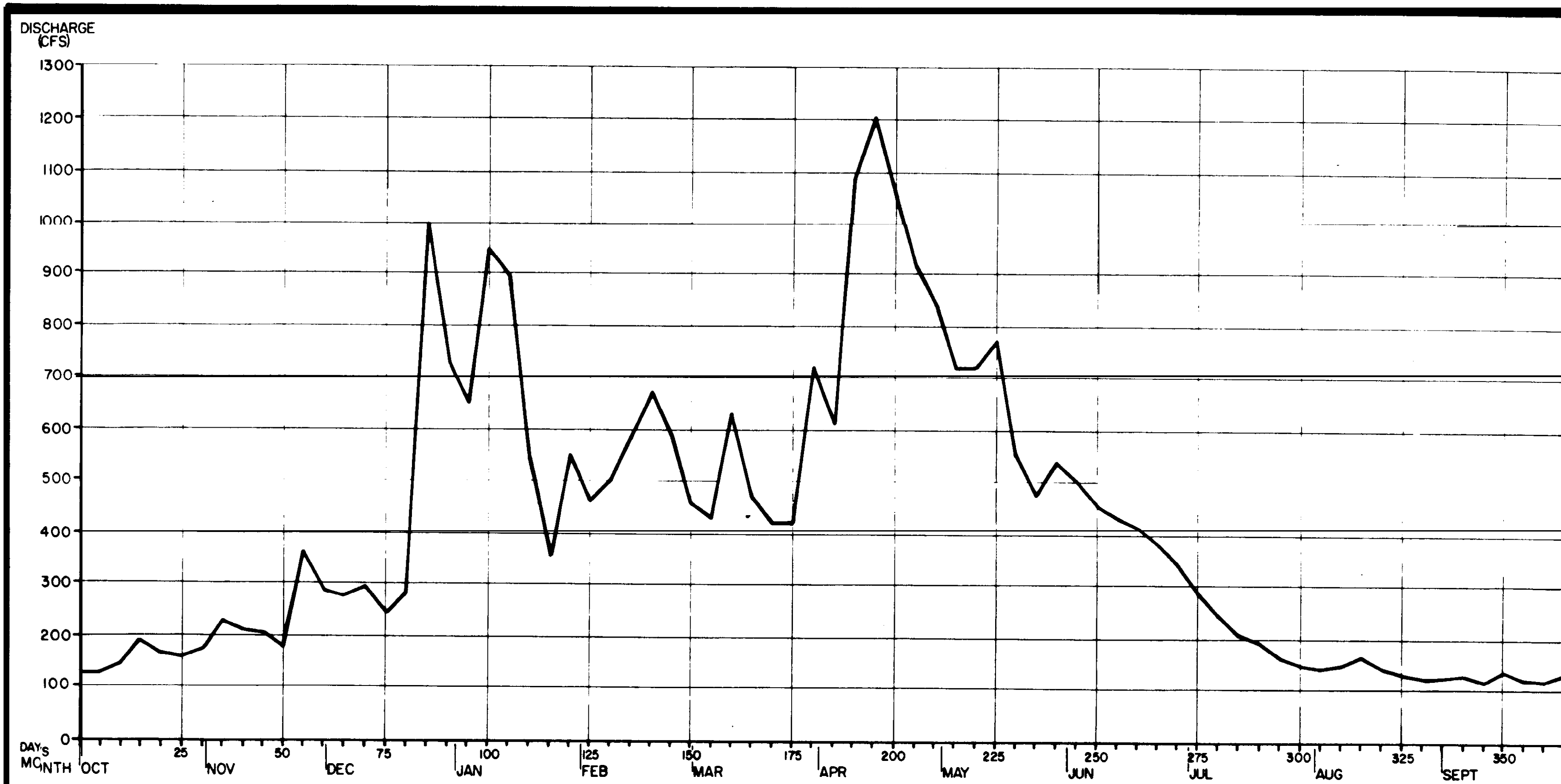
WHITE RIVER FALLS
FISH PASSAGE PROJECT

FLOW DURATION CURVE

DATE: JANUARY 1984

JOB NUMBER: 91014.02

OTT



NOTE: WATER YEAR 1962 AT USGS GAGE 1410150, WHITE RIVER BELOW TYGH VALLEY, OREGON

FIGURE 10

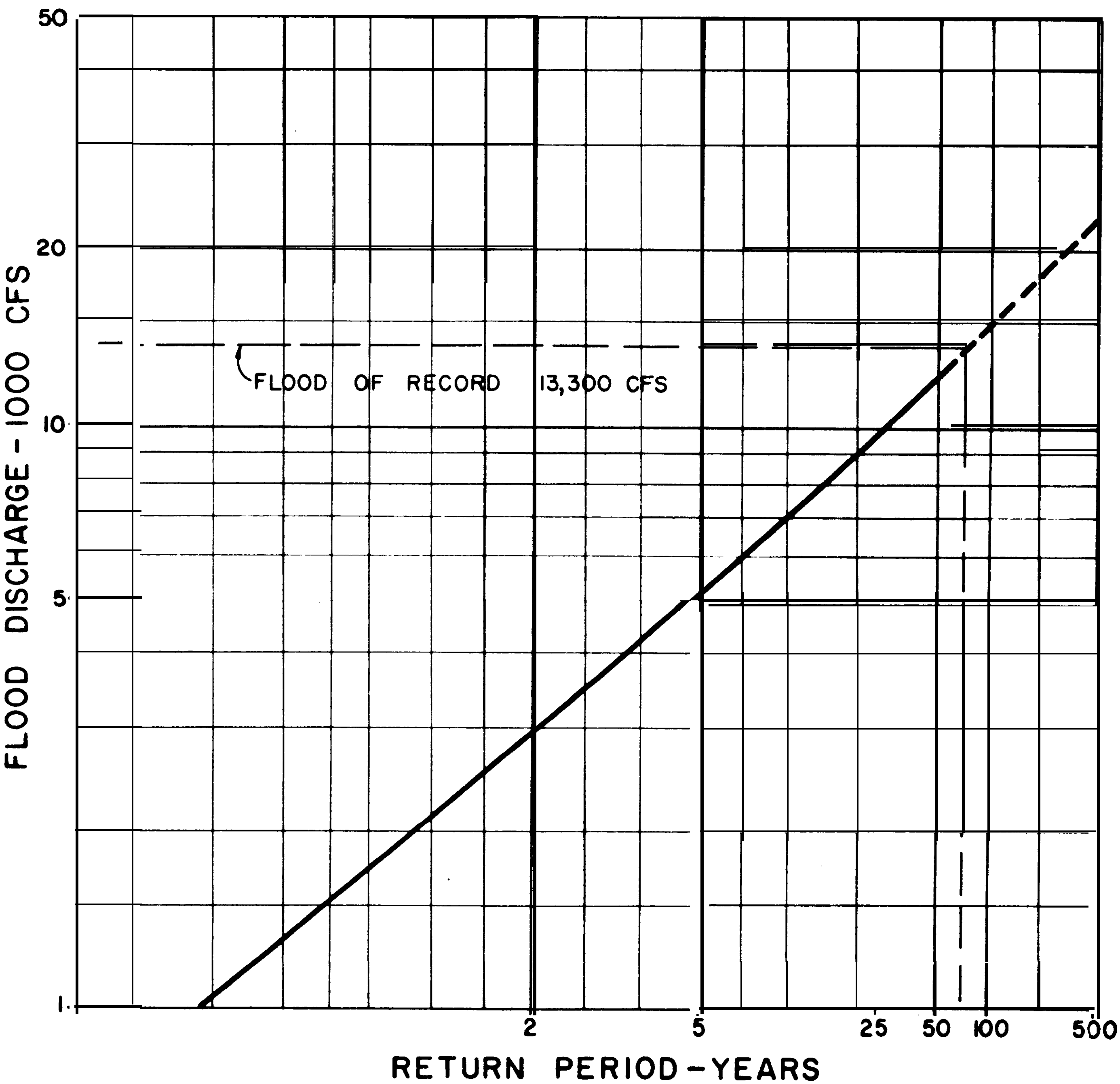
WHITE RIVER FALLS
FISH PASSAGE PROJECT

TYPICAL WATER YEAR

DATE: JANUARY 1984

PROJECT NUMBER: S1014.02

OTT



AFTER NORTHERN WASCO COUNTY PUD 1982

NOTE: WHITE RIVER AT PROJECT SITE

FIGURE 11

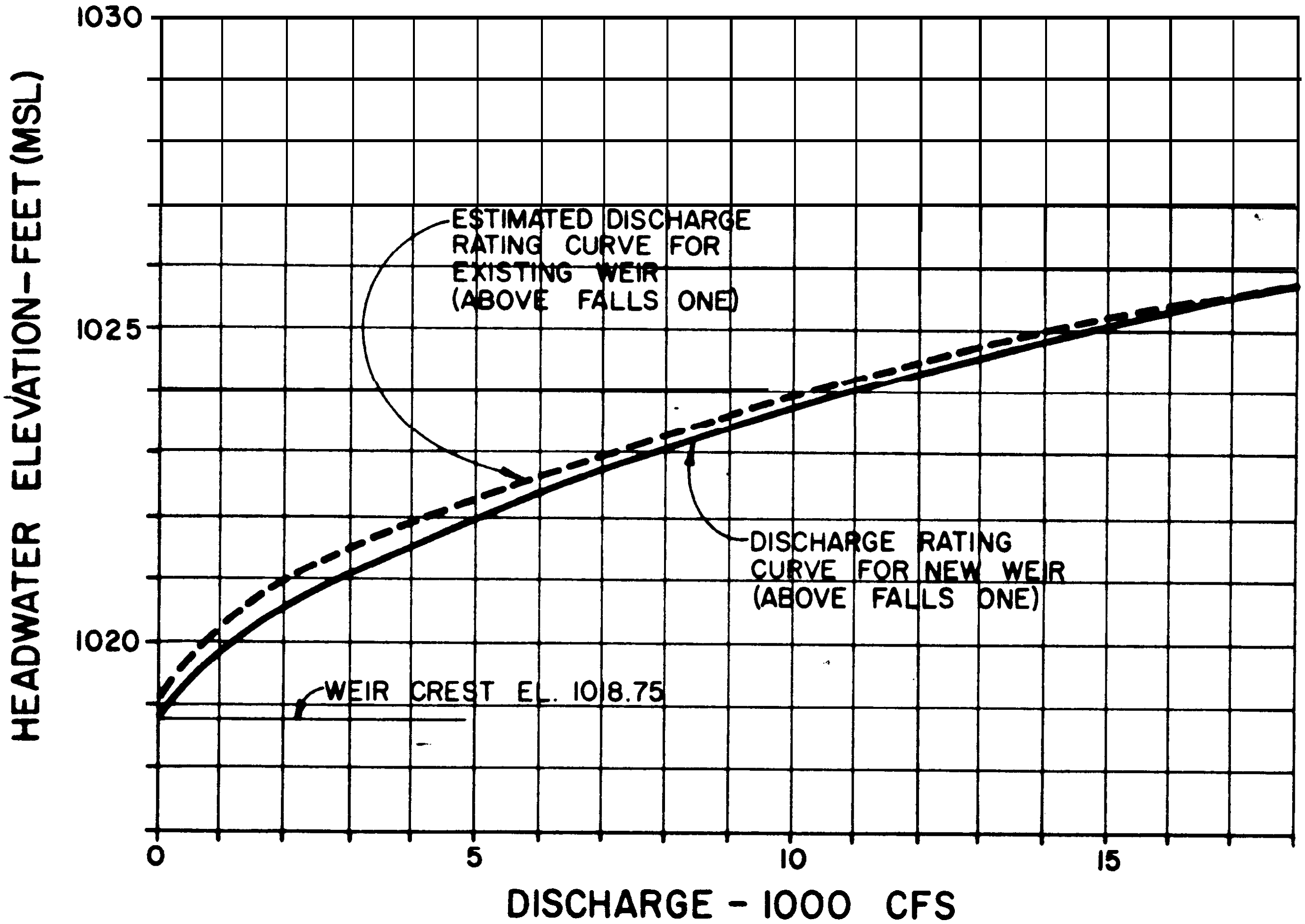
WHITE RIVER FALLS
FISH PASSAGE PROJECT

FLOOD FREQUENCY CURVE

DATE: JANUARY 1984

JOB NUMBER: S1014.02

OTT



AFTER NORTHERN WASCO COUNTY PUD 1982

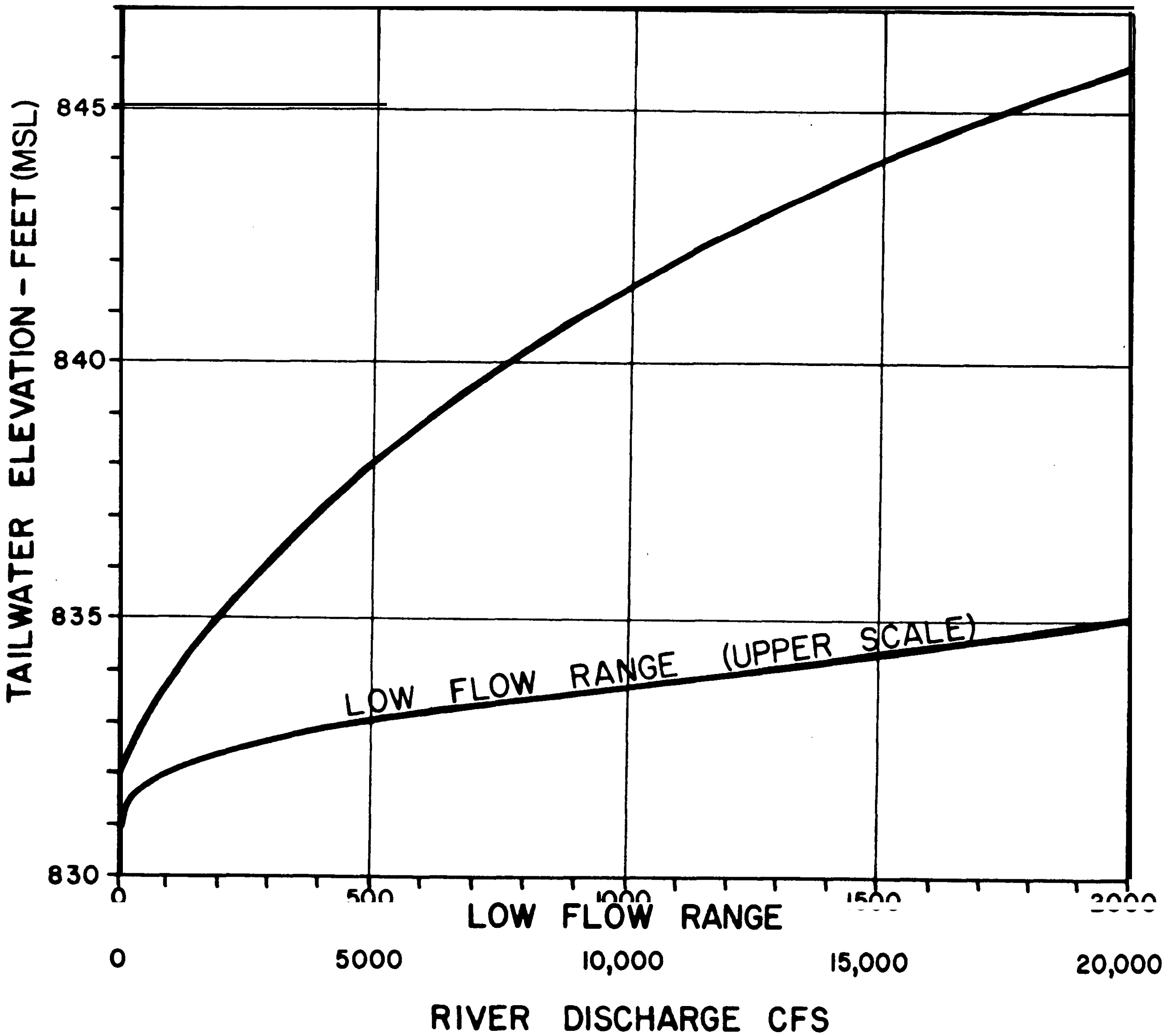
FIGURE 12

WHITE RIVER FALLS
FISH PASSAGE PROJECT

DISCHARGE RATING CURVE

DATE: JANUARY 1984
JOB NUMBER: S1014.02

OTT



AFTER NORTHERN WASCO COUNTY PUD 1982

FIGURE 13

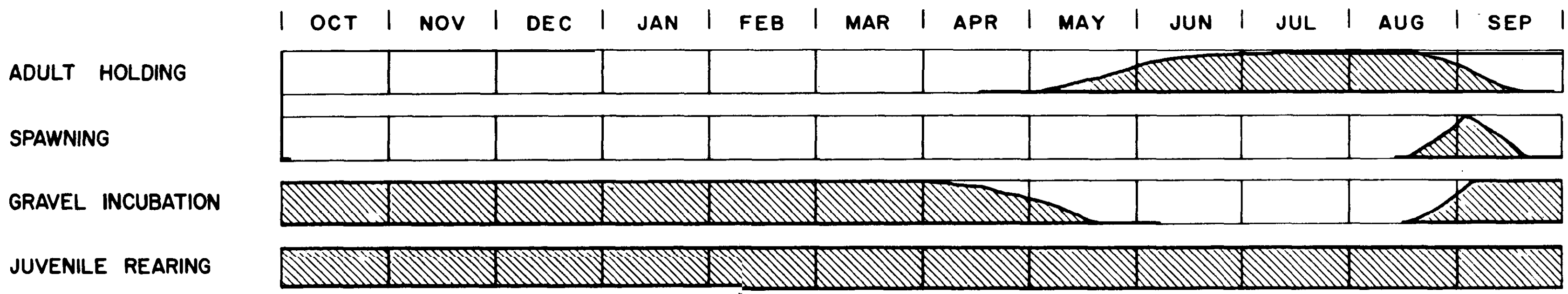
WHITE RIVER FALLS
FISH PASSAGE PROJECT

POWERHOUSE TAILWATER RATING CURVE

DATE: JANUARY 1984

JOB NUMBER: S1014.02

OTT



AFTER TERRY LUTHER, WARM SPRINGS INDIAN NATION

FIGURE 14

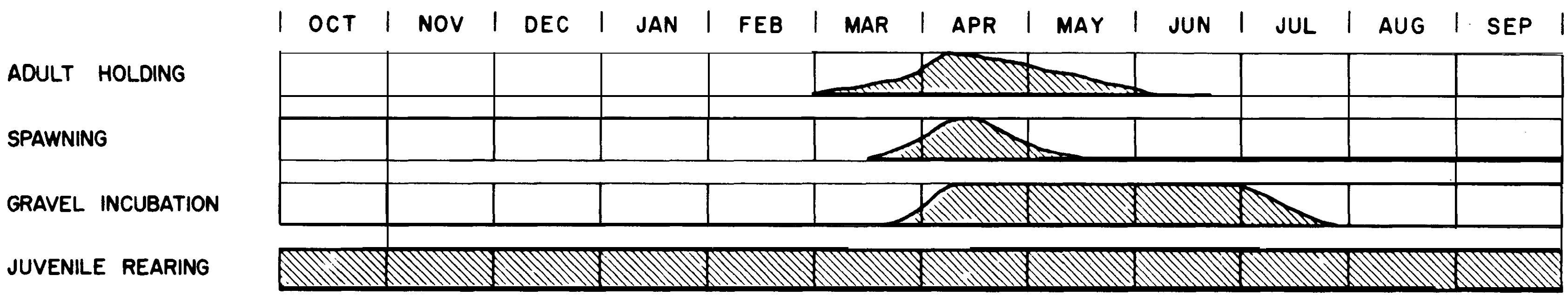
WHITE RIVER FALLS
FISH PASSAGE PROJECT

TIMING, DURATION & INTENSITY OF SPRING CHINOOK SALMON IN THE WARM SPRINGS RIVER

DATE: JANUARY 1984

PROJECT NUMBER: S1014.02

OTT



AFTER TERRY LUTHER, WARM SPRINGS INDIAN NATION

FIGURE 15

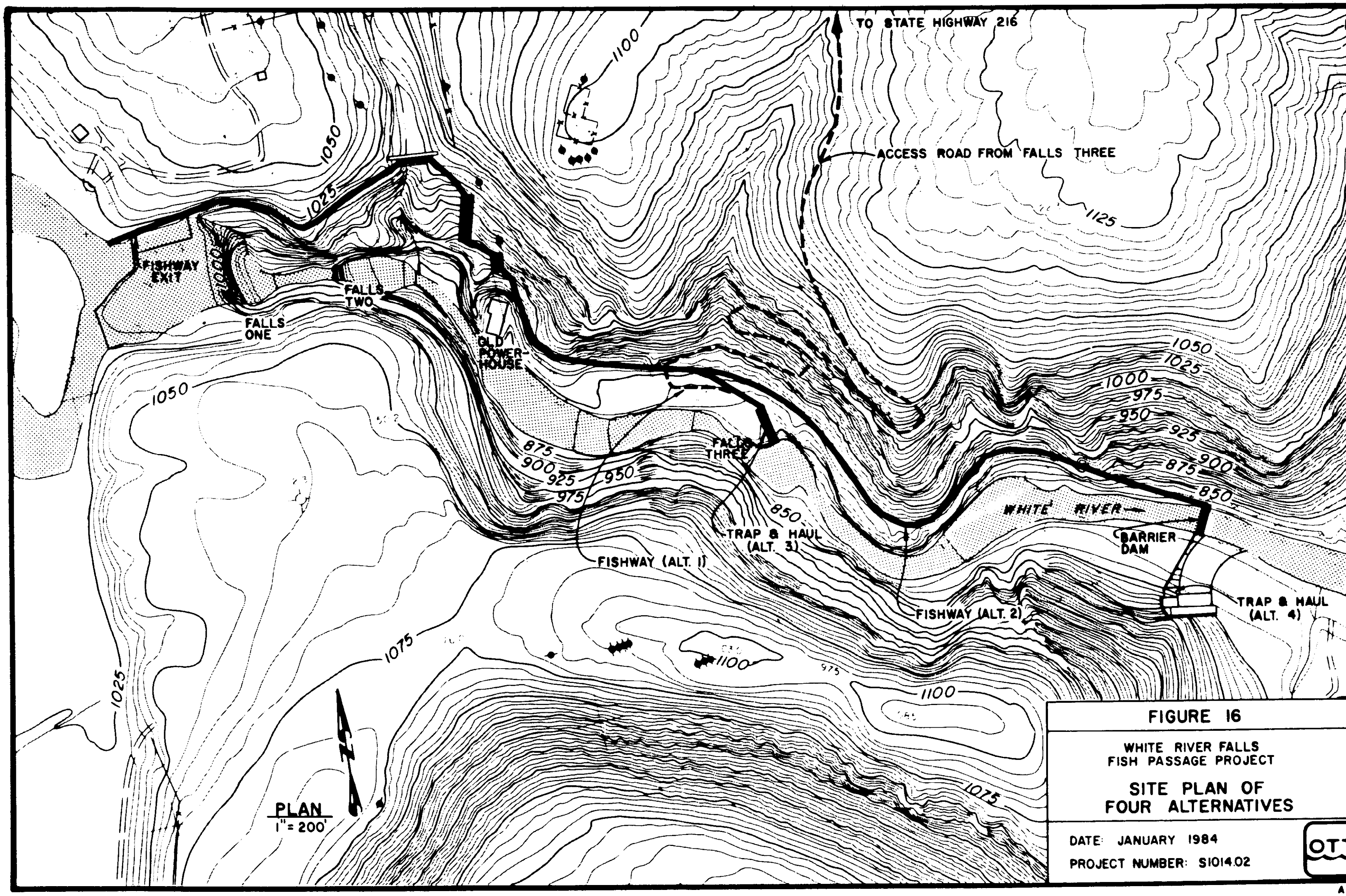
WHITE RIVER FALLS
FISH PASSAGE PROJECT

TIMING, DURATION & INTENSITY OF SUMMER STEELHEAD IN THE WARM SPRINGS RIVER

DATE: JANUARY 1984

PROJECT NUMBER: S1014.02

OTT



TO STATE HIGHWAY 216
ACCESS ROAD FROM FALLS THREE
FISHWAY EXIT
FALLS ONE
FALLS TWO
OLD POWER-HOUSE
FALLS THREE
WHITE RIVER
BARRIER DAM
TRAP & HAUL (ALT. 3)
FISHWAY (ALT. 1)
FISHWAY (ALT. 2)
TRAP & HAUL (ALT. 4)
PLAN
1" = 200'
FIGURE 16
WHITE RIVER FALLS
FISH PASSAGE PROJECT
SITE PLAN OF
FOUR ALTERNATIVES
DATE: JANUARY 1984
PROJECT NUMBER: S1014.02
OTT

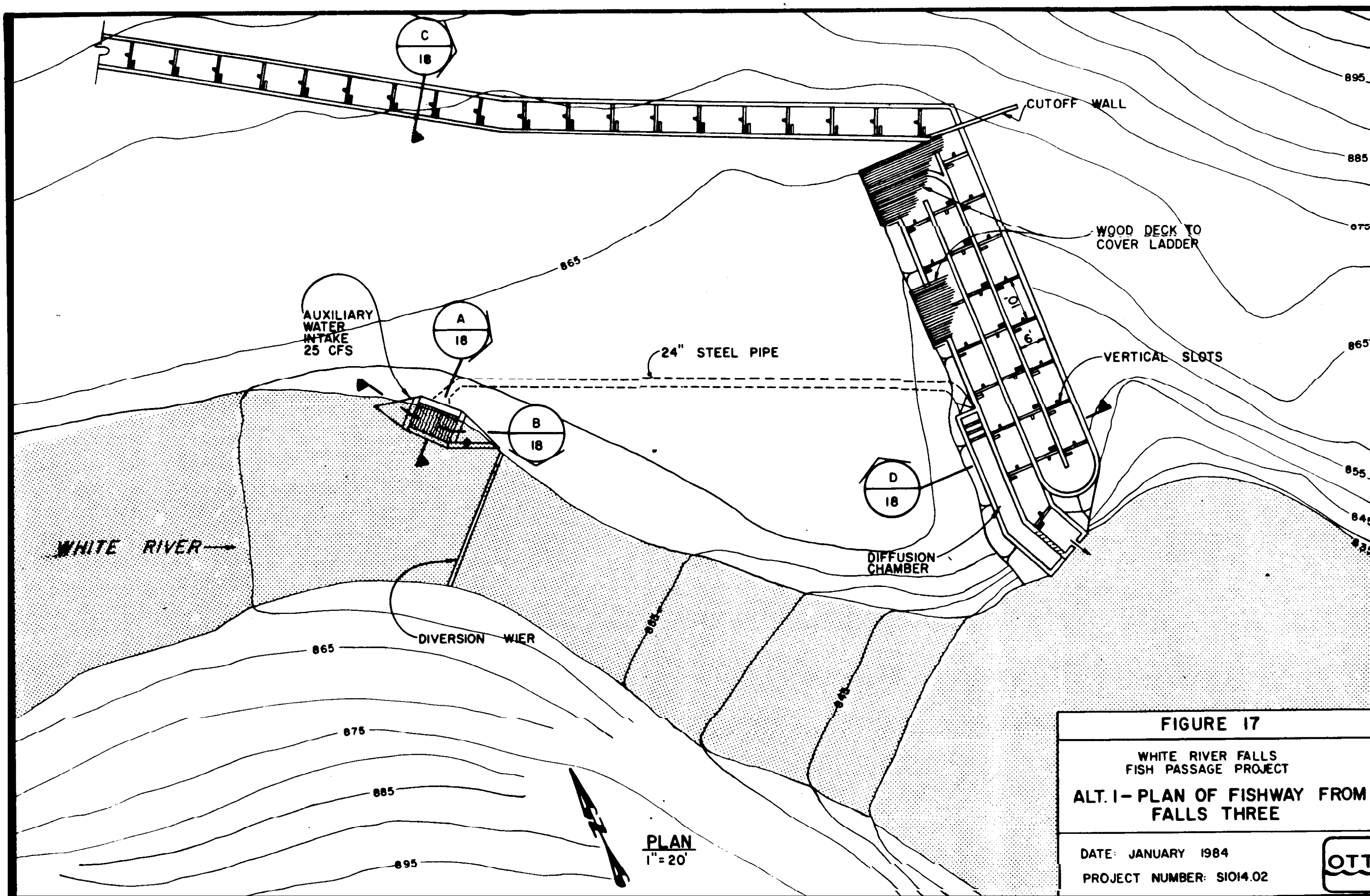


FIGURE 17

WHITE RIVER FALLS
FISH PASSAGE PROJECT

ALT. I – PLAN OF FISHWAY FROM FALLS THREE

DATE: JANUARY 1984
PROJECT NUMBER: S1014.02

OTT

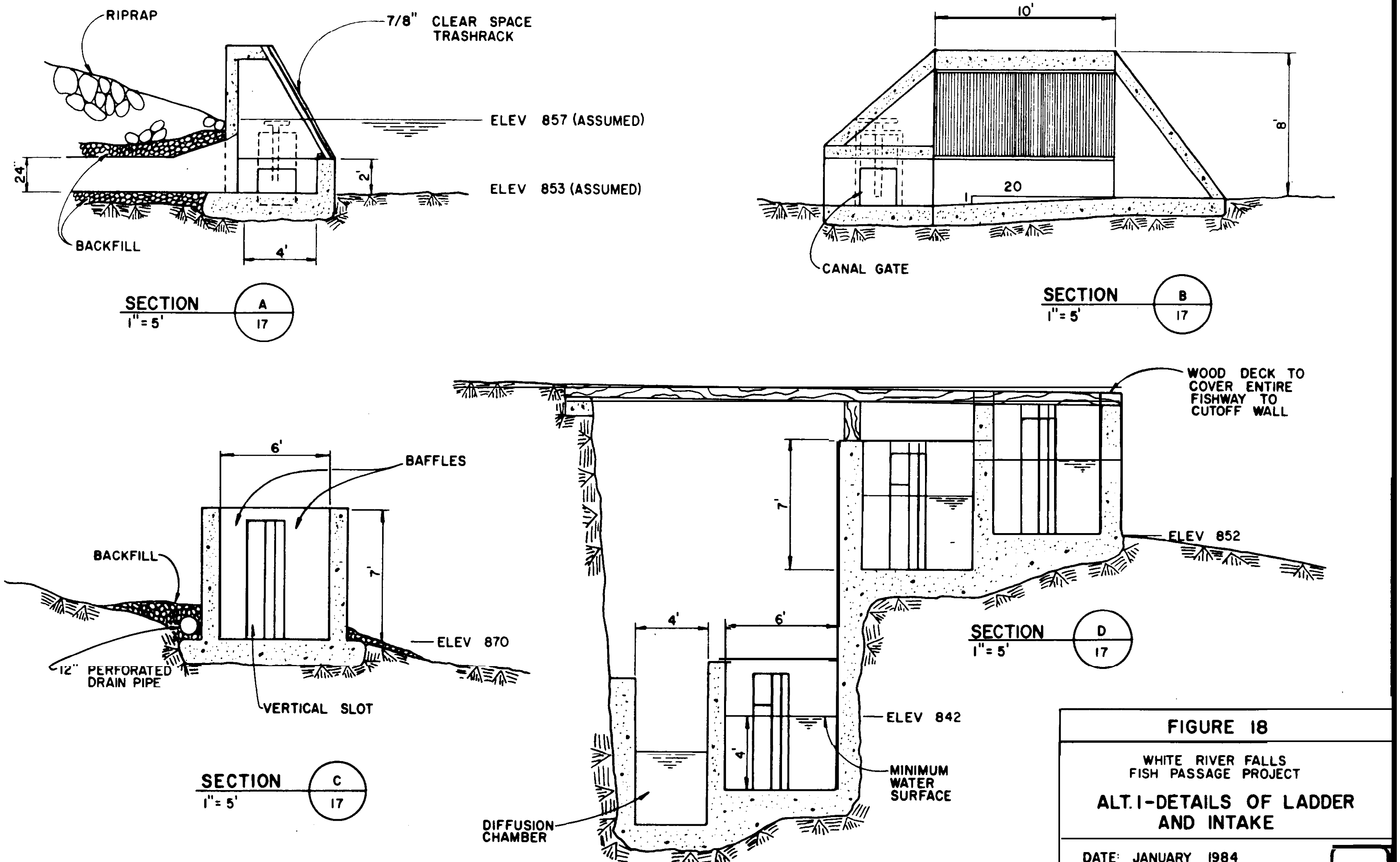


FIGURE 18

WHITE RIVER FALLS
FISH PASSAGE PROJECT

ALT. 1-DETAILS OF LADDER AND INTAKE

DATE: JANUARY 1984

PROJECT NUMBER: S1014.02

OTT

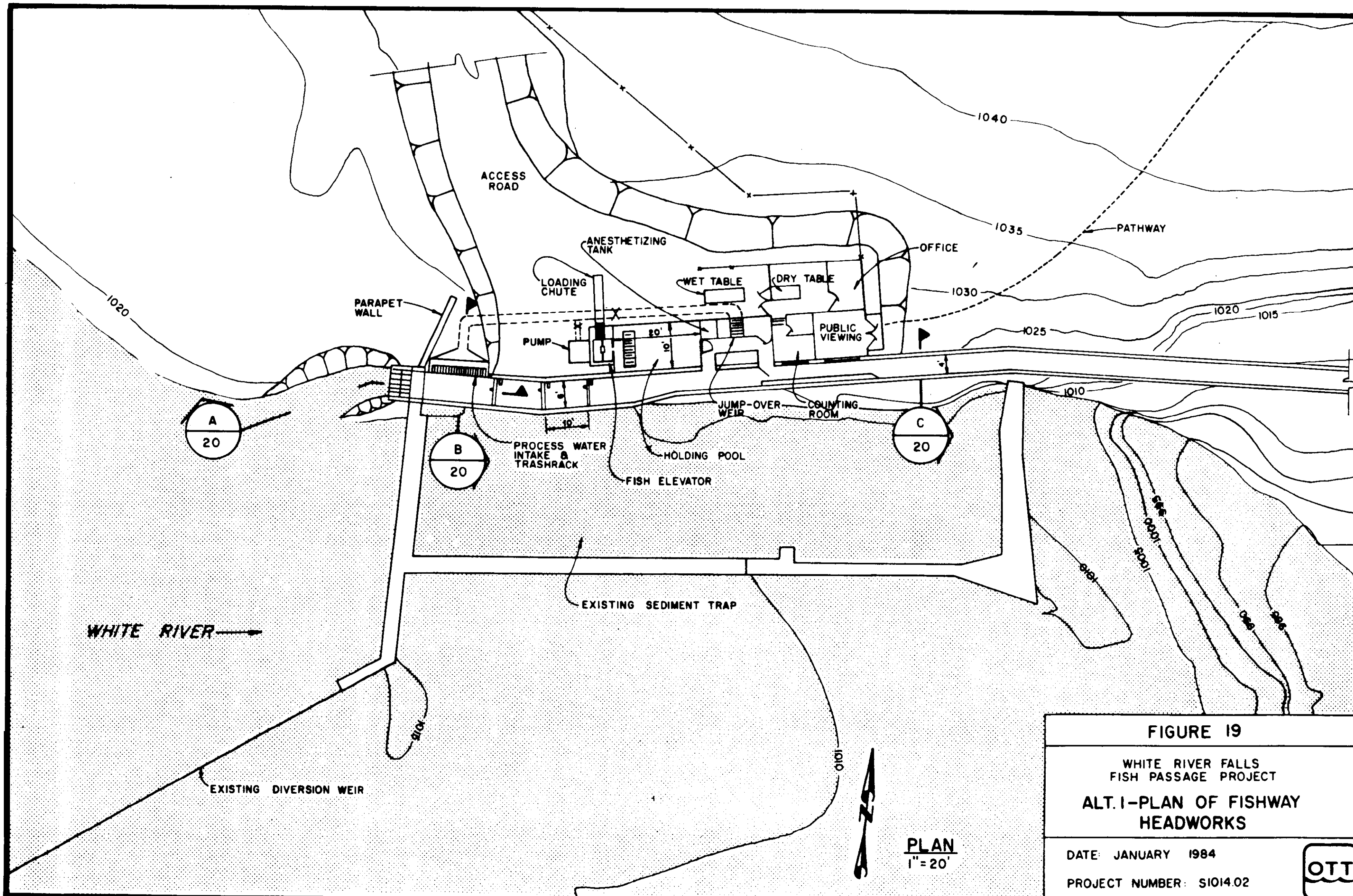
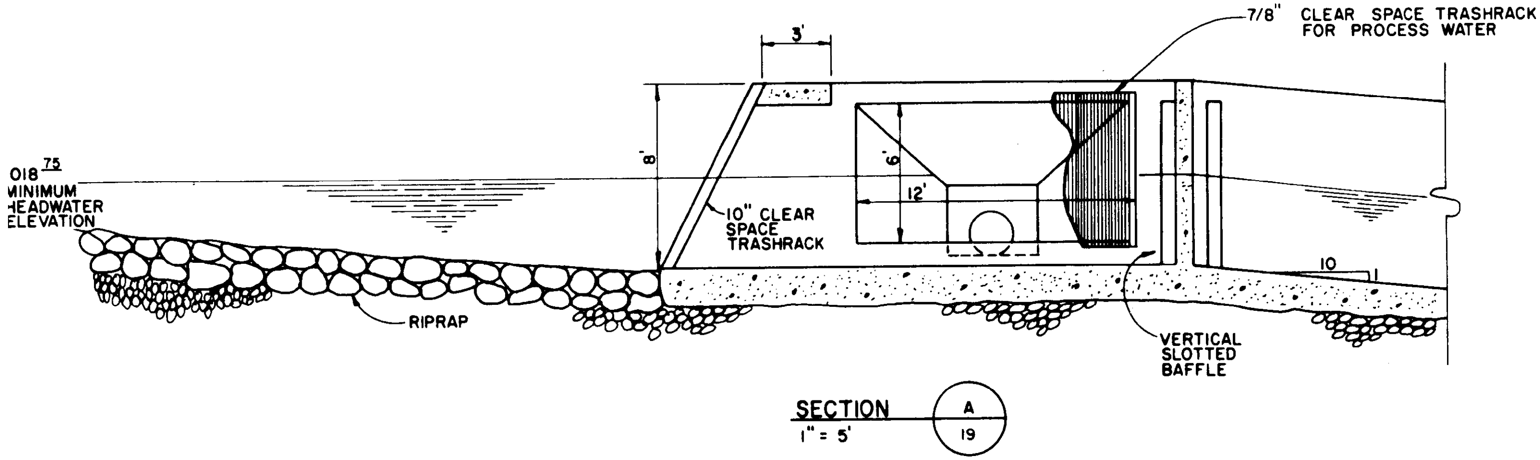
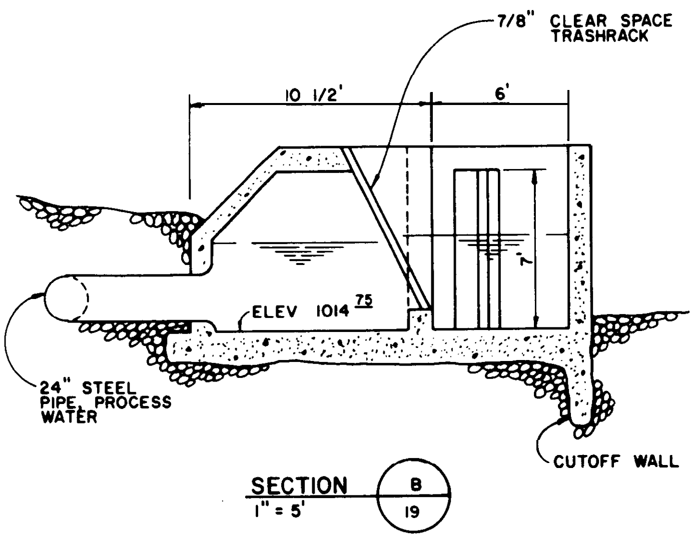


FIGURE 19
WHITE RIVER FALLS FISH PASSAGE PROJECT
ALT. 1-PLAN OF FISHWAY HEADWORKS
DATE: JANUARY 1984
PROJECT NUMBER: S1014.02

OTT





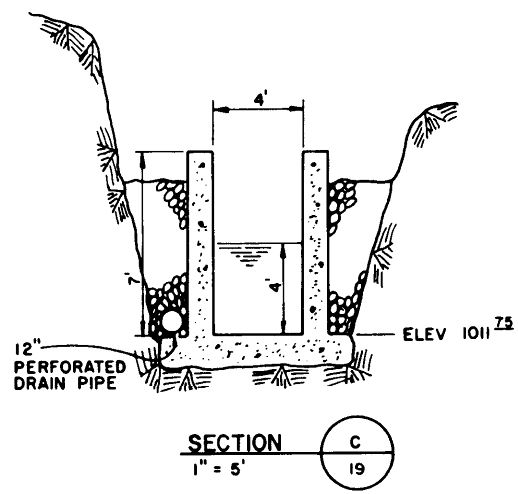


FIGURE 20

WHITE RIVER FALLS
FISH PASSAGE PROJECT

ALT. 1 – SECTIONS THROUGH FISHWAY HEADWORKS

DATE: JANUARY 1984

PROJECT NUMBER: S1014.02

OTT

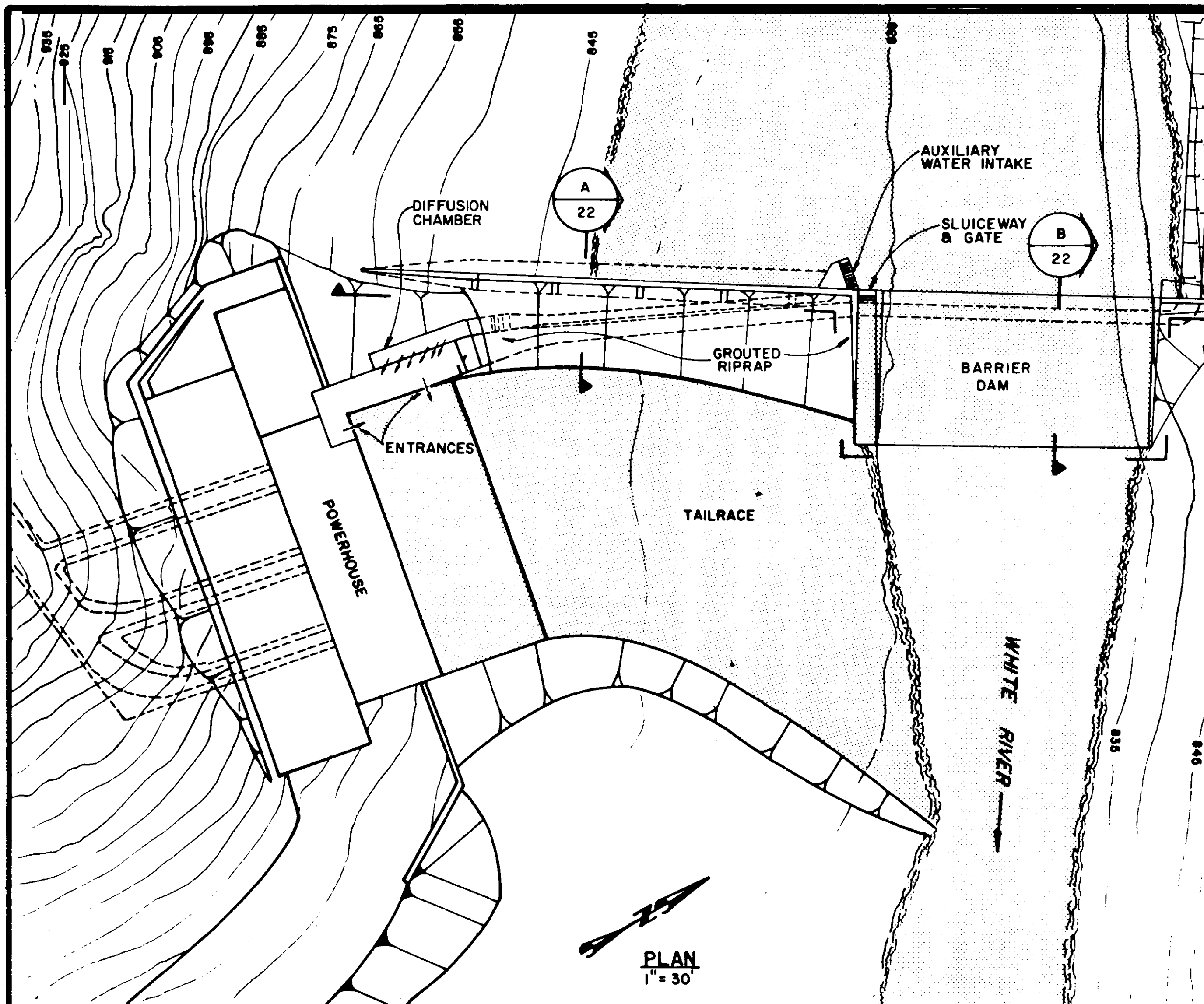


FIGURE 21

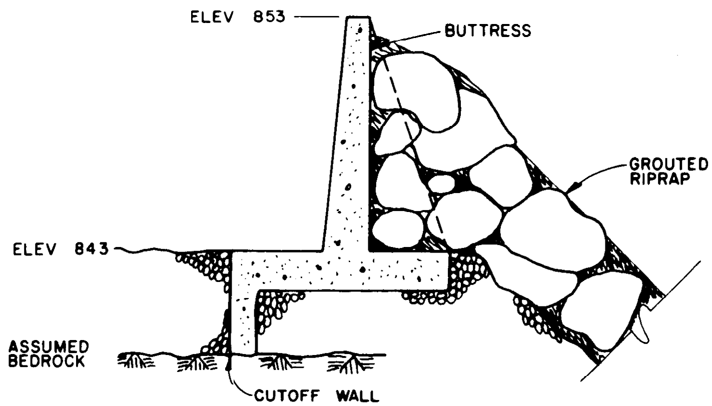
WHITE RIVER FALLS
FISH PASSAGE PROJECT

ALT. 2-PLAN OF FISHWAY ENTRANCE AND BARRIER DAM AT PROPOSED POWERHOUSE

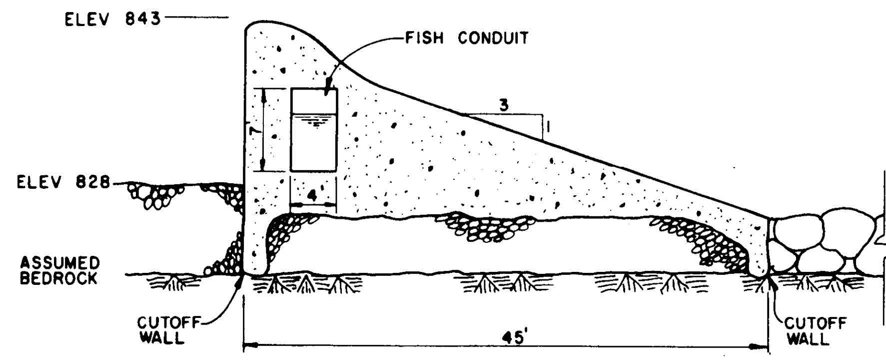
DATE: JANUARY 1984

PROJECT NUMBER: S1014.02

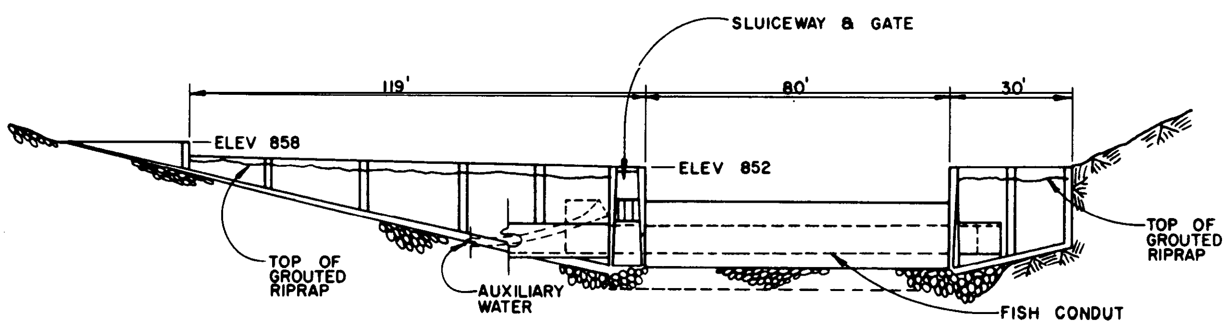
OTT



SECTION A/21
1" = 5'



SECTION B/21
1" = 5'



SECTION C/21
1" = 30'

FIGURE 22

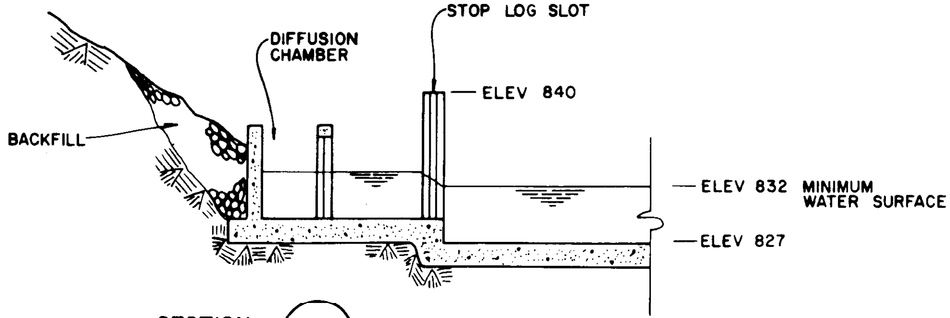
WHITE RIVER FALLS
FISH PASSAGE PROJECT

ALT. 2-DETAILS OF BARRIER DAM

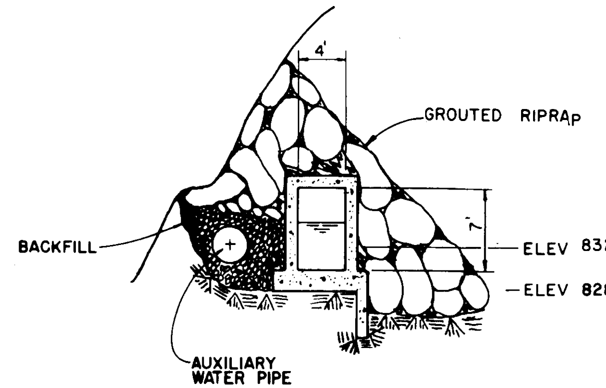
DATE: JANUARY 1984

PROJECT NUMBER: S1014.02

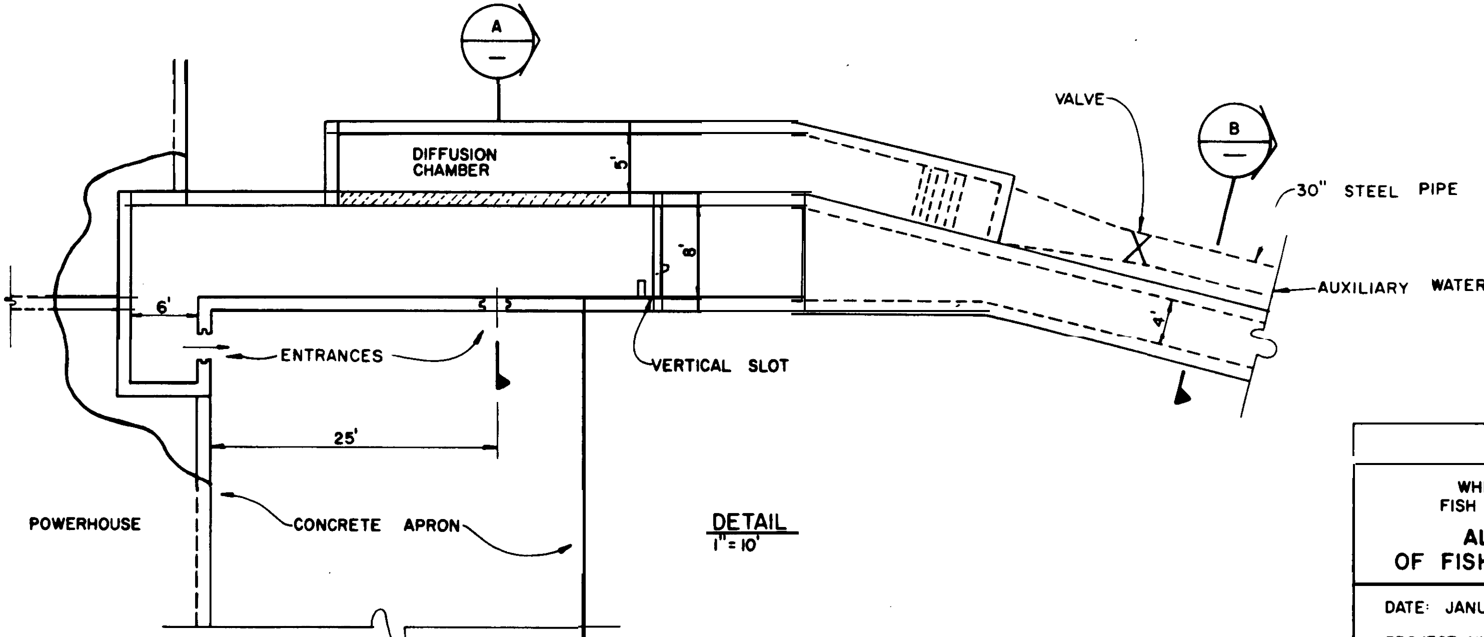
OTT



SECTION A
1" = 10'



SECTION B
1" = 10'



DETAIL
1" = 10'

FIGURE 23

WHITE RIVER FALLS
FISH PASSAGE PROJECT

ALT.2-DETAILS OF FISHWAY ENTRANCE

DATE: JANUARY 1984

PROJECT NUMBER: S1014.02

OTT

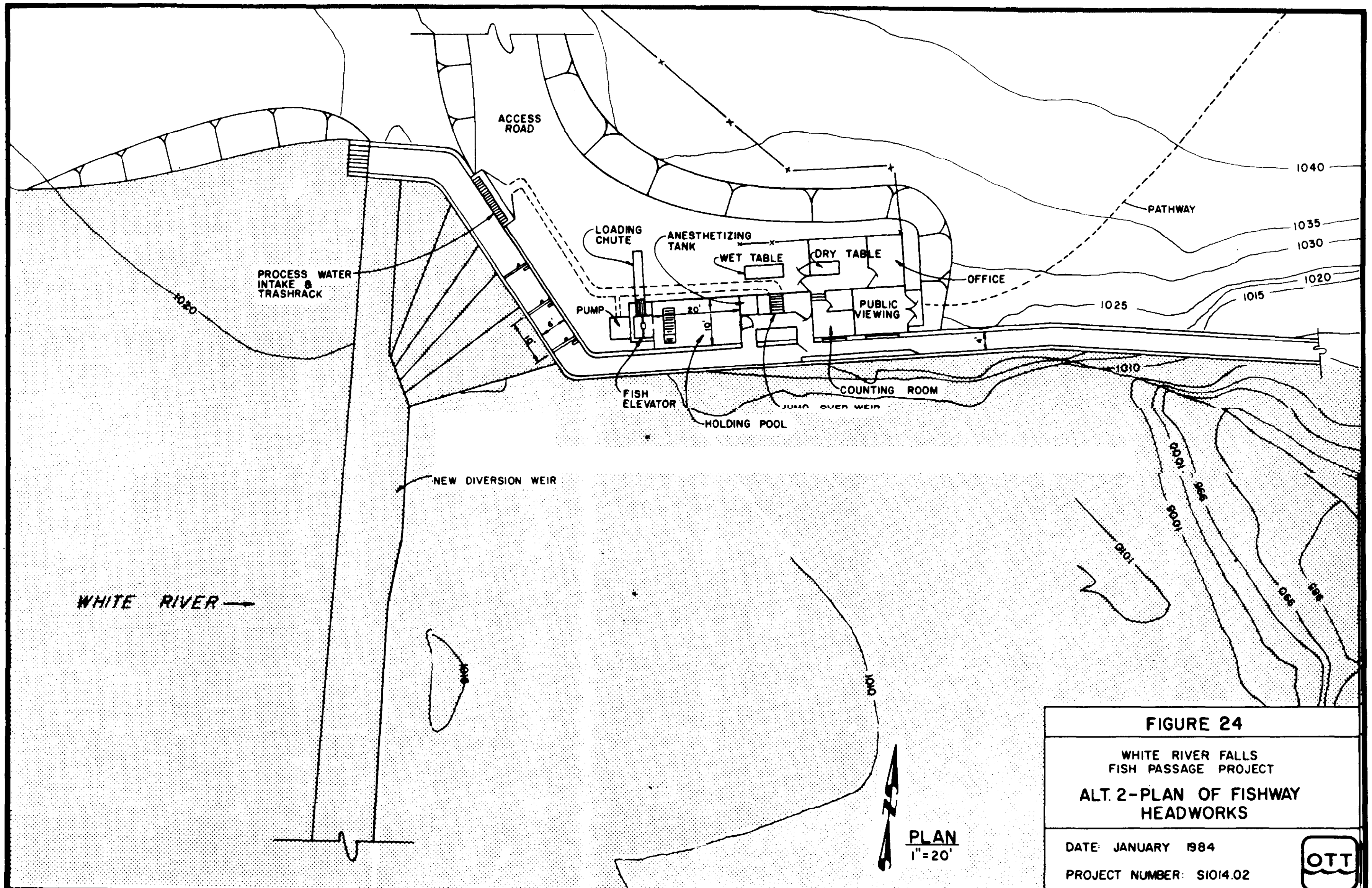


FIGURE 24

WHITE RIVER FALLS
FISH PASSAGE PROJECT

ALT. 2-PLAN OF FISHWAY HEADWORKS

DATE: JANUARY 1984

PROJECT NUMBER: S1014.02

OTT

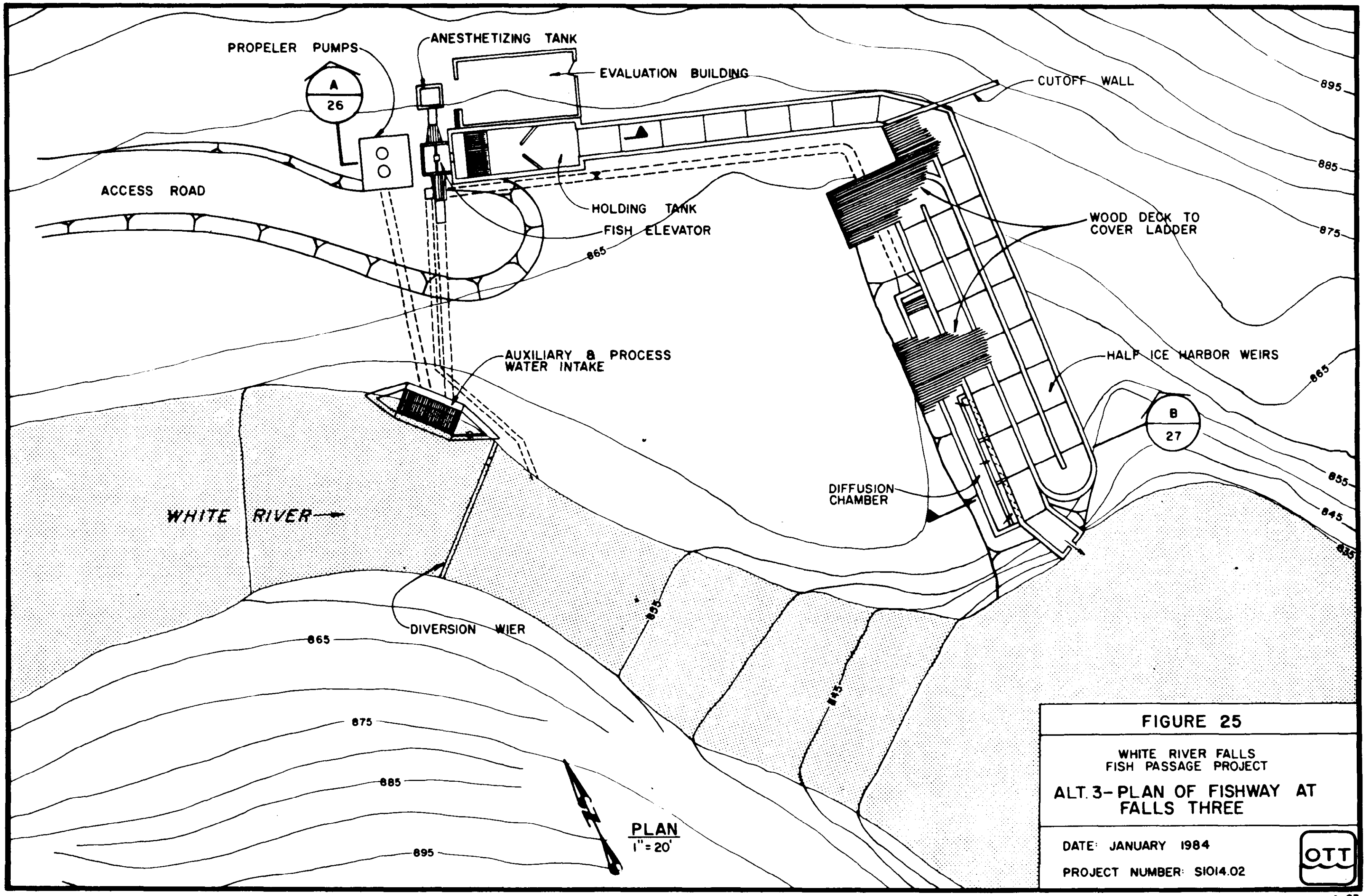


FIGURE 25

WHITE RIVER FALLS
FISH PASSAGE PROJECT

ALT. 3- PLAN OF FISHWAY AT FALLS THREE

DATE: JANUARY 1984

PROJECT NUMBER: S1014.02

OTT

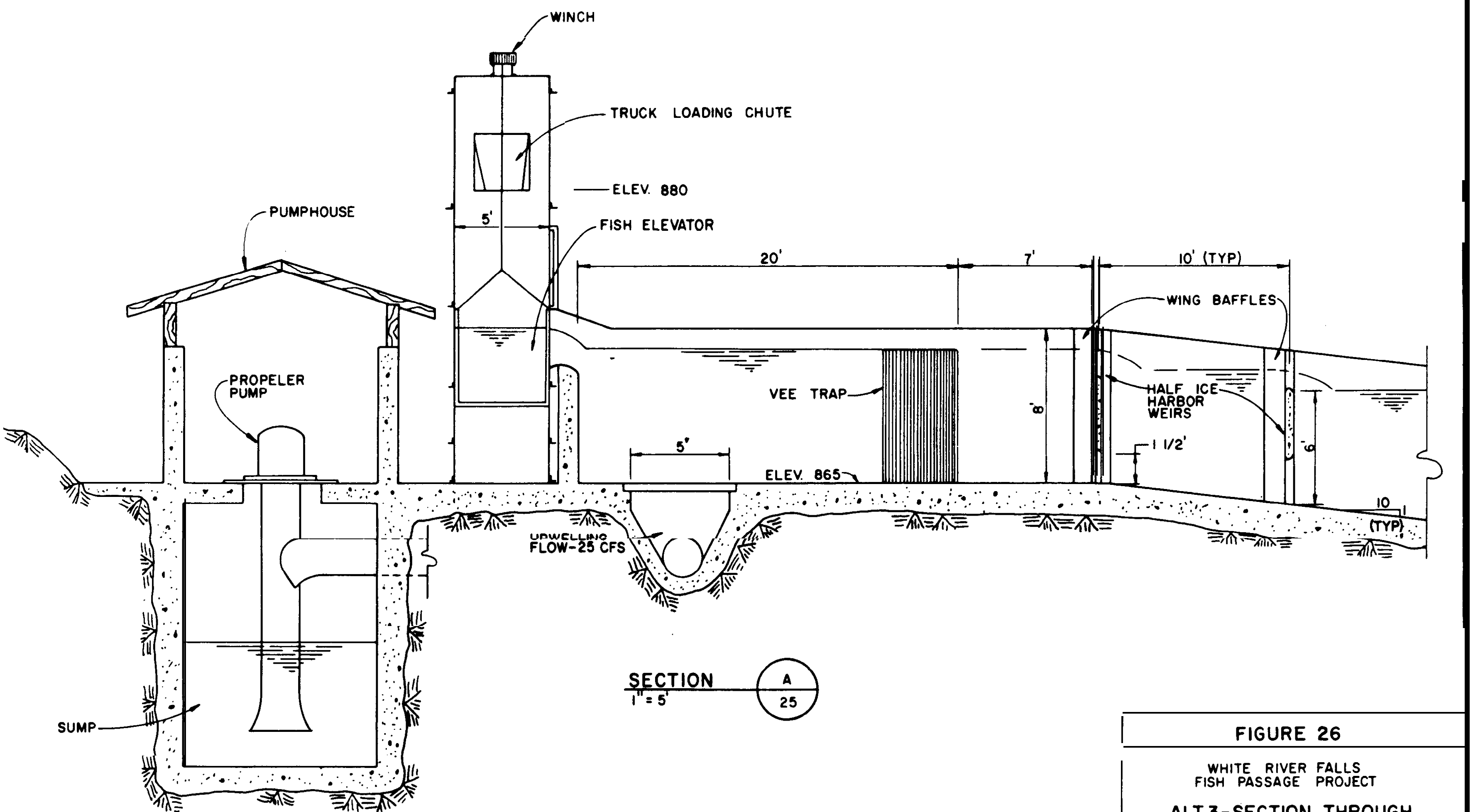


FIGURE 26

WHITE RIVER FALLS
FISH PASSAGE PROJECT

ALT.3-SECTION THROUGH
FISH TRAP ENTRANCE

DATE: JANUARY 1984

PROJECT NUMBER: S1014.02

OTT

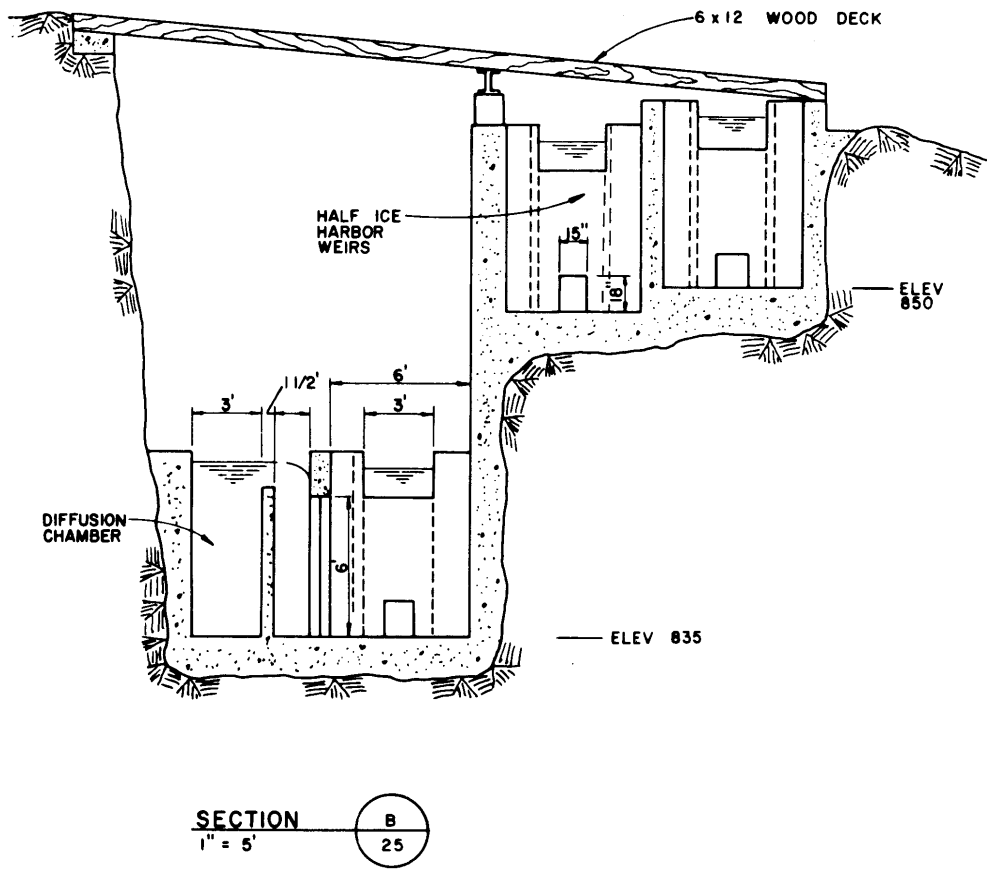


FIGURE 27

WHITE RIVER FALLS
FISH PASSAGE PROJECT

ALT. 3-SECTION THROUGH
FISH TRAP ENTRANCE

DATE: JANUARY 1984

PROJECT NUMBER: S1014.02

OTT

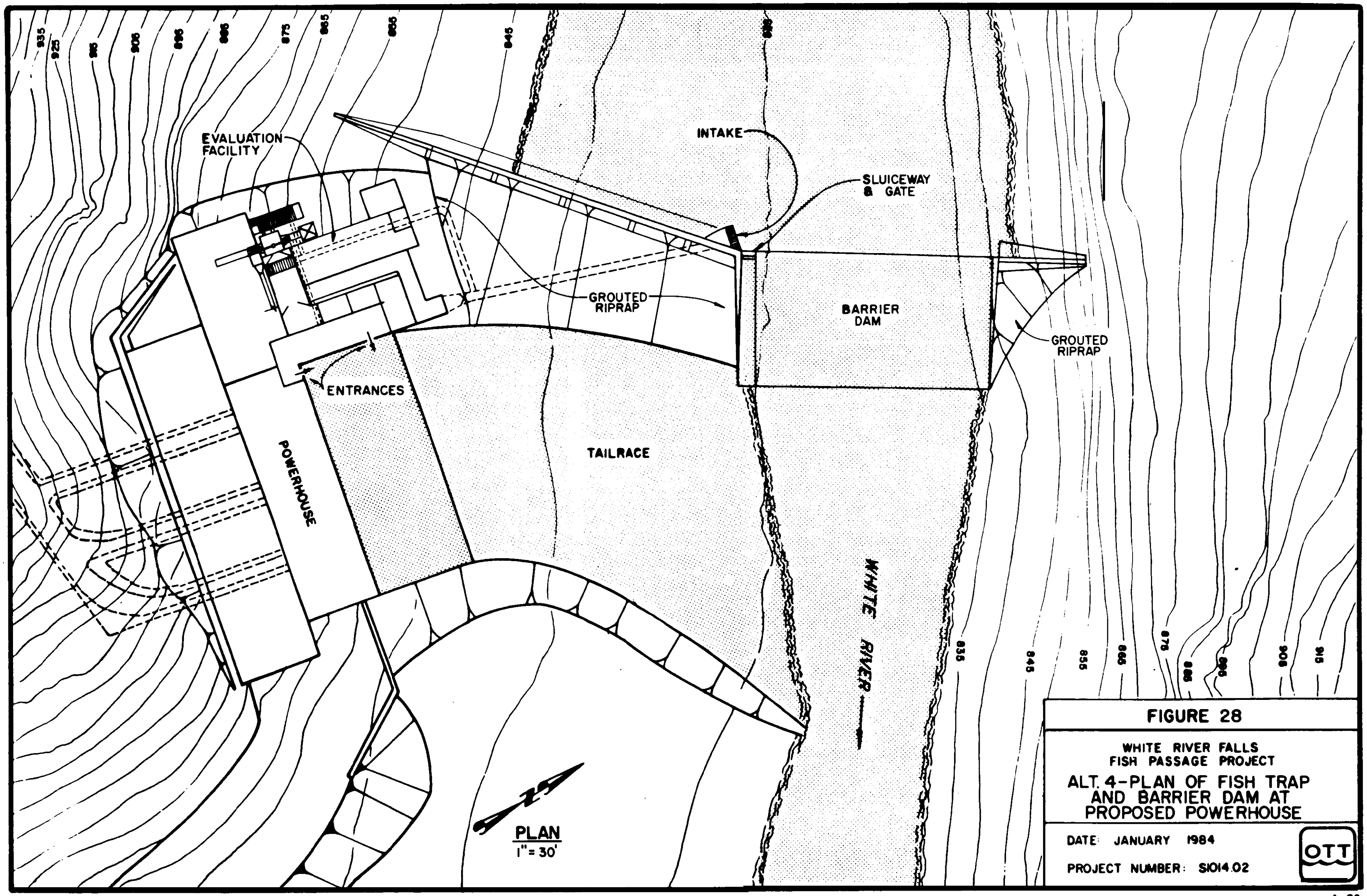


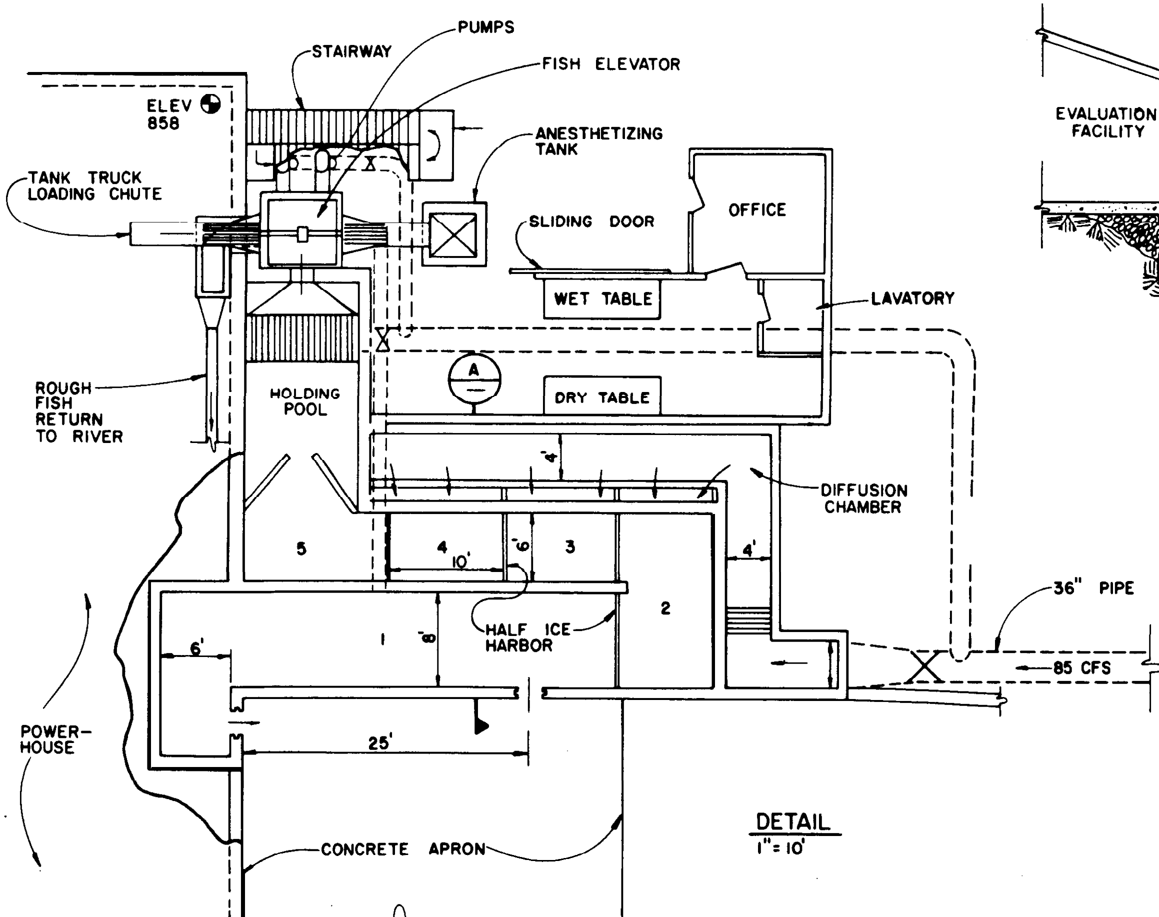
FIGURE 28

WHITE RIVER FALLS
FISH PASSAGE PROJECT

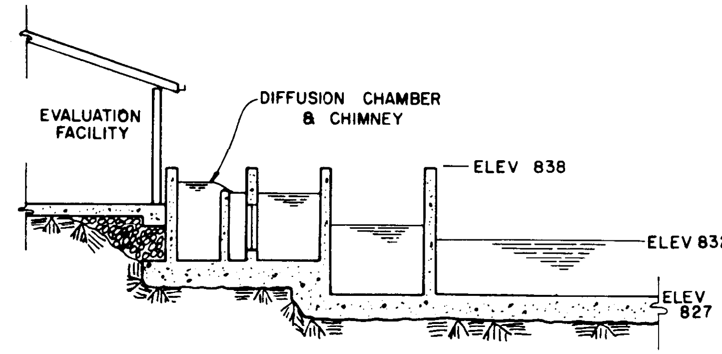
ALT. 4-PLAN OF FISH TRAP AND BARRIER DAM AT PROPOSED POWERHOUSE

DATE: JANUARY 1984

PROJECT NUMBER: S1014.02



DETAIL
1" = 10'



SECTION
1" = 10'
A

FIGURE 29

WHITE RIVER FALLS
FISH PASSAGE PROJECT

ALT. 3 – DETAILS OF FISH TRAP
AT FALLS THREE

DATE: JANUARY 1984

PROJECT NUMBER: S1014.02

OTT