Operations of the Bonifer and Minthorn Springs Juvenile Release and Adult Collection Facilities

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by

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of the

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INTRODUCTION

The Bonifer Springs salmon and steelhead juvenile release and adult collection facility is located in the upper Umatilla River drainage at Meacham Creek mile 2.0 (Appendix A). The facility is one of two that are operated on the Umatilla Indian Reservation under contract with Bonneville Power Administration. Construction of the Bonifer facility was completed in the fall of 1983 and operations began in early 1984. The facility consists of a one acre spring-fed pond and a concrete fishway and adult fish holding area at the pond outlet. The facility is used for holding and spawning of adult summer steelhead and for acclimation/release of juvenile fall and spring chinook salmon and summer steelhead. The acclimation capacity is approximately 20,000 lbs. of fish.

Minthorn Springs Creek is located about four miles east of Mission, Oregon, on the Umatilla Indian Reservation (Appendix A). It forms from several springs located immediately south of the Umatilla River. The total length of Minthorn Springs Creek is about one mile and the mouth is located at Umatilla River mile 63.7. The fishway and adult holding area of the Minthorn facility are located in Minthorn Springs Creek immediately upstream from the mouth. The juvenile raceways are located in the same general area about 25 feet from the bank of Minthorn Springs Creek.

Like the Bonifer Springs project, the Minthorn facility is used for adult fish holding and for temporary rearing or acclimation of juvenile salmon and steelhead to imprint the fish on the particular water source and reduce stress from trucking prior to their downstream migration. The facility was completed in December of 1985 and first used for juvenile acclimation in the Spring of 1986. An existing pond was not available at the Minthorn site so two concrete raceways (120 x 12 feet) were constructed for juvenile holding/rearing. At a water depth of 3 feet and a single-pass water exchange rate of about 800 gpm through each raceway, the facility has a rearing capacity of about 15,000 to 20,000 pounds of fish. This capacity could be exceeded if fish were held only for a brief acclimation period.

Both the Bonifer and Minthorn facilities are operated by the Umatilla Tribe with cooperation from the Oregon Department of Fish and Wildlife. The proposed Umatilla hatchery (scheduled for completion in 1989) will eventually be the "mother hatchery" for most salmon and steelhead releases at the satellite facilities. Until that time, juvenile fish are being acquired from various sources. This report will detail the Bonifer and Minthorn facility operations from January through December 1986.

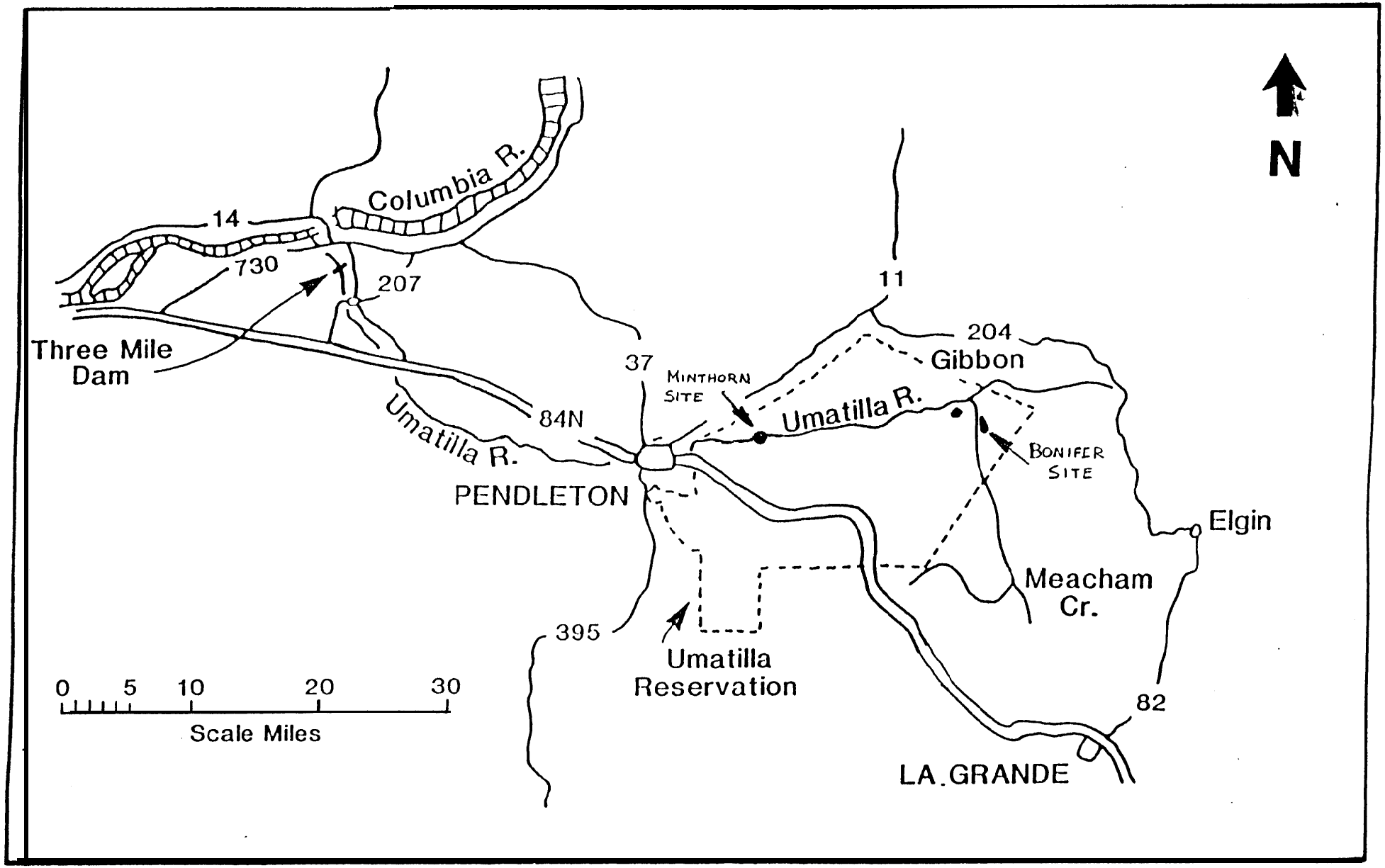


FIGURE 1

BONIFER &
MINTHORN SPRINGS
VICINITY MAP

FACILITY OPERATIONS

Adult Broodstock Collection

A total of 69 steelhead adults were captured at the Threemile Dam trap in the lower Umatilla River and transported to the Bonifer facility in early 1986 (Table 1). No adults were held at the Minthorn facility in 1986. The fish were transported throughout a large portion of the run (from January to April) by both the Oregon Department of Fish and Wildlife and the Umatilla Tribe. Although there was a relatively good run of steelhead in the Umatilla River in 1986, the target number of broodstock fish (100 total) were not collected. Most fish passed the east ladder where there is no trap. Many fish passing the west side of Threemile Dam were not trapped or were passed over. Broodstock collection needs are expected to be met more easily when the Threemile Dam fish passage improvement and trapping facility project is completed in 1987 (east side) and 1988 (west side).

TABLE 1. 1986 Adult Steelhead Broodstock Collection

Date	Fish Taken at Threemile Dam		
	Male	Female	Total
Jan 28	5	21	26
Feb 18	3	13	16
March 24	2	14	16
April 8	0	4	4
April 11	1	2	3
April 29	0	4	4
TOTAL	11	58	69

Adult steelhead held at Bonifer were checked for condition and ripeness about once every week or two. Fish were checked more frequently as spawning time approached. Thirty females, 52% of those collected, were spawned (Table 2) in April and May 1986. Approximately 150,000 total eggs were taken. Eggs were water hardened and placed in jars for transport to Oak Springs Hatchery where they were incubated and juveniles reared. Incubation and rearing will eventually occur at the Umatilla Hatchery which is scheduled for construction in 1988.

TABLE 2. 1986 Adult Steelhead Spawning and Mortality at Bonifer

Date	Females Spawned	Prespawning Mortality		
		Male	Female	Total
April 6	0	0	1	1
April 7	5	0	0	0
April 14	2	0	1	1
April 21	2	3	2	5
April 28	10	1	1	2
May 5	11	5	3	8
TOTAL	30	3	8	17

Prespawning mortalities during the adult holding period (22%) were higher than previous years at Bonifer but were still not as severe as what occurred in 1983 at McNary holding ponds (52%) prior to the completion of Bonifer. A total of 17 adults died before spawning operations were completed in early May (Table 2). Eight females died before they could be used for spawning. Nine males died, but some were used for spawning once or twice before death. Unspawned fish(those not ripen by early May) were released into Meacham Creek below the Bonifer Springs Acclimation Facility.

Adult Steelhead Return to Bonifer

The first juvenile steelhead releases at Bonifer Pond occurred in the spring of 1984. Approximately 58,000 adipose clipped smolts were released. The Bonifer adult trap was operated in 1986 in anticipation of the first one-salt adult returns from this initial juvenile release. A total of 7 adult steelhead were captured in the Bonifer trap with 6 having adipose fin clips (Table 3). Some of these fish were used for spawning purposes due to the shortage of broodstock trucked from Threemile Dam. This appears to be a low return rate, but no conclusions can be made at this time since a major portion of Umatilla steelhead returns are two-salt fish. Also, sport catch of adipose clipped fish cannot be quantified at this time. Two-salt fish from the 1984 release and one-salt adults from the 1985 release are expected to return to the Bonifer trap in 1987.

TABLE 3. 1986 Adult Steelhead Returns to Bonifer Trap

Date	Male	Female	Total	Adipose Clipped
March 28	1	0	1	1
April 21	0	2	2	2
April 23	2	2	4	3
TOTALS	3	4	7	-G

1986 Juvenile Releases - Bonifer

A total of 115,779 Bonneville stock yearling upriver bright fall chinook were released into Bonifer Pond from March 3 through March 11, 1986 (Table 4). Fish were fed 45 lbs of Bio Diet pellet daily during a 2-3 week acclimation period. Average water temperature during this time was 44 F. A total of 56 mortalities were observed at time of release and mortality through the acclimation period was negligible. Screens at the pond outlet and stoplogs were pulled on March 22, 1986 (Table 5) to allow the fish to migrate downstream.

A gravel accumulation problem (discussed later) at the outlet of the fishway prevented total draining and removal of all fish from the pond. Most fish voluntarily migrated but many (several thousand) remained and were present when other fish were stocked in Bonifer later in April. The yearlings were extremely large this year (avg. 4.7/lb) because they were reared in faster growing conditions at Irrigon Hatchery compared to the 7-8/lb fish received in previous years from Bonneville Hatchery. This large size may have affected the sense of timing for migration, causing more fish to remain in the pond compared to previous years.

TABLE 4. 1986 Juvenile Salmon and Steelhead Releases into Bonifer

Date 1/	Species	No. Released	Size
March 3	URB Chf Age 1+	16,406	4.8/lb.
March 5	"	16,696	4.8/lb.
March 6	"	26,551	4.7/lb.
March 7	"	15,702	4.8/lb.
March 10	"	32,133	4.7/lb.
March 11	"	8,291	4,7/lb.
TOTAL		115,779	
March 27	Chs Age 1+	50,000	23.3/1b.
March 28	"	49,979	23.3/1b.
TOTAL		99,979	
April 22	Sts Age 1	19,195	8.5/lb.
April 23	"	15,120	8.4/lb.
Ahril 24	"	19,822	8.4/lb.
TOTAL		54,137	
July 25	Chs Age 0+	68,400	15/lb
July 28	"	28,950	15/lb
TOTAL		97,350	

1/ Represents date of release into Bonifer; see Table 5 for release dates from Bonifer into Meacham Creek.

TABLE 5. 1986 Salmon and Steelhead Releases in the Umatilla River Basin.

Species	Brood	Stock	Hatchery	Juvenile Releases					Fish Marked	
				Number	No/lb	Location	In Facility	In River	Yes	No
Fall Chin.	84	Bonneville	Irrigon	90,841	5.0	Minthorn	March 3-11	March 21 & 24	X (CWT All)	
Fall Chin.	84	Bonneville	Irrigon	100,000	4.7	Bonifer	March 3-5	March 22-24		X
Fall Chin.	85	Bonneville	Irrigon	2.03 Mill.	86.0	Lower Uma.	--------	June 9-11	X (CWT 200,000)	
Fall Chin.	85	Bonneville	Irrigon	35,574 1/	11.6	Minthorn	July 10	October 16	X 3/ (LV clip)	
Spr. Chin.	84	Carson	Carson	99,970	22.8	Bonifer	March 27 & 28	April 11-13		X4/
Spr. Chin.	85	Carson	Irrigon	300,442 2/	87.0	Upper Uma.	--------	April 7		X4/
Spr. Chin.	85	Carson	Irrigon	75,000 1/	15.0	Bonifer	July 25 & 28	October 21 -24		X4/
Sum. Stld.	85	Umatilla	Oak Springs	54,137	8.4	Bonifer	April 22	May 1 -4	X (adipose clip)	

1/ Reared through summer & released from facilities in fall (Bonifer number is estimate).

2/ Released in habitat in upper mainstem (123,342), N. Fk. (43,340), S. Fk. (104,070), and N. Fk. Meacham Creek (26,690).

3/ Fish marked by left ventral fin clip while held at Minthorn.

4/ Although the three groups of spring chinook are unmarked, adults should be discernable by scale analysis.

	MARCH	APRIL	MAY	JUNE	JULY
Bonifer ------->	115K Accl. 1+ f. chin.	100K Accl. 1+ sp.chin.	54K Accl. stld.		100K Stock 0+ sp. chin.
Minthorn ------>	91K Accl. 1+ f. chin.				150K Stock F. chin. 0+
Lower River --->				2.03 Mill Release 0+ fall chinook	
Upper River --->		300K Release 0+ sp. chin			

In late March, approximately 100,000 Carson stock yearling spring chinook were released into Bonifer Pond (Table 4). These were the first spring chinook to be released as a part of the re-establishment program for this species in the Umatilla Basin. The fish were stocked at 23/lb and were fed 45 lbs of Bio Diet pellet daily during a two-week acclimation period. Average water temperature during the period was 54 F. The spring chinook appeared to be in excellent shape and observed mortalities were negligible during the holding period. Screens and stoplogs were pulled on April 11, 1986 and the pond was partially drained to allow the smolts to migrate downstream.

Following the voluntary outmigration of spring chinook from Bonifer Pond, 54,137 yearling summer steelhead were released in late April (Table 4). These adipose clipped fish were progeny of the adult steelhead held and spawned at the facility in the Spring of 1985. The Umatilla stock steelhead were delivered from Oak Springs Hatchery. The fish in Bonifer Pond (mainly steelhead but also some fall and spring chinook that did not migrate earlier) were again fed about 45 lbs. of feed per day. There were no mortality problems during the acclimation period. The pond was lowered on May 1, 1986, and most fish appeared to have left by May 4th. However, some fish did not move out quickly because the pond could be only half drained (discussed later).

Bonifer Pond was used for temporary rearing (mid-August through mid-October) and release of 50,000 fall chinook subyearlings in 1985. This effort was successful in terms of low mortality and health of fish at time of release. In 1986, Bonifer was again used for summer rearing and fall release with increased number of fish and rearing period. Spring chinook subyearlings (97,350) were stocked into Bonifer Pond on July 25 and 28, 1986 at 15/lb (Table 5). The daily feeding level started at 50 lbs Biomoist feed per day and was increased to near 100 lbs per day at time of release. An estimated 75,000 spring chinook were released from Bonifer Pond on October 21 through 24, 1986. The 25% loss occurred due to fish disease and excessive aquatic vegetation in the pond (see operational difficulties). Exact number of fish released and size could not be determined due to difficult sampling conditions in the pond.

1986 Juvenile Releases - Minthorn

The Minthorn Springs facility received its first juvenile fish on March 3, 4, and 5, 1986 (Table 6). These fish were yearling (84 brood) Bonneville stock upriver bright fall chinook from Irrigon Hatchery (Table 5). A total of 92,958 smolts at an average of 4.7 fish per pound were split into the two raceways for temporary holding. These fish were also larger than usual because they were trucked to the warmer water at Irrigon Hatchery for rearing due to problems at Bonneville Hatchery. Approximately 40 pounds of Bio Diet Pellet was fed each day for a total of 650 pounds fed during the acclimation period. During this time, the water temperature ranged from 44 to 51 F and dissolved oxygen levels averaged 13 mg/l.

TABLE 6. 1986 Juvenile Fall Chinook Salmon Releases into Minthorn Springs Acclimation Facility

Date 1/	Species	No. Released		Size
March 3-5	URB ChF Age 1+	45,546	(Lower pond)	4.7/lb
March 3-5	"	47,412	(Upper pond)	4.7/lb
TOTAL		92,958		
July 10	URB ChF Age 0+	85,540	(Lower pond)	4.7/lb
July 10	"	77,315	(Upper pond)	4.7/lb
TOTAL		162,855		

1/ Represents date of release into Minthorn; ChF 1+ released from Minthorn on March 21-24, 1986, ChF 0+ released on October 16, 1986.

Approximately 1417 mortalities occurred at the time the fall chinook yearlings were released into Minthorn due to problems with the pump loading system at Irrigon Hatchery. Another 700 mortalities resulted from jump-out problems during the three-week acclimation period (see operational difficulties). The final number of fall chinook age 1+ smolts released from Minthorn on March 21-24 was 90,941.

In addition to spring acclimation and release at Minthorn, temporary summer rearing and fall release was also tried in 1986. Subyearling fall chinook (162,855) were released into the Minthorn raceways in July 1986. The fall release of chinook at Minthorn was viewed as an initial test to gain knowledge regarding various release strategies that can be utilized in the Umatilla River. Separate studies by the Tribe and ODFW are expected to begin in 1987 which deal with marking and release of various salmon and steelhead release groups in order to monitor adult returns.

During the summer rearing period, fish were fed daily (50 up to 100 lbs Biomoist feed per day) in order to achieve an approximate 10 fish/lb target release size in October of 1986. Raceways were lowered and swept for cleaning on a weekly basis. Water temperatures ranged from 58 F to 64 F. Maximum water temperatures occurred as a result of warmer air temperatures (>90 F). Dissolved oxygen levels generally stayed near 11 to 12 at raceway inlets and 7 to 8 at outlets. Numerous problems occurred during the summer rearing period. Major problems regarding pump failure and fish disease (see operational difficulties) resulted in a fish loss of 127,281 (78% of fish originally released). The final release on October 16, 1986 totaled 35,574 fish at 11.6/lb (Table 5). This release number was determined during a fish marking effort one month prior to release. All fish were crowded into one raceway and marked with a left ventral (LV) fin clip in August of 1986.

All Umatilla River juvenile salmon and steelhead release sizes and locations since ODFW started releases in 1981 are detailed in Table 7.

Operational Difficulties - Bonifer

Most of the steelhead eggs collected at Bonifer in the Spring of 1986 had to be destroyed due to IHN and IPN viruses (Table 6). Out of five groups of eggs that were taken, four resulted in positive tests for IHN and/or IPN. If a test was positive, all eggs taken that day from each female had to be destroyed because they were mixed together. Out of the 166,000 eggs taken, 157,000 were destroyed. No tests in previous years resulted in positive identification of either virus in broodstock steelhead collected at Threemile Dam in the lower Umatilla River.

TABLE 8. Disease Test Results for 1986 Bonifer Steelhead Eggs

Date Spawned	No. Females	No. Eggs	Virus Present
April 7	5	26,400	IPN
April 14	2	9,000	None
April 21	2	10,600	IHN
April 28	10	60,000	IPN & IHN
May 5	11	60,000	IHN

The 9,000 "clean" eggs were incubated and juveniles reared at Oak Springs Hatchery. Additional precautions will be taken next year to reduce or prevent virus problems. It was felt that some of the large steelheadtaken at Three Mile Dam were not native Umatilla River fish but were possibly "B-run" strays from Idaho streams. An attempt will be made to collect broodstock sooner when there may be less chance of straying. In the future, no marked or obvious hatchery fish or any extremely large (3 feet plus) steelhead will be used for broodstock purposes. Some adipose clipped fish that return to the Bonifer trap may be used if necessary. Also, eggs from each female will be separated until disease tests are final. This will preclude throwing out all eggs for a given day when possibly only one female is contaminated.

High waters in the Umatilla drainage reached approximate 50-year flood levels in February of 1986. This caused an enormous bedload movement of gravel in lower Boston Canyon Creek. Gravel completely plugged up the outlet of the Bonifer fishway and also filled the entire area under the Boston Canyon Creek railroad bridge. Some gravel was removed but Bonifer Pond could only be half drained for release of all fish acclimated in the Spring of 1986. Most juveniles voluntarily migrated out but several thousand stayed or finally went out late in May or June.

Table 7. JUVENILE SALMON AMD STEELHEAD RELEASES IN THE UMATILLA RIVER BASIN/1

Year	Steelhead Releases		Fall Chinook Salmon Releases				Spring Chinook Salmon Releases	
	Upper Umatilla	Bonifer	Lower Umatilla	Upper Umatilla	Bonifer	Minthorn	Upper Umatilla	Bonifer
1981	17,558(y) 9,400(sy)	0	0	0	0	0	0	0
1982	59,494(y) 67,930(sy)	0	3,828,500(sy)/2	0	0	0	0	0
1983	60,500(y) 52,700(sy)	0	0	80,500(y)	20,000(y)	0	0	
1984	0	57,939(y) 22,000(sy)	636,759(sy)/3	169,280(y)	53,300(y)	0	0	0
1985	0	53,850(y) 39,134(sy)	3,221,993(sy)/3	60,490(y)	137,655(y) 50,000/4	0	0	0
1986	0	54,137(y)	2.03 mill (sy)/3	0	100,000(y)	90,841 (y) 35,574/4	300,442 (sy)	99,070 (y) 75,000/4

/1 y = fish released as yearlings, just prior to downstream migration
sy = fish released as sub-yearlings;Ch F will migrate following release, Sts & Chs will rear another year
/2 Salmon release in 1982 was tule stock, all others have been upriver brights -- the desired stock.
/3 Fingerlings released below Three Mile Dam to avoid loss in irrigation diversions.
/4 Sub-yearlings were reared at facilities in summer and released in late October at yearling size (11 to 16/lb)

file:Releases

A cooperative gravel removal project with Union Pacific Railroad was completed in the summer of 1986. A fish release culvert which extends below the Boston Canyon Creek bridge will also be installed under the BPA operation and maintenance agreement in 1987. This will allow the pond to be drained and fish released even if gravel piles up again at the outlet of the fishway.

Like the previous year, some of the yearling upriver bright fall chinook juveniles migrated up into the feeder springs of Bonifer Pond and did not move downstream into Meacham Creek. A cobble dam was builtacrossthe main spring to prevent this, but a beaver dam raised the water level in the spring and caused it to discharge into the pond in a different area. The best solution to this problem is not certain at this time. Possible solutions include a stoplogstructure which both blocks fish and controls water level or increased maintenance of the cobble dam and closer monitoring of water levels in Bonifer Springs Creek.

As mentioned earlier, Bonifer Pond was used for temporary summer rearing of spring chinook (July - October) prior to fall release in 1986. Several problems were encountered during the rearing period. Bonifer Pond could not be entirely drained prior to stocking of fish due to gravel accumulation in Boston Canyon Creek. This prevented us from having a pond "dry-out" period. Total drainage and drying of the bottom for a couple weeks prior to stocking would have helped retard aquatic vegetation growth in the pond. Vegetation became a problem starting in August. The slow water velocity through the pond and high summer water temperatures (60 F at inflow and maximum 67 F at outflow) resulted in thick aquatic plant growth. Feeding efficiency was questionable due to the limited amount of surface area that was "open". Fish mortalities were extremely difficult to remove in the thick vegetation and silt bottom of the pond.

Still another problem during the summer rearing period complicated the above difficulties. An ODFW pathologist determined that the spring chinook had columnaris. An estimated 100 fish per day were dying. Sixpercentterramycin was added to the bio-moist diet and fed for about three weeks. Mortalities began to drop and were at a normal level within 2-3 weeks. An estimated 25% of the fish were lost prior to the October release.

Before Bonifer Pond is used again for summer rearing, an evaluation will be conducted to determine the most efficient means of operating the Bonifer facility. It may be determined that Bonifer Pond is only suitable for short term acclimation of spring and fall releases of salmon/steelhead.

Operational Difficulties - Minthorn

In February of 1986, the flooding Umatilla River also created problems at the Minthorn facility. Water backed up from the river channel and covered the fishway and adult holding area. There were no fish in the facility at this time, andthebackwater caused no damage. However, some of the Umatilla River further upstream left the channel and joined Minthorn Springs Creek. Erosion resulted from excessive water flowing around both sides of the pumphouse fishway structure. No structural damage resulted, but backfill and gravel will have to be replaced in the eroded areas and deposited material will have to be removed from the fishway. This work will be performed in the summer of 1987 under the facility operation and maintenance contract. Also under this contract, Umatilla River streambank work will be performed to help prevent future floodwaters from entering Minthorn Springs Creek.

The February flood also caused another problem which,effects the operation of the Minthorn fish facility. The Umatilla River changed course so it no longer flowed by the mouth of Minthorn Springs Creek. The water now flows 200-300 yards down an otherwise dry Umatilla River channel before the river reenters the original channel. An s-shaped bend in the river which allowed it to flow by the facility was straightened out by the flood. This almost created a problem in March of 1986 when juveniles were released from Minthorn Springs Creek into the UmatillaRiver. Rainfall immediately prior to the release raised the river water enough so that downstream migration through the problem area was made possible. Rerouting the river back to the previous location is scheduled for the summer of 1987 under the facility operation and maintenance contract.

After fish were released into the Minthorn facility, an obvious problem was noted following the first night of operation. Fish would persistently jump up at the intake water and would sometimes go over the discharge manifold or wiggle out through a crack between the pond wall and the manifold. The next day, boards were placed over the intake end of the raceways. Screens were later constructed and placed to prevent fish from jumping out.

Although the Minthorn Facility (including pumps) was totally checked out following construction, we experienced a pump failure in July while juvenile fish were being held at Minthorn. The number-one pump quit and the reserve pump for an unknown reason did not kick on as it automatically should. Many fish were lost or severely stressed as a result of th pump being off for about two hours before help arrived. An electrician checked out the system and could not pinpoint the problem. However, it was necessary to have the pump seals repacked and circuits rechecked and pump failures were not experienced following this maintenance.

Following the pump problem and resultant stressing of fish, the daily mortality rate began to increase significantly. Upon examination of general fish appearance, behavior, and gills, it was determined that the fish had columnaris. Bio-moist diet with 6% terramycin additive was fed for about 3 weeks. Mortalities began to drop within a week and were at a normal level after two weeks.

Operation and Maintenance Costs

The total operation and maintenance cost for the Bonifer and Minthorn facilities from December through January 1986 was $42,012.31 (Table 9). The subcontract line item included $25,000 which was not spent in 1986. This money was budgeted to correct problems created by the February 1986 flood. The work was anticipated for the summer of 1986 but due to complicated planning and permit requirements, these funds will be utilized in 1987.

Table 9. Bonifer & Minthorn Acclimation Facilities 0 & M Expense Summary - 1986

Line Item	Expenditure
Salaries & Fringe	16,870.OO
Travel (all)	2,588.93
Fish Food	7,848.40
Property Lease	427.56
Facility Insurance	1,000.00
Electricity	1,606.OO
Materials (misc.)	2,527.34
Telephone/Alarm	388.20
Equip. Servicing	842.08
Indirect	7,913.11
Subcontract	0
TOTAL	42,012.31

Future Use of Facility

The use of the Bonifer and Minthorn facilities in 1987 will be similar to 1986 operations. Anticipated differences will be an additional spring release of coho salmon at Minthorn and the elimination of summer rearing of spring chinook at Bonifer. The fall release of spring chinook will remain at Bonneville Hatchery through the summer and will be acclimated at Bonifer prior to release. The projected 1987 salmon and steelhead release plans for the entire Umatilla Basin Program are detailed in Table 10.

TABLE 10. Projected 1987 Salmon and Steelhead Releases in the Umatilla River Basin. March 18, 1987

Species	Brood	Stock	Hatchery	Juvenile Releases					Fish Marked	
				Number	No/lb	Location	In Facility[1]	In River[1]	Yes	No
Fall Chin.	85	Bonneville	Bonneville	100,000	6-8	Minthorn	E. March	L. March	X (CWT 50,000)	
Fall Chin.	85	Bonneville	Bonneville	100,000	6-8	Bonifer	E. March	L. March	X (CWT 50,000)	
Fall Chin.	86	Bonneville	Irrigon	1.50 Mill.	90	Lower Uma.	-------	M. May	X (CWT 150,000)	
Fall Chin.	86	Bonneville	Irrigon	100,000 [2]	12 [3]	Minthorn	E. June	M. October	X (CWT 50,000)	
Spr. Chin.	85	Carson	Carson	100,000	8-10	Bonifer	L. March	M. April		X
Spr. Chin.	86	Carson	Oxbow	200,000 [4]	100	Upper Uma.	------	E. April		X
Spr. Chin.	86	Carson	Bonneville	100,000	10-12	Bonifer	L. September	M. October	?	
Early Coho	85	Toutle	Cascade	200,000	12-14	Minthorn	E. April	L. April	X (CWT 75,000)	
Early Coho	85	Toutle	Cascade	800,000 [5]	12-14	Lower Uma.	------	L. April		X
Sum. Stld.	86	Umatilla	Oak Springs	2,000	6-8	Bonifer	M. April	E. May	X (adipose clip)	

[1] E = Early; M = Mid; L = Late

[2] Reared through summer & released from facilities in fall (numbers are estimates).

[3] Estimated size at the time of fall release.

[4] Fish to be released in habitat in upper mainstem, N. Fk., S. Fk., and N. Fk. Meacham Creek.

[5] Fish to be released below Westland Dam (Stanfield area)

	MARCH	APRIL	MAY	JUNE	OCT
Bonifer ------->	100K Accl. 1+ f. chin.	100K Accl. 1+ sp. chin.	2K Accl. stld.		100K Accl. sp.chin.
Minthorn ------>	100K Accl. 1+ f. chin.	200K Accl. 1+ Coho		100K rearing Stock 0+ f.chin------->	Release
Lower River --->		800K Release 1+ Coho	1.50 Mill Release 0+ f.chin		
Upper River --->		200K Release 0+ sp. chin			

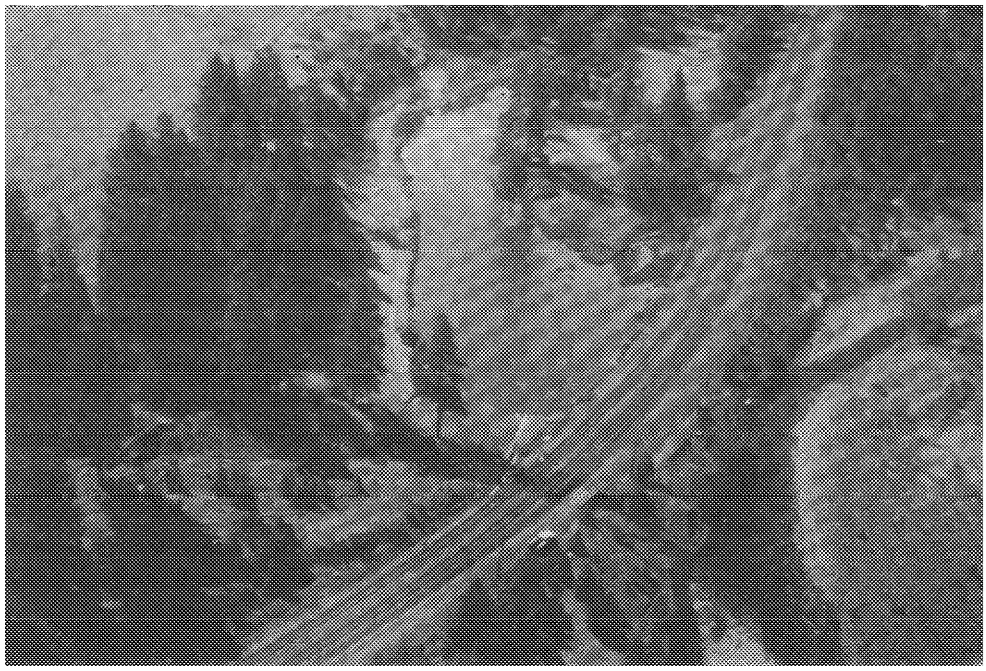


Photo 1. Bonifer facility from air showing springs, pond, fishway, Boston Canyon Creek, and Meacham Creek.

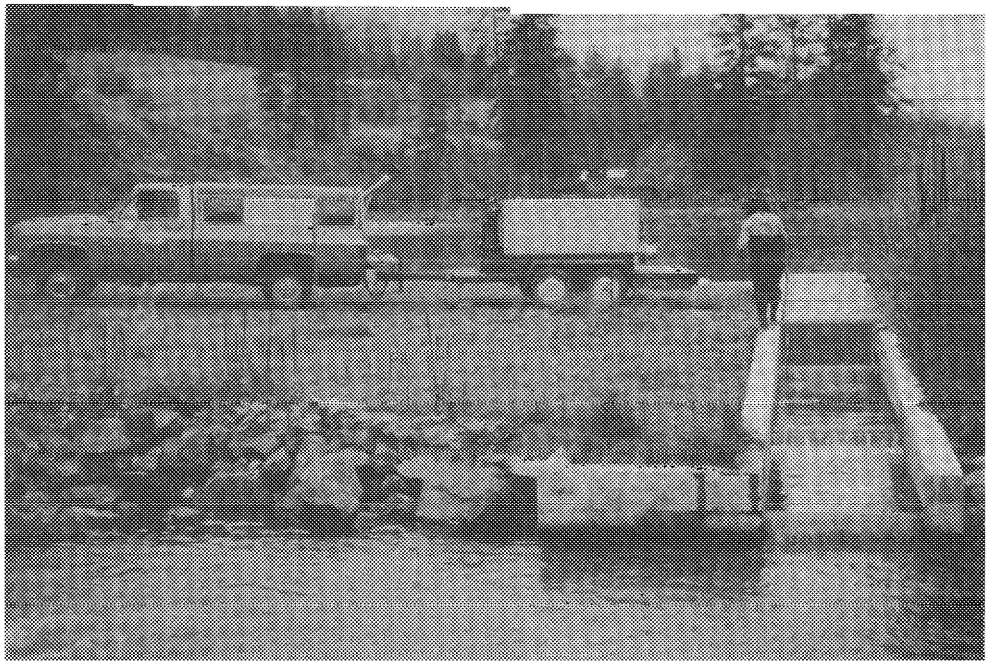


Photo 2. Bonifer fishway and fish transport tanker trailer.

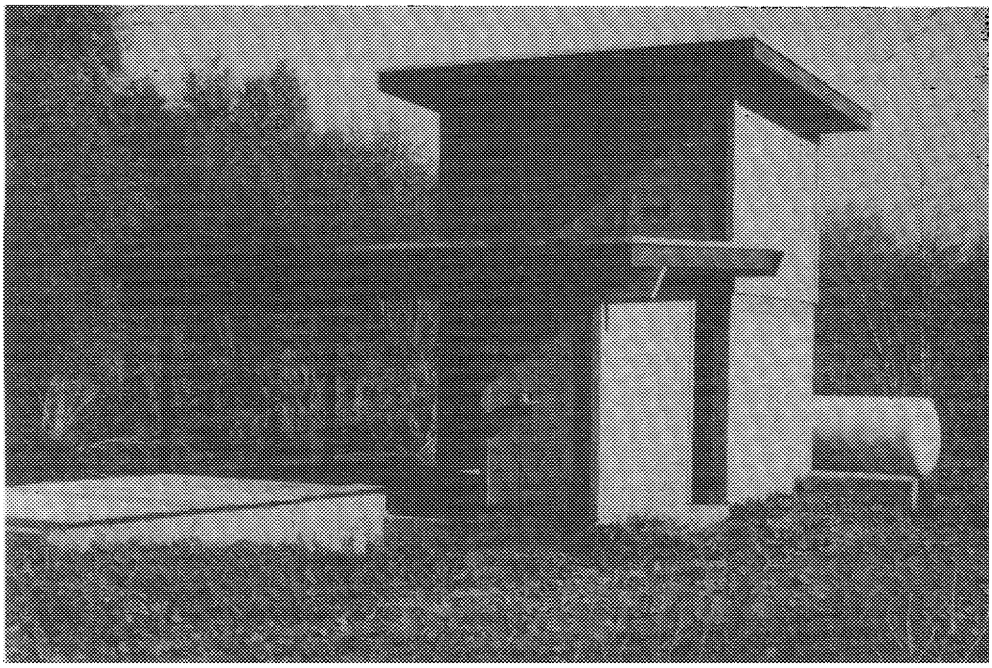


Photo 3. Minthorn facility pumphouse and adult holding area (covered walkway)

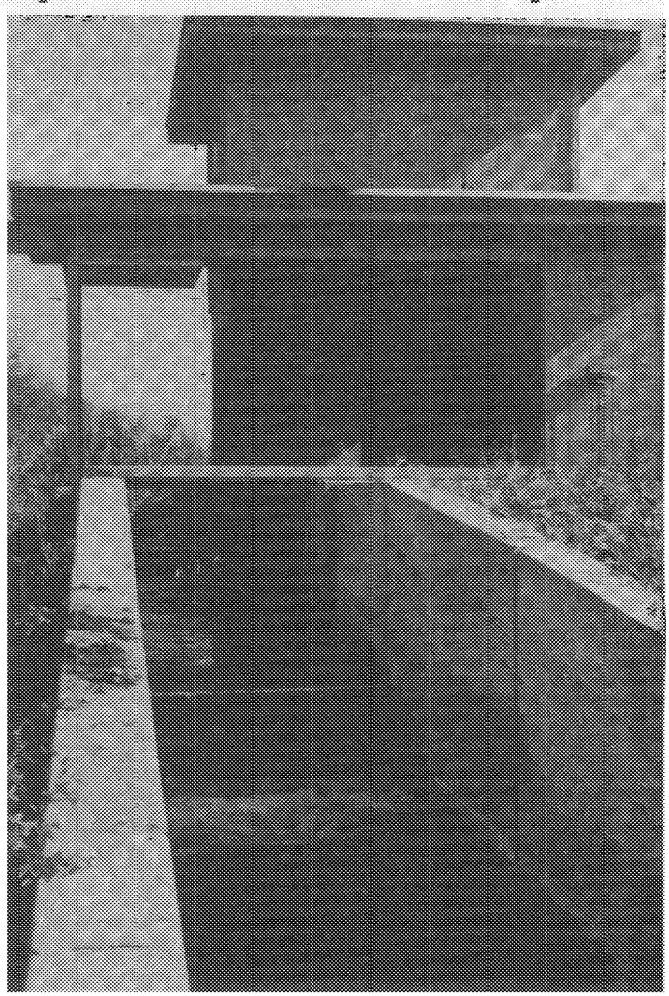


Photo 4. Minthorn facility and adult holding area.

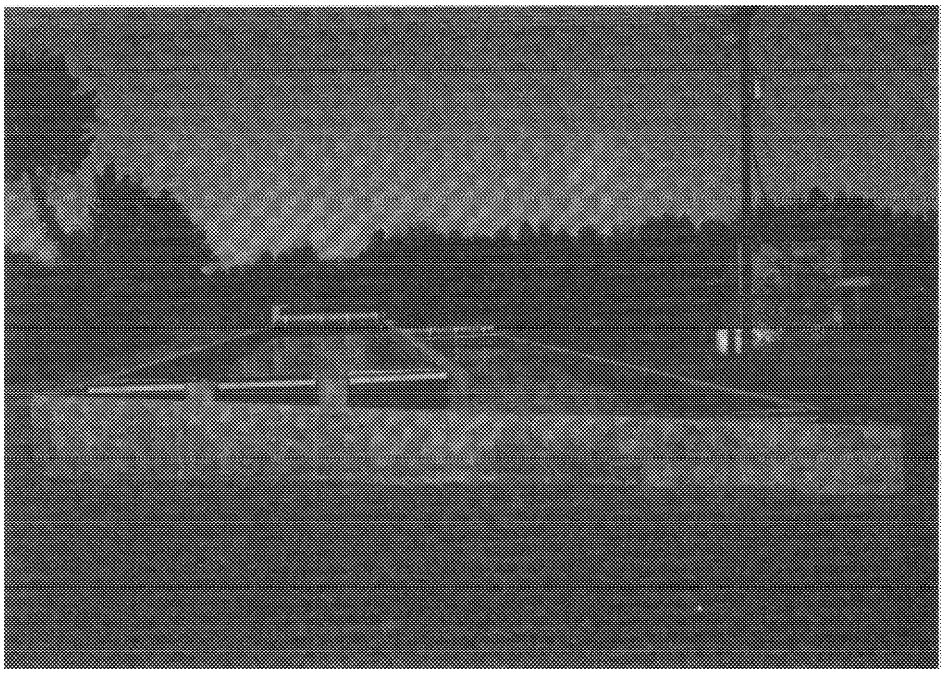


Photo 5. Minthorn raceways with pumphouse in background.

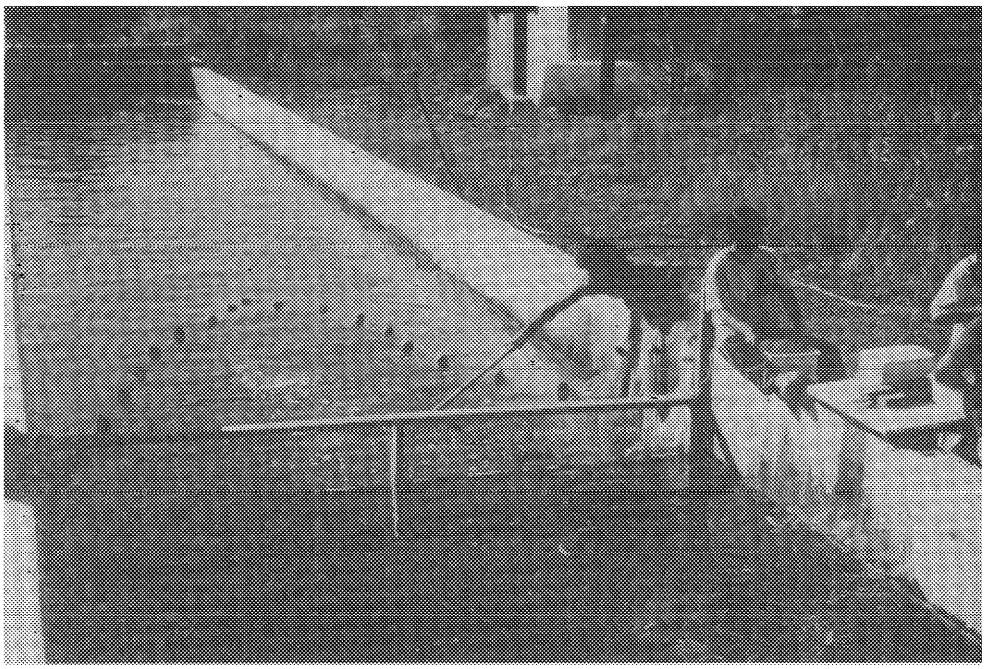


Photo 6. Crowding of juvenile fall chinook in Minthorn raceway and fin clipping operation.

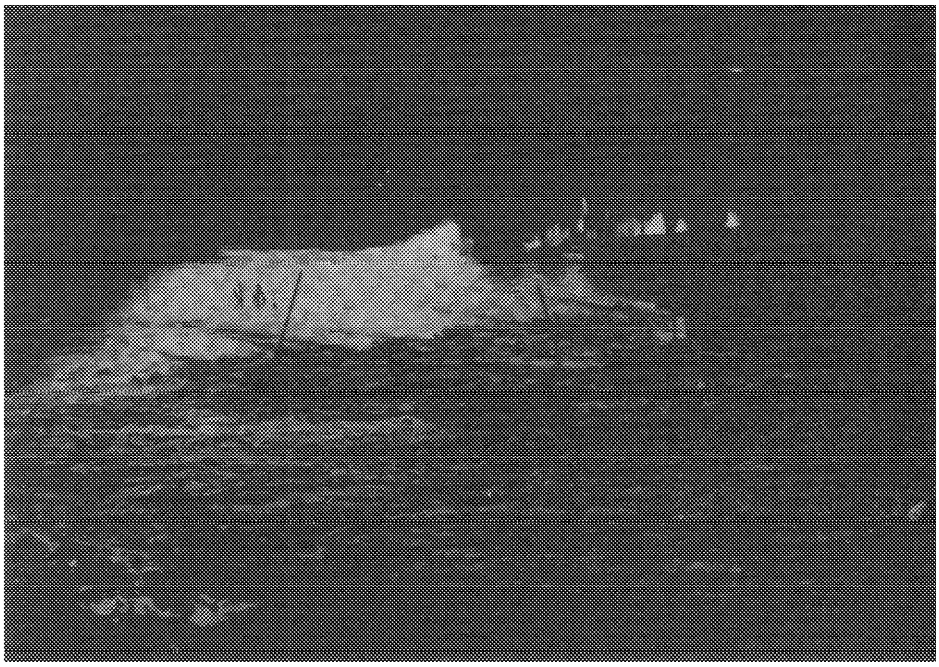


Photo 7. Boston Canyon Creek flooding over Bonifer fishway in February 1986.

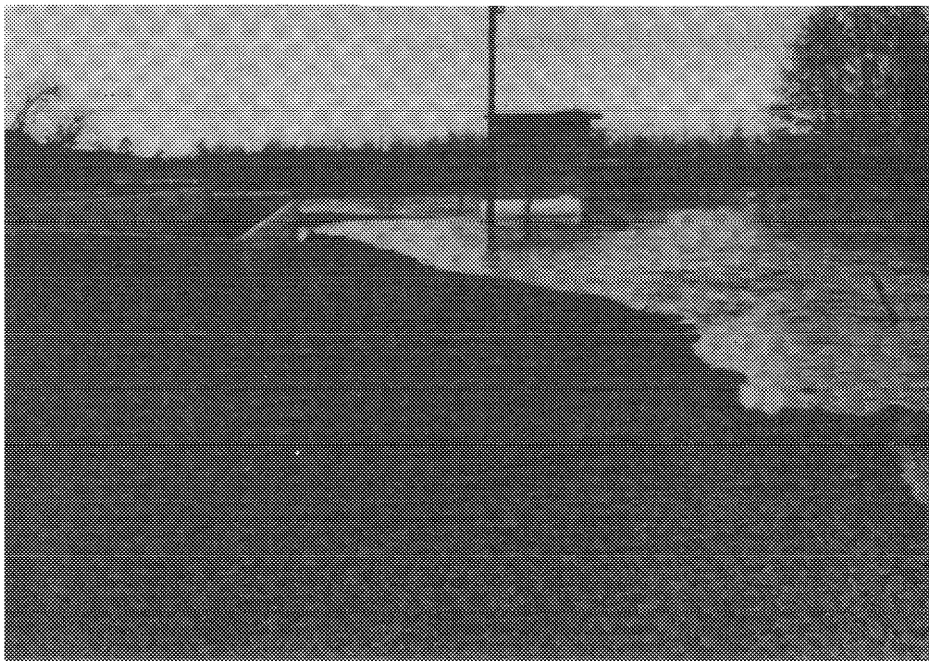
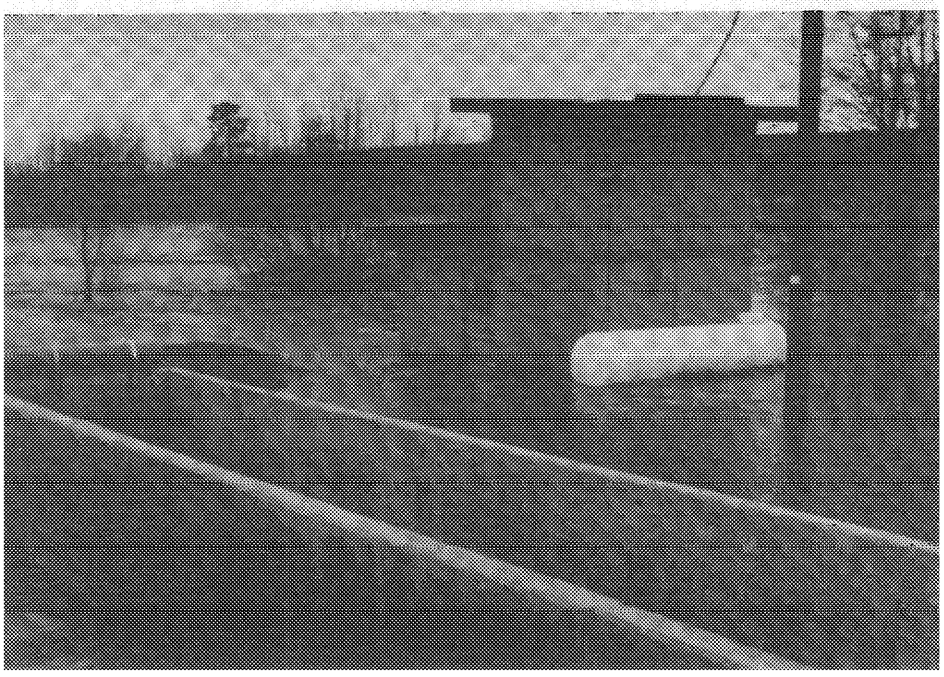
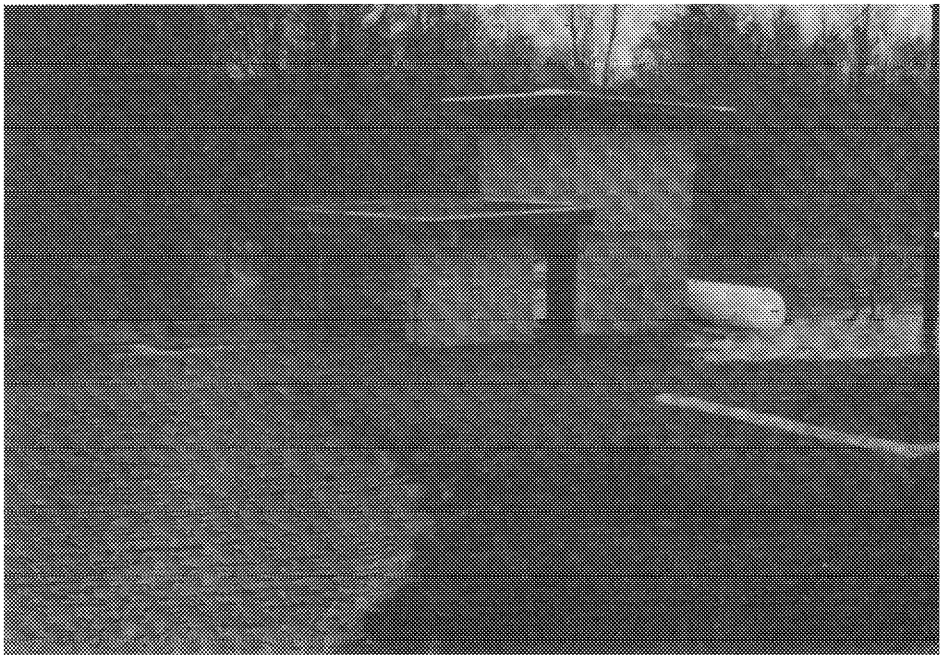


Photo 8. Minthorn Springs Creek flooding facility into swollen Umatilla River in February 1986.





Photos 9 & 10. Flooding Minthorn Springs Creek around facility in February 1986.