FIFTEENMILE BASIN HABITAT IMPROVEMENT PROJECT

Annual Report FY 1990

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ABSTRACT

The goal of the Fifteenmile Creek Habitat Improvement project is to improve wild winter steelhead habitat in the Fifteenmile Creek Basin. This goal was addressed under the Columbia River Basin Fish and Wildlife Program, Measure 703 (c) (1) - Action Item 4.2.

Construction of fish habitat structures was completed on approximately 3.5 miles of Eightmile Creek and on approximately 8.5 miles of Fifteenmile Creek. A total of 15,435 yds of rock was placed to improve rearing and spawning habitat, and to improve water quality and reduce siltation.

Riparian protection fencing was completed on 1.8 miles of Dry Creek, approximately 1.75 miles on Eightmile Creek, and 4.75 miles on Fifteenmile Creek. Approximately 10 miles of stream will receive protection from the 8 miles of new fencing installed and 6.5 miles of abandoned fence repaired.

Irrigation withdrawal screens were installed at six irrigation pump withdrawals. These screens functioned satisfactorily during the irrigation season.

Physical and biological monitoring of stream flows, water temperature, and macro-invertebrate communities was conducted.

INTRODUCTION

The Fifteenmile Creek Basin supports the eastern most stock of wild winter steelhead in the Columbia River Basin (Figure 1). The current steelhead population is depressed from historic levels. Steelhead production within the basin is limited by deficiencies within the Fifteenmile Creek basin, and by passage problems at Bonneville Dam on the main stem Columbia River.

Fifteenmile Creek was selected as a mitigation site for wild winter steelhead under the Northwest Power Planning Council's Columbia River Basin Fish and Wildlife program, measure 703 (c) (l), action item 4,2 (amended 1987). A cooperative effort between the Oregon Department of Fish and Wildlife (ODFW), USDA Forest Service (USFS), the Confederated Tribes of the Warm Springs (CTWIR), and the Wasco County Soil and Water Conservation District (WCSWCD) was undertaken to improve winter steelhead habitat. funding for the project was provided by the Bonneville Power Administration (BPA).

An implementation plan was developed to guide habitat improvements throughout the Basin (Smith et al, 1987). The initial three years (Phase 1 - Phase 3) were funded through BPA to investigate the landowner acceptance of the project and success of implementing a habitat improvement project in the Fifteenmile Creek Basin. Six objectives were identified under the complete five year implementation plan:

1. Provide unobstructed passage for migrations of adult and juvenile steelhead to achieve full seeding and utilization of suitable rearing habitat.

2. Maintain an average maximum summer water temperature of 75 degrees Fahrenheit (23.9 degrees Celsius), or less, at the mouth of Fifteenmile Creek.

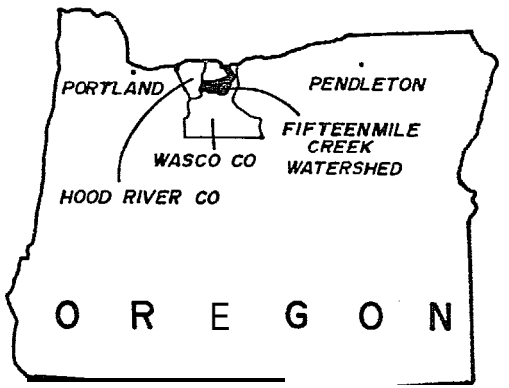
3. Provide adequate riparian vegetation on at least 80% of the perennial stream miles in the drainage.

4. Increase habitat diversity by increasing pool habitat to 40-50% of the total stream area in the drainage.

5. Within the constraints of land use practices, reduce active erosion to less than 20% of all stream banks.

6. Minimize the delivery of sediment from upland sources to the stream channel.

MAJOR TRIBUTARIES- FIFTEEN MILE CREEK BASIN



VICINITY MAP

Figure 1

Considerations relative to accomplishing these objectives included the potential benefits and cost effectiveness, the location of the potential project sites within the basin, landowner acceptance and cooperation, and logistic constraints associated with agricultural operations.

DESCRIPTION OF PROJECT AREA

Project Area

Dry Creek

Dry Creek flows into Fifteenmile Creek at river mile 24.5 (Figure 2). Dry Creek is exemplified by intensive livestock grazing on both uplands and in the stream corridor. The stream was channelized after the 1974 flood and most woody material was removed. Little recruitment of woody vegetation has occurred due to intensive livestock usage. The stream has eroded down to a bedrock layer in many areas. The lack of riparian vegetation combined with intensive livestock usage has resulted in a very unstable channel, evidenced by extensive channel migration in several areas.

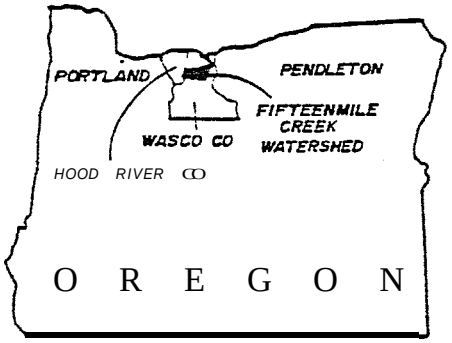
Fish habitat has been measureably degraded by organic enrichment and sedimentation (Mangum 1987).

Eightmile Creek

Eightmile Creek flows into Fifteenmile creek near its mouth at river mile 3. Habitat improvement efforts were performed between river mile 20 and river mile 15. Prior to habitat improvement the stream consisted of 90% riffles and 10% pools. Virtually all woody structure had been removed from the stream, resulting in reduced salmonid rearing capacity. The upper reaches of the stream are impacted by summer residences and by livestock grazing. The lower portion of the project area consists primarily of livestock pastures.

Macro-invetebrates inhabiting the lower portion of the project site consisted of those taxa tolerant to nutrient enrichment and sedimentation. Clean water species exist in greater numbers in the upper reaches of Eightmile Creek (Mangum 1987).

MAJOR TRIBUTARIES FIFTEENMILE CREEK BASIN



VICINITY MAP

Figure 2

ENHANCEMENT SITES

KEY

-instream structures
-instream structures and corridor fencing
m-corridor fencing
IR -irrigation screening
RD -rotary drum screening
-.fishways

Fifteenmile Creek

The head water of Fifteenmile Creek are located on the north east side of Mt. Hood. The stream flows northeasterly through private agricultural lands before emptying into the Columbia River directly downstream of The Dalles Dam. The upper one third of the basin consists of public and private timber lands. The upper bounds of the work area encompassed these timber lands exemplified as a riffle dominated stream system, lacking sufficient instream structures (most notably large woody structures). The lower two thirds of the basin is heavily channelized, with insufficient instream structure and riparian buffer. Many areas are currently subject to livestock production and are exhibiting unstable banks, a high degree of erosion, and little or no riparian vegetation. Clean water macro-inveretebrate species exist in good numbers on the upper reaches of the basin but diminish proceeding downstream in the drainage (Mangum 1987).

METHODS AND MATERIALS

Instream Structure

Areas lacking in particular habitat types were identified for structural treatment under the Fifteenmile Basin Fish Habitat Imprivement Implementation Plan (Smith et al. 1986). Fifteenmile and Eightmile Creeks lacked pool quality and quantity necessary for good production of juvenile steelhead. Both creeks were also found to be lacking in instram structural diversity and habitat complexity.

Pool: Riffle ratio was improved by construction of rock and log weirs, jetties, flow deflectors, and boulder clusters. These structures dissipate the energy of the stram, improve habitat diversity, provide cover and rearing habitat and trap gravels, thereby improving biological productivity.

Material used for structures, (logs or rock) depended on site location relative to a suitable source of construction materials.

Cedar and Douglas-fir logs were obtained from a lumber company in Hood River, and then transported by truck to the work site. Log weirs were prescribed for most of the work sites in the upper reaches of the basin. Log weirs increase habitat diversity and improve rearing habitat and insect production. Basalt rock, obtained from local rock pits was used for the rock structures and boulder clusters. Rock size varied from about cobble size to approximately five yds 3 (3000 lbs). Columnar basalt was utilized with colums averaging over three feet in diameter and reaching lengths of up to fifteen feet.

Log structures were installed by excavating a two foot deep toe trench into the stream bed. The trench was keyed into the banks approximately one third the length of the log. The log was then placed into the trench, and approximately 30 cubic yards of rock were laid on the ends of the log. The material removed for the trench was placed on top of the larger rock that had already been placed in the keys. Rough cut 2"x12" Douglas Fir planks were then nailed on the upstream side of the log. Planks were installed leaving one half inch space to allow for limited water movement through spaces.

Installation of rock structures was similar to that of log structures except that rock in the proper graduation was used to fill the toe trench. A toe trench was dug into the stream bed and into the stream bank. The depth of the trench was approximately two feet and was keyed into the stream bank, a length equivalent to one third of the stream width. The toe trench was filled with 50 to 100 yd^3 of rock, and then covered with soil and gravel removed from the toe trench. The bank directly upstream and downstream of the structure was rip-rapped with approximately 10-20 cubic yards of rock to prevent the strean from cutting behind the structure. The rip-rap installed around the weir provides the added benefit of providing winter habitat for rearing juveniles (Gebhart Pers. Comm. 1988).

Corridor Fencing

Corridor fencing was installed to facilitate the re-vegetation of the stream banks and to protect recently installed instream habitat structures and existing bank integrity. Corridor fencing protects streambanks by eliminating livestock usage around instream structures. The elimination of livestock provides for the fastest rate of recovery of riparian plant communities that were being suppressed through grazing. The fence specifications, type, and location were decided by the project biologist, ODFW engineers, and the private landowner. The fence was built by private contractors with ODFW personnel acting as project inspectors. Both four-strand barb wire, and six-strand high tensile New Zealand style fence were constructed as corridor fencing. Fence sections take into account normal ranch activities and include livestock water gaps and equipment crossings. Fence corners and end structures for these fences were made with driven railroad ties, driven five inch round posts, or four inch round post rock cribs. In-line fence structures consisted of four inch round posts, rock jacks made from four inch round posts, or steel 133 T-posts, depending on the fence type. Equipment crossings and water gaps were made using an adjustable barb wire crossing. These crossings allow adjustment to accommodate flow conditions throughout the year.

Irrigation Screens

Rotary irrigation screens were installed on six irrigation withdrawals on Fifteenmile Creek and Ramsey Creek. The screens were installed directly on the irrigation intake line. The screens are self cleaning and provide acceptable protection to juvenile sized (>50mm FL) salmonids.

Maintenance

Project maintenance included monitoring all passage structures, fence, irrigation withdrawal screens, rotary screens, and instream habitat structure for proper operation.

Screens were monitored on a weekly basis, and fence projects once every six weeks when not being used for livestock and more frequently during the grazing season, or when wildlife activities affected the fence (beavers, etc.). Screen maintenance also included educating the landowner operating the screens to insure proper funtioning.

Macro-Invertebrates

Macro-invertebrate populations are biological indicators of riparian corridor health. Macro-invertebrate populations respond more quickly to changes in their physical environment (water temperature, flow, sediment loads, etc.) than do fish populations. Monitoring of the macro-invertebrates provides an indicator of the success of the fish habitat improvement project.

Macro-invertebrates were collected from eight representative sample sites located on private lands (Appendix A). Samples were collected from the spring, summer, and fall periods. Samples collected by ODFW and USFS were analyzed by Dr. Fred Mangum (Aquatic Ecologist, USDA Forest Service, Region 4). (Results will be reported in a summary being prepared by the USFS).

Photo Points

Photo points of the riparian corridor were photographed on a seasonal basis. These photos document riparian recovery of plant communities as well as the narrowing and deepening of the stream channel (Appendix D).

Stream Temperatures

Stream temperatures were measured with Omnia Data thermographs. The four sample locations were:

1) Fifteenmile Creek at Dufur
2) Fifteenmile Creek approximately 4 miles downstream of the National forest boundary (Petersburg)
3) Eightmile Creek at Endersby
4) Ramsey creek approximately 2 miles above the mouth (Appendix B).

The upper lethal limit, (or highest temperature at which no mortality occurred during a five day period) under laboratory conditions for Oncorhynchus mykiss was 25c (Cherry et al).

Stream Flows

Stream flows were recored with a Marsh-McBirnay flow meter by the direct discharge method at all macro-invertebrate sample sites (Appendix B).

RESULTS

Dry Creek Project Implementation

A total of 1.8 miles of four-strand barbed wire fence was installed on George Fax's property on Dry Creek. Mr. Fax's property was the one remaining gap in the riparian fence project constructed in 1988. With the addition of the Fax property a continuous corridor fence exists for approximately five miles (RMO - RM5).

Twelve miles of stream on Eightmile and Fifteenmile Creeks were treated with instream structures. A total of 15,435 yd^3 of rock was used to construct weirs, deflectors, jetties, and boulder clusters. In addition, logs were used to construct 26 weirs and jetties.. Following instream construction, 10 miles of stream were protected by riparian corridor fencing to exclude livestock. Riparian vegetation recovery will protect and enhance the benefits provided by the instream habitat improvements.

Irrigation Screening

Six irrigation screens were installed on Fifteenmile and Ramsey Creeks during this field season. The self-cleaning screens have provided acceptable protection to juvenile salmonids. The six screens were installed in the Dufur Valley on previously unscreened or inadequately screened irrigation withdrawals.

Baseline Biological Information

Stream Flows

Stream flows were measured during the months of May (prior to irrigation season), and October (after irrigation season) (Figure 3). Spring stream flows were lower in 1989 than in 1988. This may be due to the difference in the time of snow melt as opposed to the relative amount of snow pack. Summer low flows were much higher than the previous year (Figure 3). Drought conditions coupled with a limited data base make it extremely difficult to draw conclusions pertaining to flow enhancement and riparian habitat recovery.

Temperature

Stream temperatures were monitored from May through early October in 1989 (Figure 4, 5 and Appendix C). Of the four stations monitored (Appendix B), only one, Fifteenmile Creek at Petersburg registered temperatures that would be considered stressful for steelhead. Durations of high water temperatures were not long enough to create direct mortalities.

DISCUSSION

The acceptance of the fish habitat project continues to be excellent within the basin. Several landowners have made contact with project personnel for the possibility of having enhancement activities performed on their property in the future.

Approximately 25 miles of stream have been improved for steelhead production under the current habitat project. The addition of nine passage and screening projects has helped to ensure that available steelhead habitat will be utilized. Seeding levels will be improved by allowing unobstructed passage to existing habitat. Juvenile survival will be increased by reducing direct mortalities from improperly screened irrigation withdrawals. Steelhead habitat improvement efforts are having very positive social and biological ramifications. The habitat project has laid the ground work to educate landowners on improved streamside stewardship as well as benefit resident cutthroat trout populations and numerous wildlife species.

Cost effectiveness was improved during the first three years of the project by reducing construction costs. Despite increases in material costs, overall fence construction costs were reduced from approximately $9,000 per mile in 1988 to approximately $6,000 per mile in 1989. The reduction in cost is attributable to changing from a four-strand barbed wire fence to a six-strand smooth wire fence. the smooth wire fence has proven to be very effective in livestock management and has lower maintenance costs. Improvements were made in contracting, and in the technical aspects of the structures installed.

Figure 3

STREAM FLOWS, FIFTEENMILE CREEK BASIN 1988-89

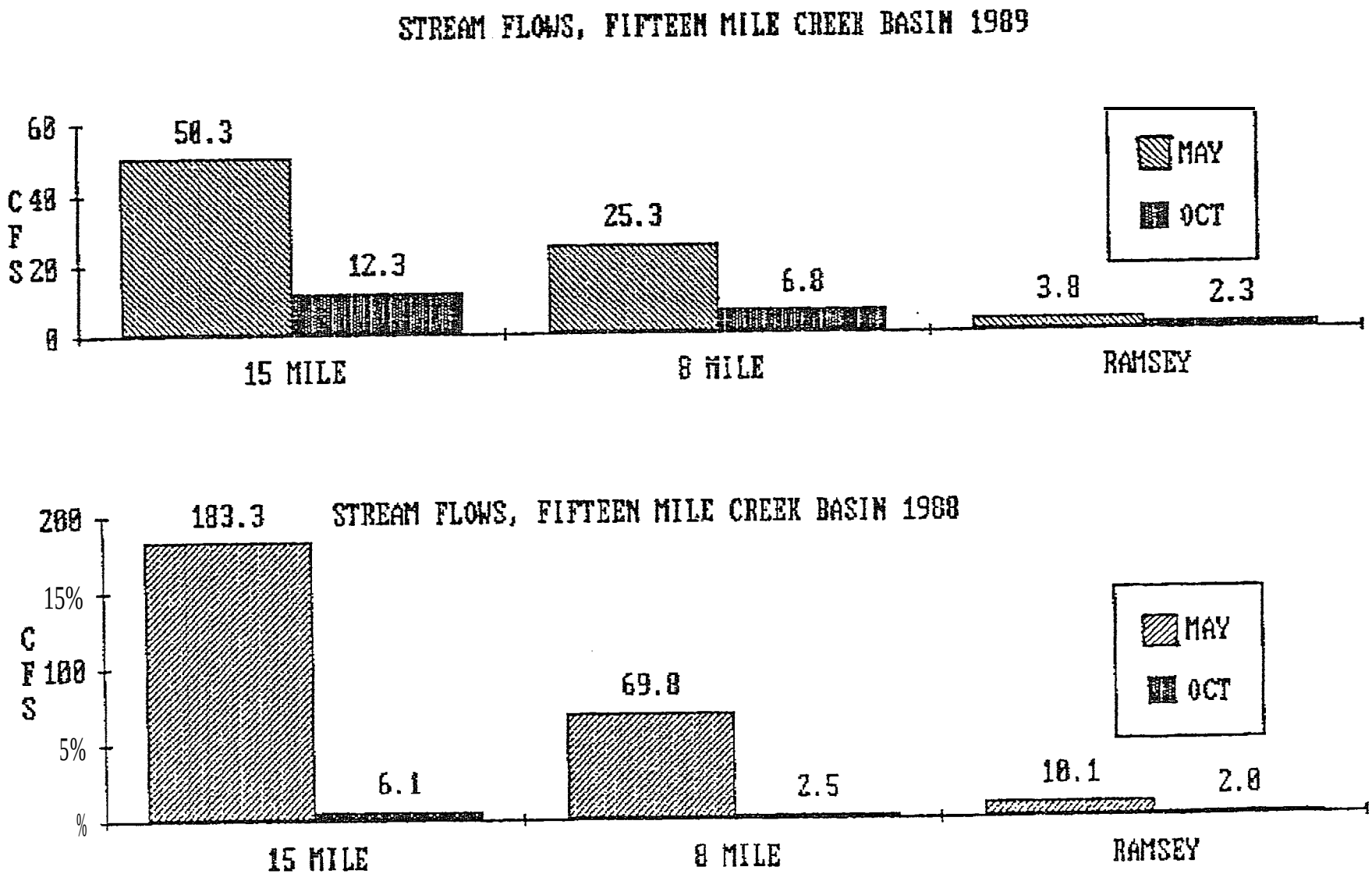


Figure 4

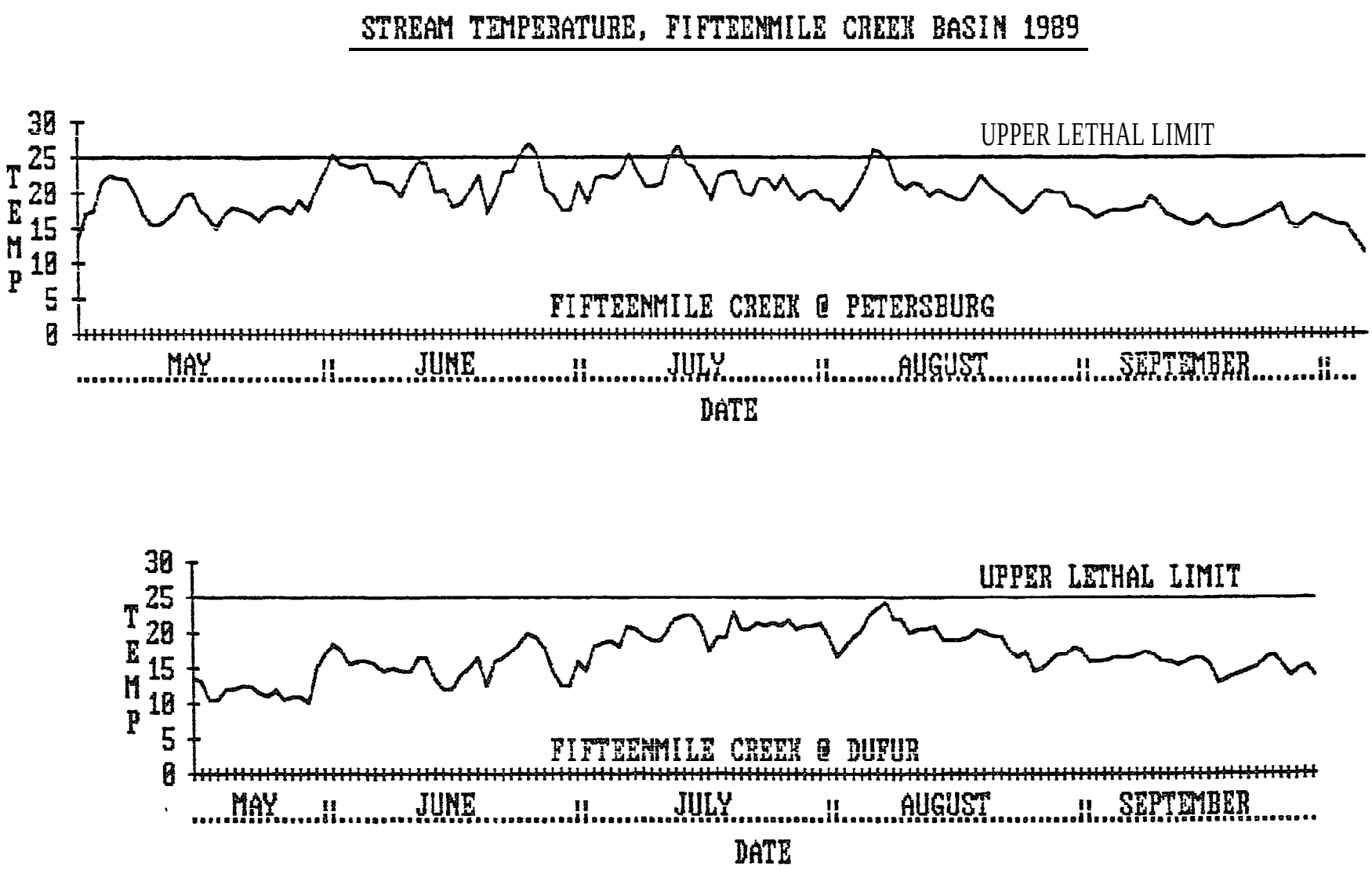
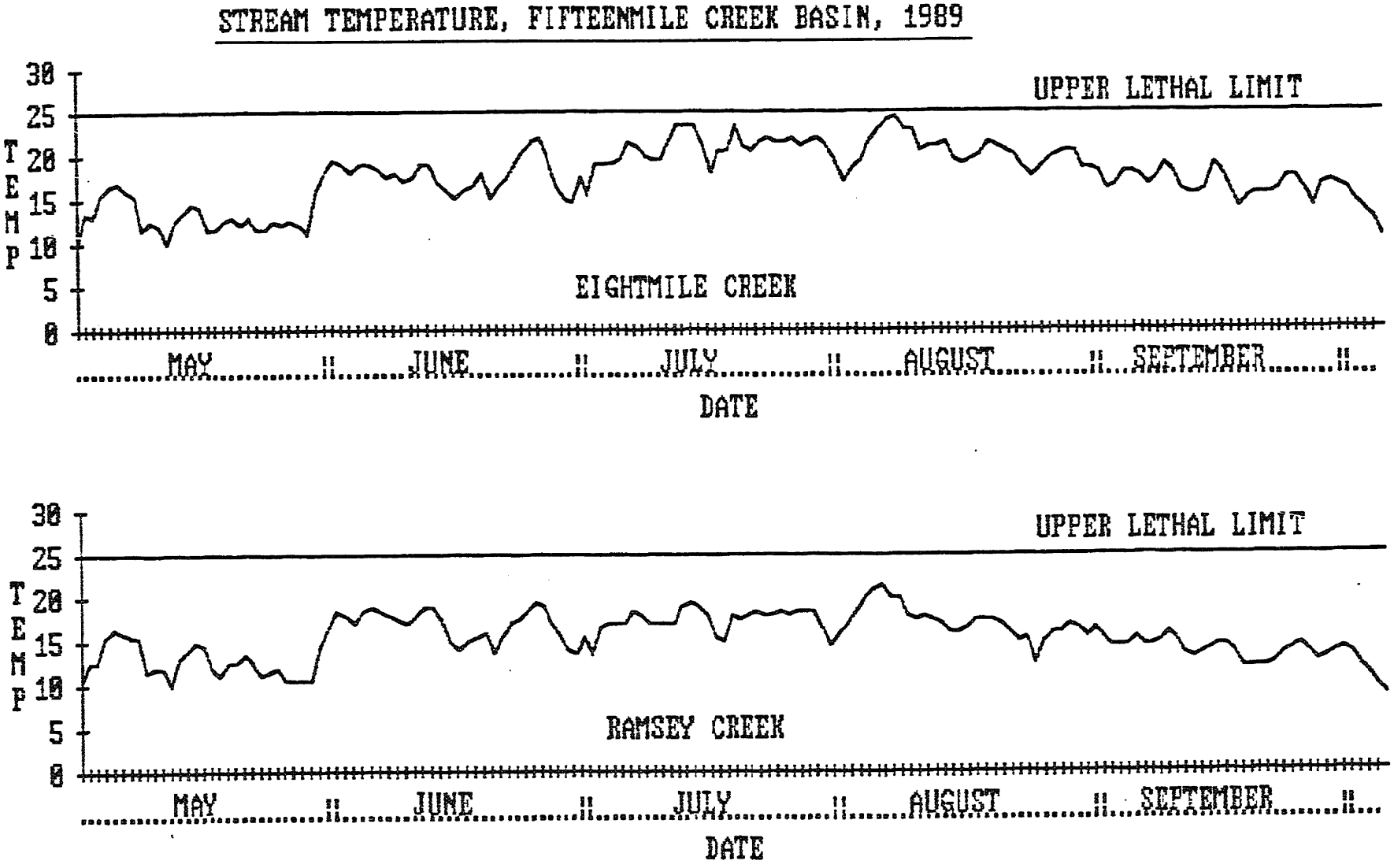

STREAM TEMPERATURE, FIFTEENMILE CREEK BASIN 1989
UPPER LETHAL LIMIT
TEMP
30
25
20
15
10
5
0
FIFTEENMILE CREEK @ PETERSBURG
MAY
JUNE
JULY
AUGUST
SEPTEMBER
DATE
UPPER LETHAL LIMIT
TEMP
30
25
20
15
10
5
0
FIFTEENMILE CREEK @ DUFUR
MAY
JUNE
JULY
AUGUST
SEPTEMBER
DATE

Figure 5


STREAM TEMPERATURE, FIFTEENMILE CREEK BASIN, 1989
30
25
20
15
10
5
0
TEMP
UPPER LETHAL LIMIT
EIGHTMILE CREEK
MAY
JUNE
JULY
AUGUST
SEPTEMBER
DATE
30
25
20
15
10
5
0
TEMP
UPPER LETHAL LIMIT
RAMSEY CREEK
MAY
JUNE
JULY
AUGUST
SEPTEMBER
DATE

SUMMARY OF EXPENDITURES

April 1, 1989 through March 31, 1990

1.	Personnel	101,757.68
2.	Services/Supplies	290,866.19
3.	Capitol	422.52
4.	Indirect Cost (@26.7% to 21.4%)	32,742.66
5.	Total Cost	425,789.05 *

* Expenditures for the months of February and March have been estimated, Total Expenditures will be provided by ODFW Fiscal Section.

Literature Cited

Cherry, D. S., K. L. Dickson, J. Cairns Jr., and J. R. Stauffer. 1977 Preferred, avoided, and lethal temperatures of fish during rising temperature conditions. J. Fish. Res. Board Can. 34:239-246

Mangum, Fred A. 1986. Aquatic Ecosystem Inventory, Macro-Invertebrate Analysis. In Annual Progress Report Mt. Hood National Forest, 1987. 76 pages.

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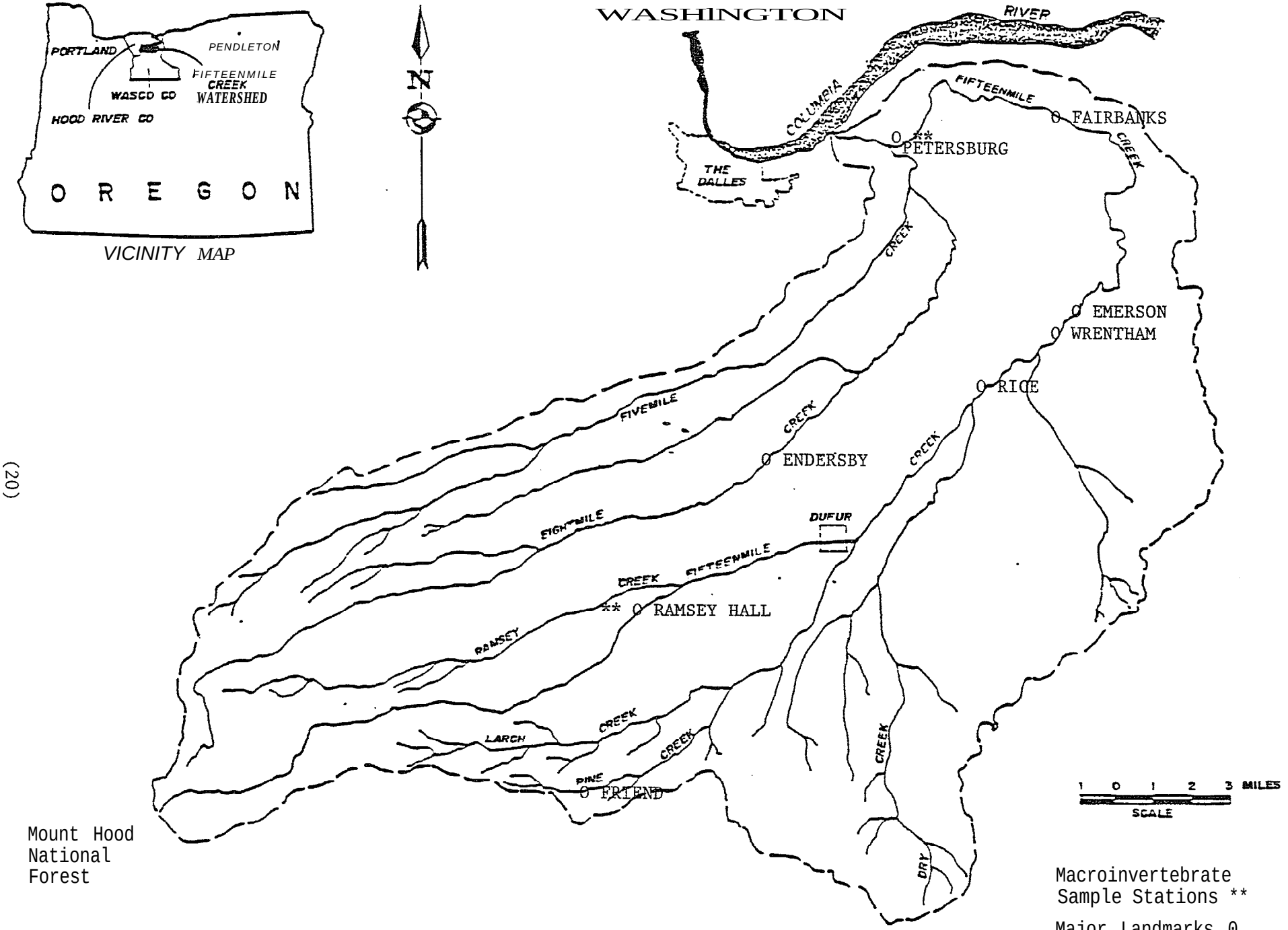
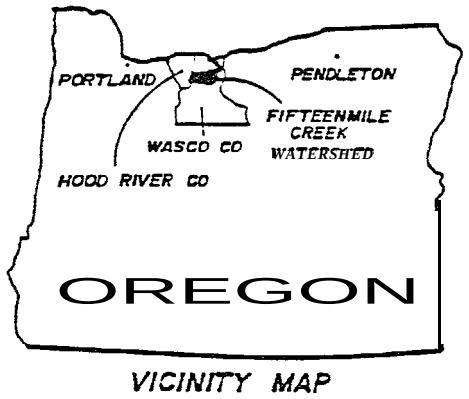
Appendix A

MAJOR TRIBUTARIES FIFTEENMILE CREEK BASIN

FIFTEENMILE PROJECT MACROINVERTEBRATE COLLECTION STATIONS



MAJOR TRIBUTARIES- FIFTEENMILE CREEK BASIN
FIFTEENMILE PROJECT TEMPERATURE AND FLOW MONITOR STATION



VICINITY MAP

WASHINGTON

RIVER

COLUMBIA

FIFTEENMILE CREEK

O FAIRBANKS

O PETERSBURG

THE DALLES

O FREEBRIDGE

O EMERSON

O WRENTHAM

O RICE

FIVEMILE CREEK

**O ENDERSBY

EIGHTMILE CREEK

DUFUR

FIFTEENMILE CREEK

**O RAMSEY HALL

RAMSEY CREEK

LARCH CREEK

PINE CREEK

O FRIEND

DRY CREEK

MOUNT HOOD NATIONAL FOREST

1 0 1 2 3 MILES
SCALE

Datapod Stations **
Major landmarks 0

Appendix C-l

Temperature Data by Julian Day for Ramsey Creek

Julian Day	Temperature	Julian Day	Temperature
122	10.5	171	16.0
123	12.5	172	13.5
124	12.5	173	15.5
125	15.5	174	17.0
126	16.5	175	17.5
127	16.0	176	18.5
128	15.5	177	19.5
129	15.5	178	19.0
130	11.5	179	17.0
131	12.0	180	15.5
132	12.0	181	14.0
133	10.0	182	13.5
134	13.0	183	15.5
135	14.0	184	13.5
136	15.0	185	16.5
137	14.5	186	17.0
138	12.0	187	17.0
139	11.0	188	17.0
140	12.5	189	18.5
141	12.5	190	17.0
142	13.5	191	17.0
143	12.5	192	17.0
144	11.0	193	17.0
145	11.5	194	19.0
146	12.0	195	19.5
147	10.5	196	19.0
148	10.5	197	18.0
14.9	10.5	198	15.5
150	10.5	199	15.0
151	14.5	200	20.0
152	16.5	201	18.0
153	18.5	202	17.5
154	18.0	203	18.0
155	17.0	204	18.5
156	18.5	205	18.0
157	19.0	206	18.0
158	15.0	207	18.5
159	18.5	208	18.0
160	18.0	209	18.5
161	17.5	210	18.5
162	17.0	211	18.5
163	18.0	212	16.5
164	19.0	213	14.5
165	19.0	214	16.0
166	17.5	215	17.0
167	15.0	216	18.5
168	14.0	217	20.0
169	15.0	218	21.0
170	15.5	219	21.5

Temperature Data by Julian Day for Ramsey Creek

Julian Day	Temperature	Julian Day	Temperature
220	20.0	270	12.5
221	20.0	271	13.0
222	18.0	272	13.5
223	17.5	273	14.0
224	18.0	274	13.5
225	17.5	275	12.0
226	17.0	276	11.0
227	16.0	277	9.5
228	16.0	278	8.5
229	16.5	279	
230	17.5	280	
231	17.5	281	
232	17.5	282	
233	17.0	283	
234	16.0	284	
235	15.0	285	
236	15.5	286	
237	12.5	287	
238	16.0	288	
239	16.0	289	
240	17.0	290	
241	16.5		
242	15.5		
243	16.5		
244	15.5		
245	14.5		
246	14.5		
247	14.5		
248	15.5		
249	14.5		
250	14.5		
251	15.0		
252	16.0		
253	15.0		
254	13.5		
255	13.0		
256	13.5		
257	14.0		
258	14.5		
259	14.5		
260	13.5		
261	12.0		
262	12.0		
263	12.0		
264	12.0		
265	12.5		
266	13.5		
267	14.0		
268	14.5		
269	13.5		

Appendix C - 2

Temperature Data by Julian Day for Eightmile Creek

Julian Day	Temperature	Julian Day	Temperature
122	10.0	171	15.0
123	13.5	172	16.5
124	13.0	173	17.5
125	15.5	174	19.0
126	16.5	175	20.5
127	17.0	176	21.5
128	16.0	177	22.0
129	15.5	178	19.5
130	11.5	179	16.5
131	12.5	180	15.0
132	12.0	181	14.5
133	10.0	182	17.5
134	12.5	183	15.5
135	13.5	184	19.0
136	14.5	185	19.0
137	14.0	186	19.5
138	11.5	187	21.5
139	11.5	188	21.0
140	12.5	189	20.0
141	13.0	190	19.5
142	12.0	191	19.5
143	13.0	192	21.5
144	11.5	193	21.0
145	11.5	194	20.0
146	12.5	195	19.5
147	12.0	196	19.5
148	12.5	197	21.5
149	12.0	198	23.5
150	11.0	199	23.5
151	16.0	200	21.5
152	18.0	201	18.0
153	19.5	202	15.5
154	19.0	203	20.5
155	18.0	204	20.5
156	19.0	205	23.5
157	19.0	206	21.0
158	18.5	207	20.5
159	17.5	208	21.5
160	13.0	209	22.0
161	17.0	210	21.5
162	17.5	211	21.5
163	19.0	212	22.0
164	19.0	213	21.0
165	17.0	214	21.5
166	16.0	215	22.0
167	15.0	216	21.0
168	16.0	217	19.5
169	16.5	218	17.0
170	18.0	219	18.5

Appendix C - 2 (con't)

Temperature Data by Julian Day for Eightmile Creek

Julian Day	Temperature	Julian Day	Temperature
220	19.5	270	15.5
221	21.5	271	15.5
222	23.0	272	16.0
223	24.0	273	17.5
224	24.5	274	17.5
225	23.0	275	16.0
226	23.0	276	17.5
227	20.5	277	17.5
228	21.0	278	16.0
229	21.0	279	14.0
230	21.5	280	16.5
231	19.5	281	17.0
232	19.0	282	16.5
234	19.5	283	16.0
235	20.0	284	14.5
236	21.5	285	13.5
237	21.0	286	12.5
238	20.5	287	10.5
239	20.0		
240	18.5		
241	17.5		
242	18.0		
243	18.5		
244	19.5		
245	20.0		
246	20.5		
247	20.5		
248	18.5		
249	18.5		
250	18.0		
251	16.0		
252	16.5		
253	18.0		
254	18.0		
255	17.5		
256	16.5		
257	17.5		
258	19.0		
259	18.0		
260	16.0		
261	15.5		
262	15.5		
263	16.0		
264	19.0		
265	18.0		
266	16.0		
278	14.0		
268	15.0		
269	15.5		

Appendix C - 3

Temperature Data by Julian Day for Fifteenmile Creek at Petersburg

Julian Day	Temperature	Julian Day	Temperature
122	13.5	171	17.0
123	17.0	172	19.5
124	17.5	173	23.0
125	21.5	174	25.5
126	22.5	175	27.0
127	22.0	176	25.5
128	22.0	177	20.5
129	20.0	178	19.5
130	17.0	179	17.5
131	15.5	180	17.5
132	15.5	181	21.5
133	16.5	182	18.5
134	17.5	183	22.0
135	19.5	184	22.5
136	20.0	185	22.0
137	17.5	186	23.0
138	16.5	187	25.5
139	15.0	188	23.0
140	17.0	189	21.0
141	18.0	190	21.0
142	17.5	191	21.5
143	17.0	192	25.0
144	16.0	193	26.5
145	17.5	194	24.0
146	18.0	195	23.5
147	18.0	196	21.5
148	17.0	197	19.0
149	19.0	198	17.5
150	17.5	199	23.0
151	20.5	200	23.0
152	23.0	201	20.0
153	25.5	202	19.5
154	24.0	203	22.0
155	23.5	204	22.0
156	24.0	205	20.5
157	24.0	206	22.5
158	21.5	207	20.5
159	21.5	208	19.0
160	21.0	209	20.0
161	19.5	210	20.5
162	22.5	211	19.0
163	24.5	212	19.0
164	24.0	213	17.5
165	20.0	214	19.0
166	20.5	215	21.0
167	18.0	216	23.0
168	18.5	217	26.0
169	20.5	218	25.5
170	22.5	219	24.5

Temperature Data by Julian Day for Fifteenmile Creek at Petersburg

Julian Day	Temperature	Julian Day	Temperature
220	21.5	270	15.0
221	20.5	271	16.0
222	21.5	272	17.0
223	21.0	273	16.5
224	19.5	274	16.0
225	20.5	275	15.5
226	19.5	276	15.5
227	19.0	277	13.5
228	19.0	278	11.5
229	20.5	279	
230	22.5	280	
231	21.0		
232	20.0		
233	19.0		
234	18.0		
235	17.0		
236	18.0		
237	16.5		
238	19.5		
239	20.5		
240	20.9		
241	20.0		
242	18.0		
243	18.0		
244	17.5		
245	16.5		
246	17.0		
247	17.5		
248	17.5		
249	17.5		
250	18.0		
251	18.0		
252	19.5		
253	18.5		
254	17.0		
255	16.5		
256	16.0		
257	15.5		
258	16.0		
259	17.0		
260	15.5		
261	15.0		
262	15.5		
263	15.5		
264	16.0		
265	16.5		
266	17.0		
267	17.5		
268	18.5		
269	16.0		

Appendix C - 4

Temperature Data by Julian Day for Fifteenmile Creek at Dufur

Julian Day	Temperature	Julian Day	Temperature
122		171	16.5
123		172	12.5
124		173	16.0
125		174	16.5
126		175	17.5
127		176	18.5
128		177	20.0
129		178	19.5
130		179	18.0
131		180	14.5
132		181	12.5
133		182	12.5
134		183	16.0
135		184	14.5
136	13.5	185	18.0
137	13.0	186	18.5
138	10.5	187	19.0
139	10.5	188	18.0
140	12.0	189	21.0
141	12.0	190	20.5
142	12.5	191	19.5
143	12.5	192	20.5
144	11.5	193	22.0
145	11.0	194	22.5
146	12.0	195	22.5
147	10.5	196	21.0
148	11.0	197	17.5
149	11.0	198	14.5
150	10.0	199	19.5
151	15.0	200	19.5
152	17.0	201	23.0
153	18.5	202	20.5
154	17.5	203	20.5
155	15.5	204	21.5
156	16.0	205	21.0
157	16.0	206	21.5
158	15.5	207	21.0
159	14.5	208	22.0
160	9.5	209	20.5
161	15.0	210	21.0
162	14.5	211	21.0
163	14.5	212	21.5
164	16.5	213	19.5
165	16.5	214	16.5
166.	13.5	215	18.0
167	12.0	216	19.5
168	12.0	217	20.5
169	14.0	218	22.5
170	15.0	219	23.5

Temperature Data by Julian Day for Fifteenmile Creek at Dufur

Julian Day	Temperature	Julian Day	Temperature
220	24.5	270	15.5
221	22.0	271	14.0
222	22.0	272	
223	20.0	273	
224	20.5	274	
225	20.5	275	
226	21.0	276	
227	19.0	277	
228	19.0	278	
229	19.0	279	
230	19.5	280	
231	20.5	281	
232	20.0	282	
233	19.5	283	
234	19.5	284	
235	17.5	285	
236	16.5	286	
237	17.5	287	
238	14.5	288	
239	14.0	289	
240	17.0	290	
241	18.0		
242	17.5		
243	16.0		
244	16.0		
245	16.0		
246	16.5		
247	16.5		
248	16.5		
249	17.0		
250	17.5		
251	17.0		
252	16.0		
253	16.0		
254	15.5		
255	16.0		
256	16.5		
257	16.5		
258	15.5		
259	13.0		
'260	13.5		
261	14.0		
262	14.5		
263	15.0		
264	15.5		
265	16.5		
266	17.0		
267	15.5		
268	14.0		
269	15.0		

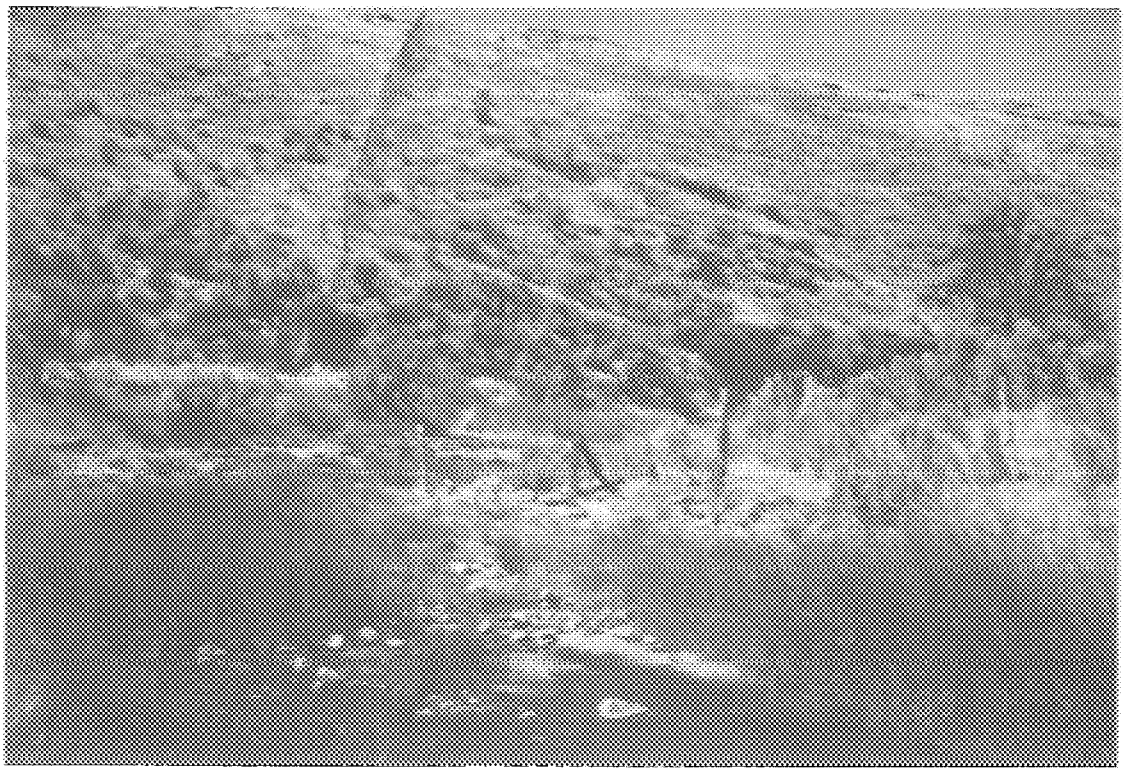
Appendix D-1

Dry Creek

Riparian corridor fencing.
Protected area right, unprotected area left.

Appendix D-2

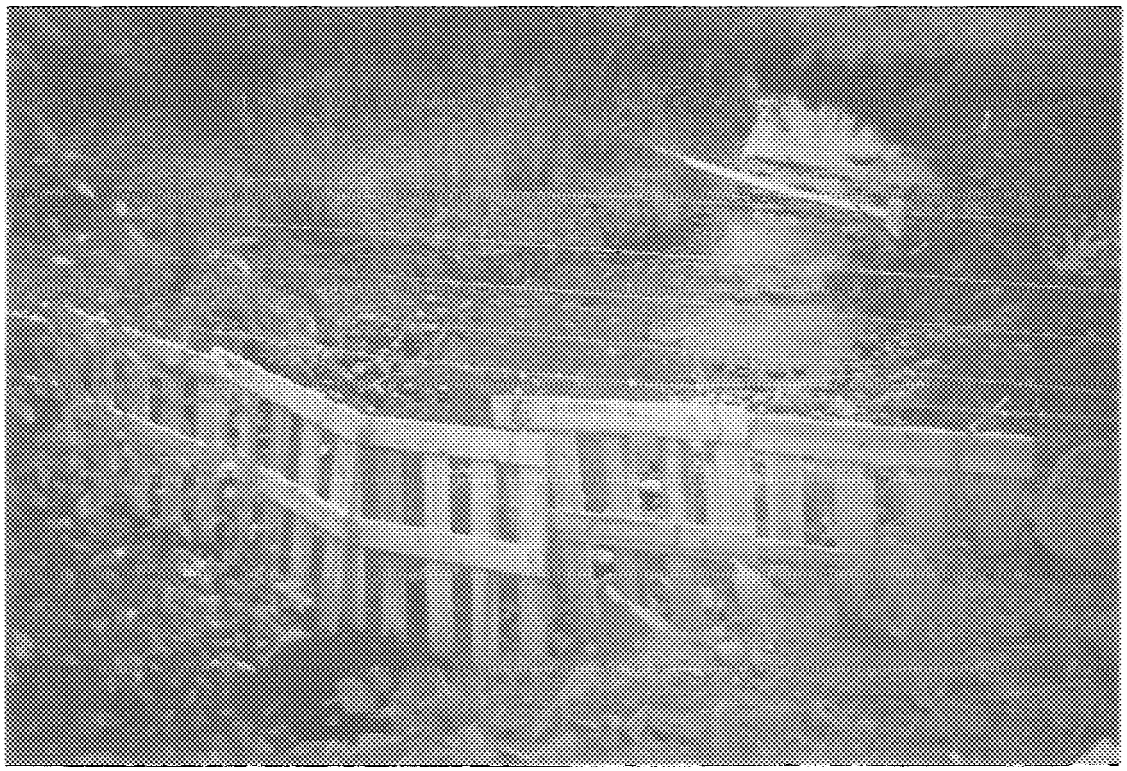
Dry Creek



Bolton property after one year of protection

Appendix D-3

Eightmile Creek



Panel stream crossing

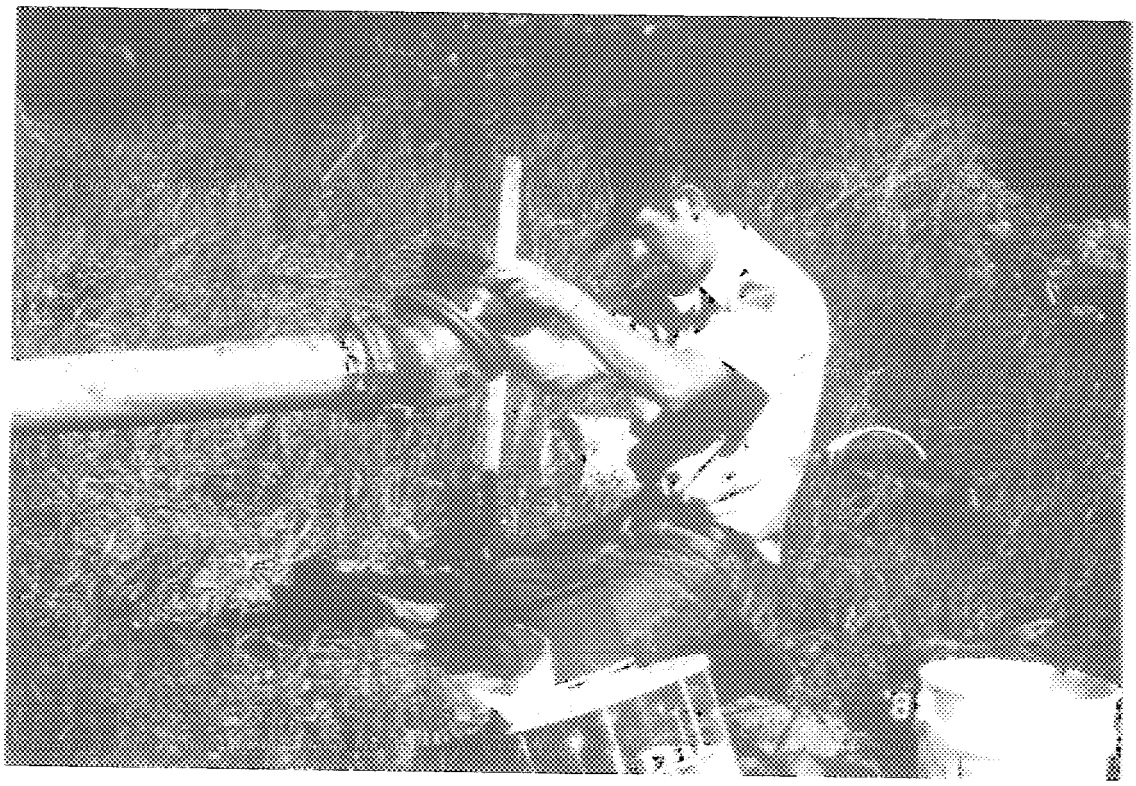
Appendix D-4

Fifteenmile Creek

Wire Stream Crossing

Appendix D-5

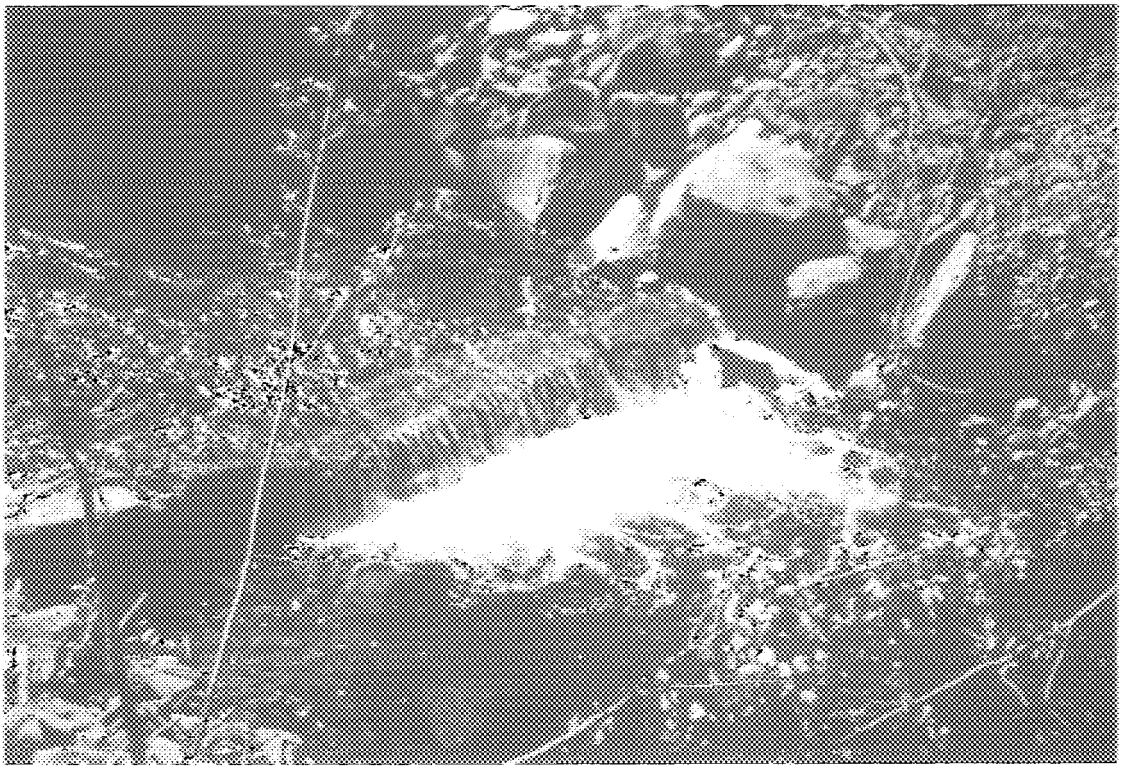
Pump screen



Installation of Plumb Creek Screen

Appendix D-6

Fifteenmile Creek



Rock weir designed to create a pool downstream and recruit gravel upsteam

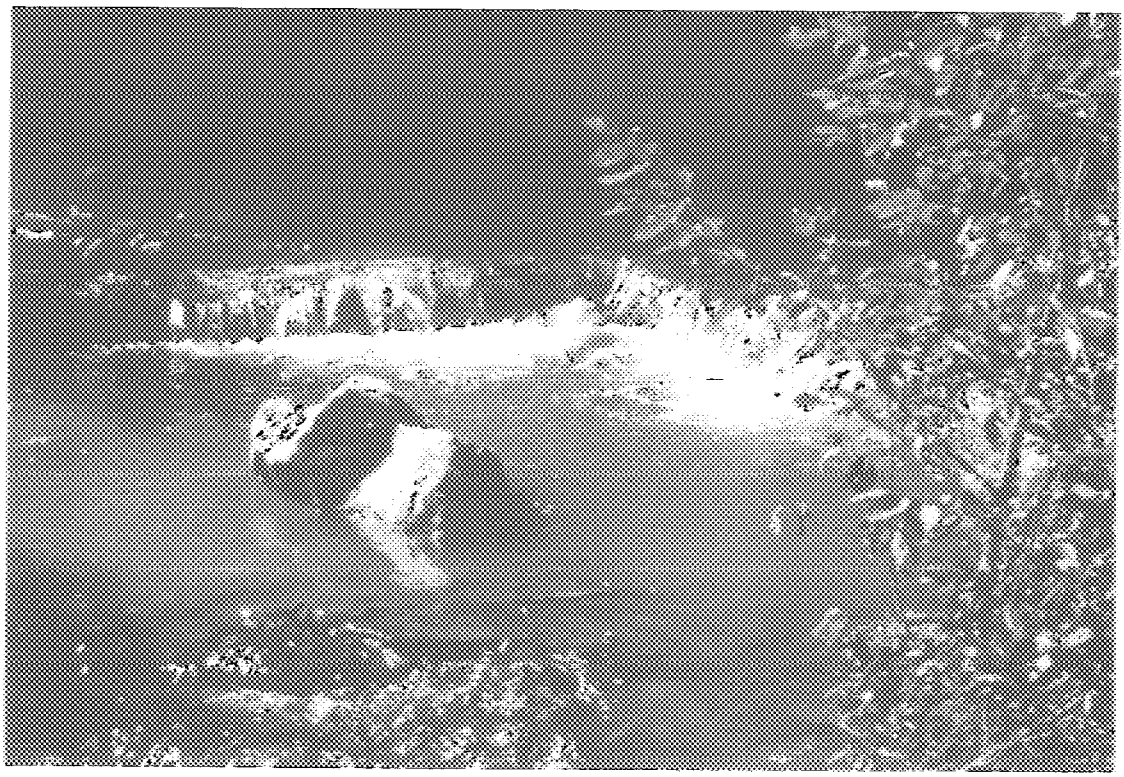
Appendix D-7

Fifteenmile Creek

Rock weir demonstrating size and type of aggregate
Columnar basalt acquired within Dufur Valley was primary rock type

Appendix D-8

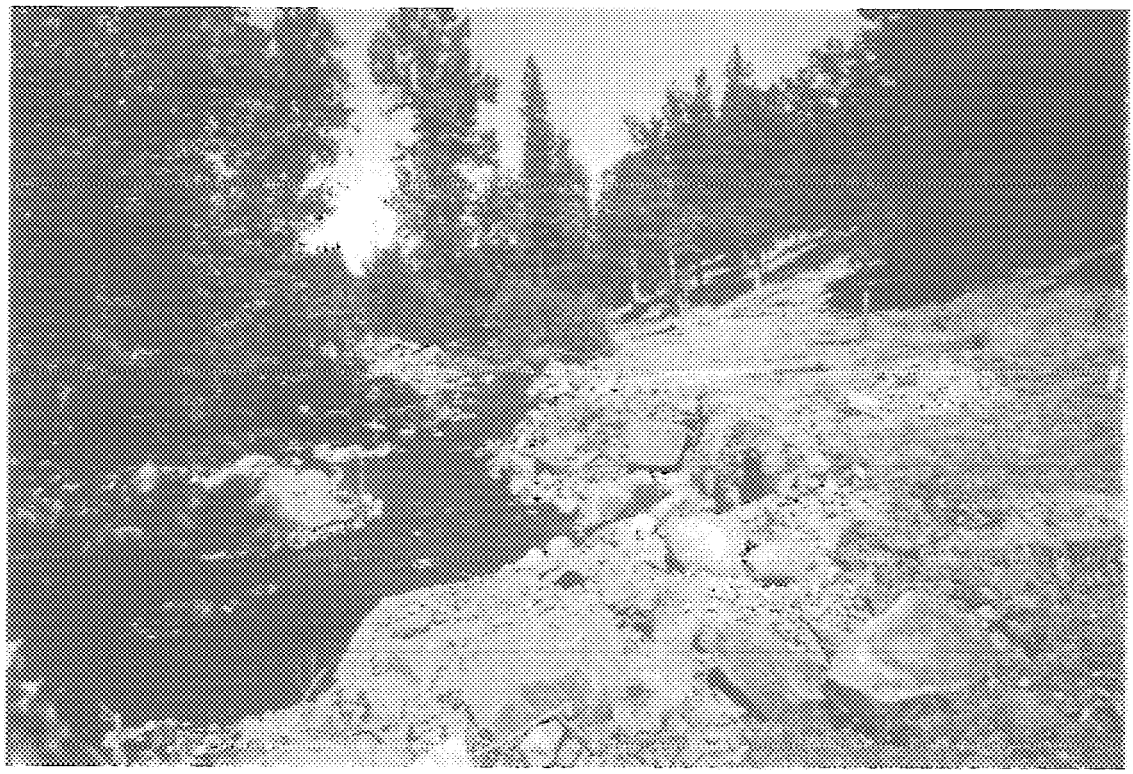
Eightmile Creek



Upstream "V"-log weir with fish boulder in pool.

Appendix D-9

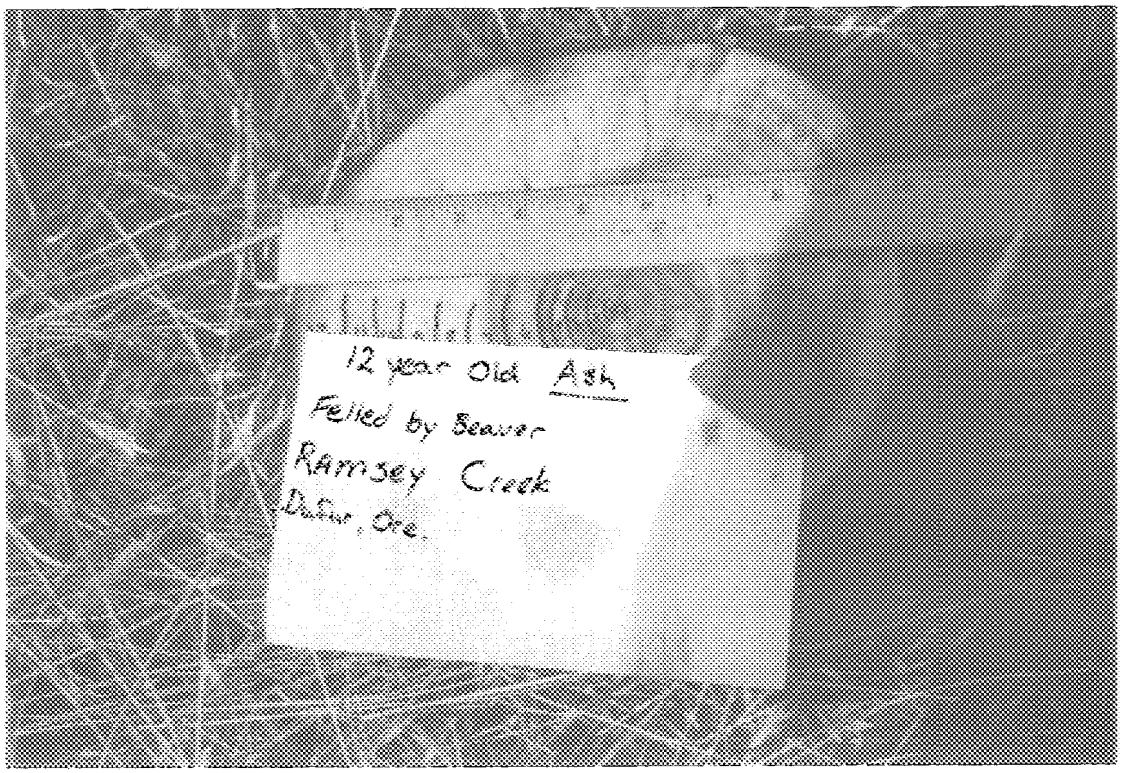
Fifteenmile Creek



Rock jetty designed to create pools as well as protect stream bank.

Appendix D-10

Ramsey Creek



Ash tree from protected riparian zone.
10 inches in diameter growth in twelve years

APPENDIX E

Summary of Implementation

	FENCING				INSTREAM		PASSAGE	FISH SCREENS	
	Miles of Stream Excluded from livestock w/o riparian fencing	Miles of NEW FENCE installed	Miles of OLD FENCE repaired	Type of NEW FENCE installed	Miles of OLD FENCE repaired	Miles Treated: Approx. # of Structures	Type of Structure	Fishways	Type	umber
FIFTEENMILE CREEK	1 3.5	5.9	6.5	5.5 ml. smooth wire 0.4 barbed wire	10	10 miles, 380 structures	log 6 rock weirs root wads cover logs boulders jetties rip-rap deflectors	2	Irrigation withdrawal (Plumb Creek type 1 Rotary screen (ditch screen)	5 1
EIGHTMILE CREEK		1.75	0	All smooth	0.8	3.5 miles, 40 structures	Log & rock weirs boulders jetties rip-rap deflectors			
RAMSEY CREEK		5.5	2.5	All barbed	4	4 miles, 115 structures	jetties rock weirs rip-rap deflectors		Irrigation withdrawal (Plumb Creek type)	1
DRY CREEK		6.3	5.7	All barbed	6.0	0				
TOTALS	3.5 stream miles	19.45 fence miles Installed	14.7 fence miles repaired		20.8 stream miles	17.5 miles 535 structures		2	Irrigation withdrawal 1 (Plumb Creek 1 type) Rotary screen (Ditch type) 1	6 1

Stream mileage estimated from 1975 water resources map (No.4.6)