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North Fork John Day River Habitat Improvement

Annual Report

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ABSTRACT

Personnel from the Umatilla National Forest completed all construction work planned for 1985. Work on the North Fork John Day River consisted of opening six side channels, constructing two alcove or blind channels, constructing 16 side channel and 22 main stem rock weirs, placing six rock deflectors at side channel entrances for flow control, constructing 17 rock deflectors to direct flow in side channels, planting eight shrubs and 182 cuttings, and placing 283 large boulders and 35 logs in side channels and in the main river to provide instream cover.

Work on Desolation Creek last year created an estimated 18,664 square feet of rearing pool habitat by constructing 52 rock weirs, 1 adult holding pool, and five alcove or blind channels in 0.8 miles of Desolation Creek. In addition, 2 side channels, 0.3 miles in length were constructed, 97 boulders and 11 logs were placed in the stream, and 18 cottonwood cuttings were planted to provide shade and improve juvenile anadromous fish rearing habitat.

A detailed stream survey of anadromous fish habitat covering 70.5 miles of stream in the lower North Fork John Day Sub-basin was completed and an anadromous fish habitat improvement project planned for Wilson Creek.

An environmental assessment that discusses anadromous fish habitat improvement within the Umatilla Basin was completed during the spring of 1985. This report was prepared with interdisciplinary input from soils, watershed and wildlife specialists as well as participation by Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and Oregon Department of Fish and Wildlife (ODFW).

SUBPROJECT I - North Fork John Day River Side Channels

INTRODUCTION

The commercial and recreational values of Oregon's anadromous salmon and Steelhead fisheries are well known. The John Day River and its tributaries are important areas for natural anadromous salmonid reproduction. The North Fork John Day River is a major contributor to this production.

The project area is located in northern Grant County on the North Fork John Day Ranger District, Umatilla National Forest in T.6S., R.32E., and T.6 8 7S., R.33E. (Figure 1).

The 1984 estimate of spring chinook salmon (Oncorhynchus tshawytscha) production for the 14 miles of main stem of the North Fork John Day River on the Umatilla National Forest outside of the North Fork John Day Wilderness was 108,000 smolts annually. There is an estimated potential of producing 190,500 smolts annually if habitat conditions are brought to optimum levels.

Degradation by gold dredging in this area began in 1939 and ended in 1950. Dredging activities changed the natural course and hydrology of the North Fork John Day River. High flow channels were created by the gold dredging. To date, the anadromous fish rearing habitat in this portion of the river has not recovered from the impacts of this dredging.

Fourteen miles of the North Fork John Day River offers the opportunity to significantly increase smolt production at relatively low cost. Twenty-six of thirty-two side channels trapped rearing chinook parrs or pre-smolts annually. During low flow periods, the channels dried up and the trapped fish died which resulted in an estimated loss to the system of 26,000 pre-smolt spring chinook salmon.

During August 1971, the Oregon Department of Fish and Wildlife (ODFW) in cooperation with the U.S. Forest Service increased the juvenile spring chinook rearing area by pushing dredge tailings into the river. This forced a portion of the streamflow down several secondary channels that were left dry by the dredging. From 1979-1985, the Umatilla National Forest rebuilt these two side channels and reopened an additional 24 side channels. The Forest also constructed structures in the river and side channels to increase juvenile spring chinook rearing habitat.

This has been a cooperative venture. CTUIR and ODFW has been heavily involved in the planning stages. The Louisiana-Pacific Corporation has made a source of boulders available to the project. Bonneville Power Administration has provided major financing since 1983 through the Northwest Power Act. The USDA Forest Service has been responsible for the planning and administration of the project.

The overall project goal has been to increase the production of spring chinook salmon by meeting the following objectives:

1 Decrease the hazard of juvenile salmon being trapped in the side channels during low flow periods. This has been accomplished by constructing structures at the channel entrances to provide a year-round streamflow through the channels.

2. Increase juvenile salmon rearing habitat in the mainstem river and side channels. Constructed pools below weirs and boulder placements are contributing to meeting this objective.

3. Improve Bank Stability. Rock deflectors and riprap were used to control erosion from unstable banks.

4. Increase adult salmon resting areas. The constructed pools below the main stem sills are being used by adult salmon for resting prior to spawning.

5. Restoration of riparian vegetation. Shrub cuttings and the placement of entire shrubs are being used to establish riparian vegetation along the barren dredge tailings.

Due to the use of streams by Steelhead and spring chinook salmon, the only period available for instream work is July 15 to August 31. Remaining work on the project consists of additional weir construction, boulder placement, bank stabilization, and shrub establishment and fertilization in the thirteen-mile stretch of the river previously worked.

PROJECT DESCRIPTION

Project activities consisted of preparing and administering a contract to: (1) haul boulders and riprap from the rock pit to the construction sites on the river, (2) reopen side channels to the North Fork John Day River, (3) construct flow control deflectors at the entrances, (4) place boulders, woody material, rock weirs, and rock deflectors in the side channels and in the main river.

The contractor began work on June 10, 1985, and construction was completed on August 31, 1985. Boulders and riprap were hauled from a pit at the lower end of the project and stockpiled at the construction sites.

An excavator was used to place 283 boulders and 35 logs in several side channels and in the North Fork John Day River between river miles 63 and 76 (Table 1). The excavator was used to dig a key and rearing pool and place the boulder in the key. The boulders provide physical cover for rearing juvenile salmon and also as create turbulence and pools which provide additional cover. Many natural and previously placed boulders in the river were repositioned to increase their effectiveness. The logs, some with root wads attached, were placed in the larger excavated pools and either held down with large boulders or wired in place.

Six side channels were excavated to grade, and 16 rock weirs were constructed in the channels prior to opening the entrance and allowing the water to flow through them. A flow control structure was constructed at the entrance of each side channel to divert between 20 and 30 percent of the main river flow into the side channel. Riprap was used to protect unstable banks and to construct rock deflectors for increased juvenile fish rearing.

The alcoves or blind channels were constructed by excavating a channel from the river at a upstream angle while holding the grade to that of the stream bottom at the lowest end of the channel. In addition to the rearing habitat provided, the resulting off-channel pool provides refuge for juvenile fish during flood events.

ACHIEVEMENTS

Anadromous fish in the North Fork John Day sub-basin are maintaining themselves at very low population levels. It is anticipated that the increased rearing area associated with the boulders, rock weirs, and side channels will result in increased anadromous fish survival from egg to smolt. Assuming the increased rearing area equates to a porportional increase in fish production, this increase is estimated at 7,260 smolts annually and will require at least one generation of five years before results become readily apparent. These smolts would provide 45 additional escaping adults which would have an estimated annual net value of $24,750 using National Marine Fisheries Service Economic Values (Table 2).

Table 1. Summary of the North Fork John Day River Side Channel Project to Date.

Structure	1979	1980	1981	1982	1983	1984	1985	TOTAL
Side Channels	1	8	1	1	6	3	6	26
Alcoves and Blind Channels							2	2
Boulders Placed	63	50	60	80	492	250	283	1278
Log Weirs						2		2
Rock Weirs			2		16	8	16	42
Main Stem Rock Sills							22	22
Rock Deflectors	14	3		1	4	7	23	52
Adult Holding Pools						1		1
Instream Logs Placed						1	35	36
Erosion Control Structures					4	1		5
Shrubs Planted							8	8
Cuttings Planted							182	182

Table 2. Increase in Smolt Production, North Fork John Day River Side Channels.

	ChS
Estimated increase in numbers of smolts	7,260
@ 0.625 percent spawning escapement 1/	x.00625
Estimated increased numbers of adult spawners	45
Net value per escaping chinook 2/	x$550
Estimated annual value 1985 BPA project	$24,750
Benefit-Cost Ratio 3/	2.6:1

1/ As per conversation with Errol Clair 3/5/84.
2/ Meyers 1982. "Net Economic Values for Salmon and Steelhead from The Columbia River System," U.S. Department of Commerce, June 1982.
3/ Based on 4% interest for a 20-year project life.

SUBPROJECT II - Desolation Creek Habitat Improvement

INTRODUCTION

The project area is located in the northern edge of Grant County in the North Fork John Day Ranger District, Umatilla National Forest in T.8S., R.33E. and T.9S., R.33E. Desolation Creek is tributary to the North Fork John Day River from the south, 0.5 miles upstream from the Highway 395 bridge.

Forest Service employees that were in the area in the 1930's observed numerous spring chinnok salmon spawning in Desolation Creek. Several barriers in the lower portions of the stream apparently blocked salmon passage since that time. Louisiana-Pacific Corporation, landowner in the blockage area, removed the barriers during last three years.

Presently, spring chinook salmon, summer Steelhead, and resident trout utilize Desolation Creek. The spring chinook spawning population is at a low level; Oregon Department of Fish and Wildlife estimates that 20 adults or less spawn in the stream annually.

Each spring, trout anglers report catching late migrating spring chinook smolts in lower portions of the stream, and an August 1982 pre-work stream inventory of Desolation Creek fish habitat conditions tallied one spring chinook adult at stream mile 20.5.

An evaluation of the 1982 stream inventory data indicated that existing pool habitat for both adult holding and juvenile rearing is naturally limiting anadromous fish production. Presently the pool/riffle ratio is 11% percent pool and 89 percent riffle as opposed to the 60:40 pool/riffle ratio which is considered optimum for rearing juvenile salmon and Steelhead. The opportunity exists to increase the pool percentage from 11% toward 60%. All of the pools will be designed to increase juvenile rearing while several pools will be designed to provide the depth and size required for adult holding. The opportunity also exists to add gravel catching structures to Desolation Creek to increase anadromous fish spawning areas.

The overall project goal is to increase the production potential of spring chinook salmon by meeting the following objectives:

1. Changing the pool/riffle ratio from the present 11:89 tp 60:40 and improving the quality of the existing pools by adding cover and increasing depth.

2. Contructing at least one adult anadromous fish resting pool per mile.

3. Increasing the amount of woody material in the stream.

4. Increasing anadromous fish spawning areas in both size and quality by constructing rock weirs that will retain bedload gravels.

5. Designing and installing fish habitat structures that control bank erosion.

PROJECTDESCRIPTION

Project activities consisted of preparing and administering a contract to place rock structures, boulders and riprap in Desolation Creek from stream miles 20.7 to 21.5 (Table 3). The contractor began work on September 3, 1985, and construction was completed on September 29, 1985.

The 1985 Desolation Creek project began with the construction of approximately one-half mile of access to the creek. The equipment used for access construction, which consisted of clearing fallen lodgepole from an existing trail, and instream construction was a tracklayer hoe with street pads and a 1-yard bucket on a boom that would reach 30-feet. Instream work began at the conjuction of the North and South Forks of Desolation Creek and progressed for 0.8 of a mile downstream. Within this section of stream we constructed 2 side channels totaling 0.3 of a mile of additional stream habitat, 38 weirs and large pools in the main channel, 1 large resting pool in the main channel, 4 blind channels, one bypass around a potential barrier, 14 weirs and pools in the side channels, and 1 side channel alcove. As work progessed downstream, we also placed 14 boulders in the channel, 59 boulders in the newly constructed pools, dug 24 small pools behind boulders already in the stream, placed and tied in 11 trees as woody debris, and planted 18 cottonwoods along the longest of the side channels.

The rock weirs were designed to catch moving bedload gravel. The pools that were constructed below the weirs were generally 10 to 12 feet wide, 15 to 20 feet in length and a depth of 4 to 6 feet. Boulders were placed in the pools to increase structure and cover in the pool. Boulders excess to the needs of weir and resting pool construction were placed in the stream in scattered groups to provide additional instream cover. Blind channels were dug to approximately 4 feet in depth and 8 feet in width, and ranged in length from 50 feet to 150 feet. Woody debris was tied in with #9 wire to trees on the bank. All ground scarified by equipment was seeded with streamside grass. Access roads were blocked by trees or boulders to prevent more access that than which existed before the project and to prevent resource damage from vehicle use in the wet areas that exist along the streamside.

ACHIEVEMENTS

Anadromous fish in the North Fork John Day sub-basin are maintaining themselves at very low population levels. It is anticipated that the increased rearing area associated with the boulders, rock weirs, and side channels will result in increased anadromous fish survival from egg to smolt. Assuming the increased rearing area equates to a porportional increase in fish production, this increase is estimated at 1,600 smolts annually and will require at least one generation of five years before results become readily apparent. These smolts would provide 29 additional escaping adults which would have an estimated annual net value of $15,950 using National Marine Fisheries Service Economic Values (Table 4).

Table 3. Summary of the Desolation Creek Project to Date.

Structure	1985	TOTAL
Rock Weirs	52	52
Adult Holding Pools	1	1
Boulders Placed	97	97
Instream Logs Placed	11	11
Side Channels	2	2
Side Channel Length (ft.)	1,584	1,584
Alcove and Blind Channels	5	5
Alcove and Blind Channel Length (ft.)	550	550
Debris Jam Bypass	1	1
Cuttings Planted	18	18

Table 4. Increase in Smolt Production, Desolation Creek, 1985.

	Spring Chinook
Estimated increase in numbers of smolts	1,600
Multiplied by: percent spawning escapement 1/	x.00625
Estimated increase in numbers of adult spawners	29
Net value per escaping chinook 2/	x$550
Estimated annual value 1985 BPA project	$15,950
Benefit-Cost Ratio 3/	8.6:1

1/ As per conversation with Errol Claire, 3/5/84.
2/ Meyers 1982. "Net Economic Values for Salmon and Steelhead from The Columbia River System," U.S. Department of Commerce, June 1982.
3/ Based on 4% interest for a 20-year project life and project cost @ 25M.

SUB-PROJECT III - Lower North Fork John Day Sub-basin

INTRODUCTION

A detailed stream survey of anadromous fish habitat covering 70.5 miles of streams in the lower North Fork John Day Sub-basin was completed and an anadromous fish habitat improvement project planned for Wilson Creek. An evaluation of the 1985 physical stream inventory data indicates that both the quality and quantity of pool habitat for adult and juvenile anadromous fish is naturally limiting production. In addition, many of the pools are shallow and not have sufficient volume for good fish production. In Wilson Creek, the opportunity exists to increase the pool percentage, as well as, increase the maximum depths in the pools from under two feet to over three feet. All of the pools will be designed to increase juvenile rearing while several pools will be designed to provide the additional depth and size required for adult holding.

STREAM SURVEY METHODS AND RESULTS

The survey was a basic on-the-ground inventory of anadromous and potentially anadromous streams. Each stream was walked during the low flow period to collect data on biological and hydrological conditions. The result was a combination of stream reach inventory, channel stability evaluation and fishery habitat survey for each stream. Survey methods were derived from previous experience and procedures developed by the Forest Service in Region 1 (Stream Reach Inventory & Channel Stability Evaluation, Dale Pfankuck, 1975). These methods have proven reliable and effective for inventorying habitat conditions for northwest salmonids.

The survey method relies on both measurements and observations. A minimum of equipment was necessary. The equipment included: a thermometer, for water and air temperature; a compass, for stream orientation; a clinometer, for gradient and slope; a spherical densiometer for cover determinations and a camera. These were readily available and didn't require special purchase. Length and area determinations were made by pacing. The parameters that couldn't be quantitatively measured, such as stability or stream morphology, were rated using a set of evaluation criteria. Results were surprisingly uniform between surveyors and produced an accurate account of stream conditions.

Each stream was divided into reaches. They were generally about 1/2 mile in length and usually delineated by changes in gradient *or* when a tributary entered a larger stream. The physical and biological parameters of each reach were recorded to provide the information summarized below:

Fishery Habitat:	Estimated flow, water quality, water & air temperature, gradient, channel depth profile and fish species present.
Riparian Vegetation:	Cover, size composition, riparian zone cross-section, dominant species, percent overhanging vegetation and stream surface shade.

Channel Stability:	Upper bank-land form, slope, mass wasting hazard, debris jam potential and vegetation bank protection. Lower bank-channel capacity, bank rock content, flow deflectors/obstructions, bank cutting and point-bar deposition. Channel bottom-rock anaularity, brightness, particle packing, percent stable material & size distribution, scour and deposition, and the amount of clinging aquatic vegetation.

This data proved a comprehensive description of each reach. In addition within each reach, every pool and riffle was measured. There areas were determined and tabulated to provide an accurate pool/riffle ratio. Spawning gravel areas were also inventoried along with notes on gravel size, quality and factors causing quality degradation.

Photography was used extensivily to document the conditions of each reach. Beginning and ending photos were taken on each reach. Pictures were also taken of major hydrological features such as barriers, characteristic features such as typical pool or riffle stretches, and examples of past management activities. These photos provide good documentation of the present ecosystem and will be used to evaluate long term changes in trend.

An evaluation of the data collected from the 70.5 miles of stream surveyed during 1985 indicates that both the quality and quantity of pool habitat for adult and juvenile anadromous fish is naturally limiting production. This data was used to design a habitat improvement project and prepare a work statement for three miles of Wilson Creek, a tributary to Wall Creek.

SUB-PROJECT IV - Umatilla Basin

INTRODUCTION

The completion of the comprehensive plan for the rehabilitation of anadromous fish stocks in the Umatilla River Basin, the improvement of passage in the lower Umatilla River, and the recent adoption of minimum streamflows by the State of Oregon coupled with results of the Umatilla National Forest's physical survey of anadromous streams which indicates that rearing habitat for juvenile anadromous is at a low level points to the need for an anadromous fish habitat improvement project in the Umatilla Basin. This work will be coordinated with the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and Oregon Department of Fish and Wildlife (ODFW) and a work statement is being prepared for a habitat improvement project in FY 1986.

ACHIEVEMENTS

The stream survey conducted on Forest streams in the upper Umatilla River drainage during the summer of 1984 indicated a significant lack of adult holding and rearing pool habitat. Pool:riffle ratios in the range of 5:95 were common. Using this stream survey data as a basis, the Forest proposed that anadromous fish habitat values in the various stream reaches be enhanced through construction of log and rock weir structures. In line with this proposal, the Forest conducted an environmental analysis of the impact of this type of project proposal on various resource issues and concerns. A report, Environmental Assessment for Anadromous Fish Habitat Enhancement on the Umatilla National Forest Portion of the Umatilla River Drainage, was prepared by the Walla Walla Ranger District to document this analysis process. The Umatilla Forest Supervisor signed a Decision Notice and Finding of No Significant Impact for the proposed project work on June 7, 1985.

During July, August, and September of this year 365 log and rock pool creating weir structures were located, inventoried, and designed in the Thomas Creek stream reach (tributary to the South Fork of the Umatilla River). In addition, access for equipment to place the structures was located and designated along the reach.

Placement of the weir structures in the channel will accomplish the following:

1. Improve Steelhead access to the reach.

   The summer crew noted a dead adult Steelhead 100 yards below the culvert under Forest Road 32 (T. 2 N., R. 37, Section 13). While it is documented that spawning adults have access to the reach it is very difficult and many more do not make it than do. Improvement of this access will therefor increase the number of spawning adults reaching the available habitat.

2. Dramatically improve the abilitv of the stream to produce downstream Steelhead outmigrant smolts.

   This will result primarily from the creation of mid-summer low flow holding pool habitat. The summer crew noted almost complete mortality of native

trout and anadromous Steelhead along the reach due to lack of holding pools during low flow periods.

3. Stabilize channel bedload movement.

This bedload stabilization should increase Steelhead redd success and may be enough to permit future runs of chinook salmon to become established in the lower mile or so of the reach.

PROJECT MONITORING

Biological monitoring of the project results in the North Fork John Day Sub-basin has and will be coordinated with the Oregon Department of Fish and Wildlife; however, no on-the-ground monitoring occurred in 1985. The use of the created rearing areas by salmonids will be tallied for different types of structures during the 1986 field season by Forest Service personnel. --

Physical monitoring of all BPA anadromous fish improvement project start with a comprehensive pre-project physical survey. All projects in this year's program had this survey prior to 1985. Physical monitoring of the North Fork John Day River Side Channel sub-project will consist of a physical stream survey which is scheduled for September 1986. The survey will monitor the physical habitat changes that have occured since the pre-work survey of 1982.

Physical monitoring of the Desolation sub-project has consisted of preliminary measurements of constructed pool area (18,644 square feet). Physical monitoring next year will consist of resurveying the portion of Desolation Creek where habitat improvement work was completed in 1985 and 1986 with emphasis on measuring the surface area and volume of constructed pools and comparing this data with that obtained in the 1982 survey.

PROJECT COSTS

Incurred and anticipated expenses from April 1, 1985 to March 31, 1986 are shown in table four. These costs are broken out to show both Bonneville Power Administration costs and USDA Forest Service costs.

USDA Forest Service appropriated funds spent for fish habitat improvement on the Umatilla National Forest totaled $64,254 of which $11,590 was associated with this project and $42,244 was spent installing 32 log weirs, 6 rock weirs, 1 adult anadromous fish holding pool,and 740 cubic yards of riprap in Tucannon River, Touchet River, Mottet Creek, Mallory Creek and Indian Creek (streams included in the Northwest Power Planning Council's 1984 Columbia River Basin Fish and Wildlife Program). In addition, the Forest spent $10,400 installing 27 log weirs in Jarboe Creek (a resident trout stream not in the NWPPC program).

Table 5. Project Costs, April 1985 to March 1986.

Bonneville Power Administration Funds: 1/		
a. Salaries		$47,500
b. Transportation and travel		7,500
c. Materials and supplies 2/		1,200
d. Equipment rental contracts		66,500
	Subtotal	$122,700
e. Overhead @ 10.7%		13,100
	Total	$135,800
Umatilla Forest Appropriated Funds:		
a. Salaries		$19,712
b. Transportation and travel		2,030
c. Materials and supplies		5,750
d. Equipment rental contracts		$36,662
	Total	$64,254

1/ Estimated Costs.
2/ No major property purchased.

Literature Cited

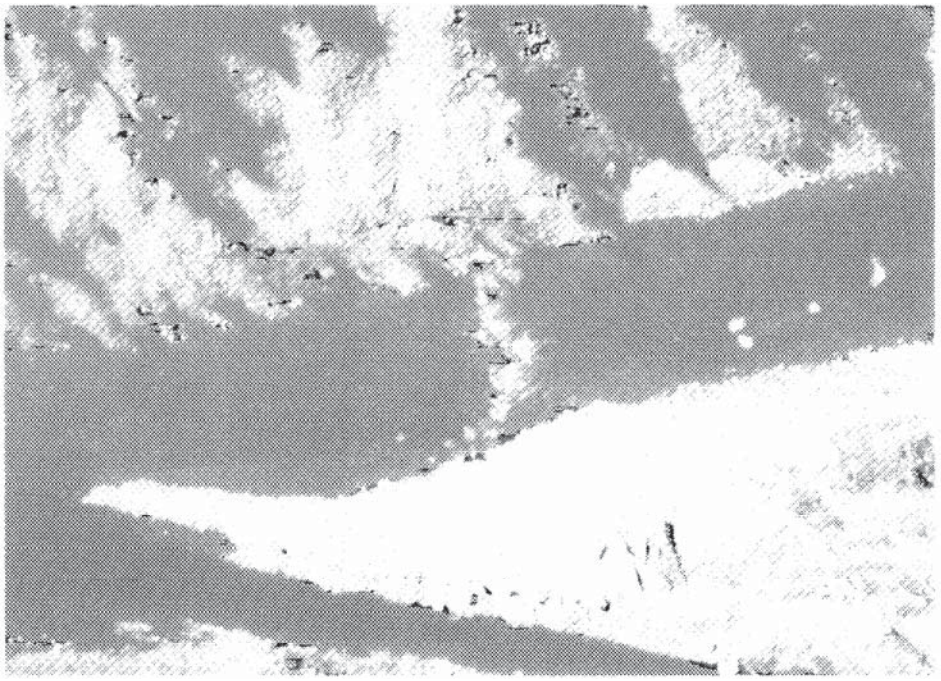
Claire, Errol. 1984. Personal communication on March 5, 1984.

Meyers, Philip A. 1982. Net Economic Values for Salmon and Steelhead from the Columbia River System. U.S. Department of Commerce. 23 pages.

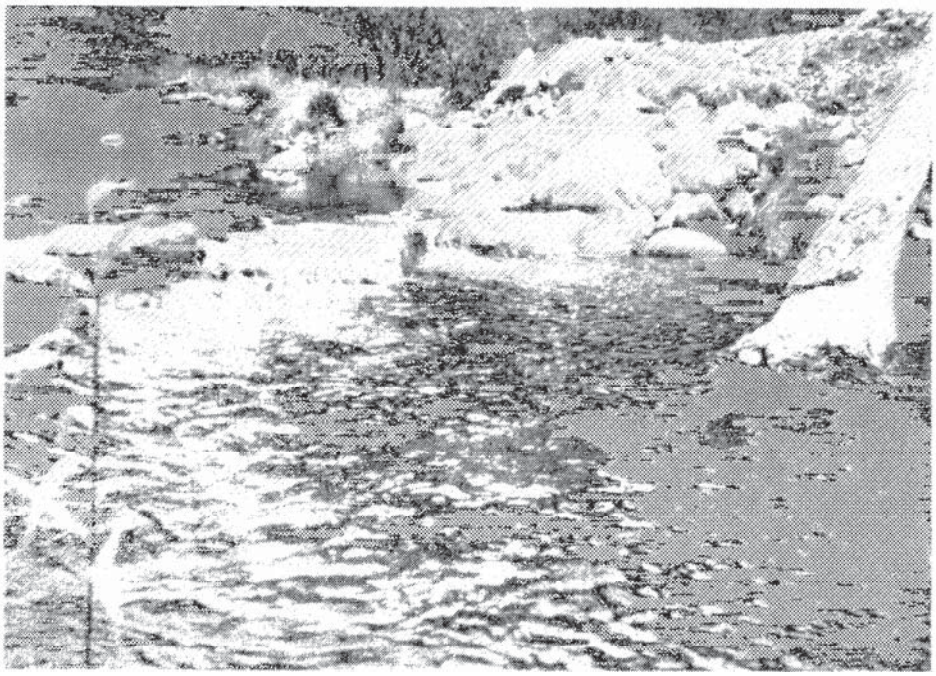
Oregon State Game Commission. 1959. Fishery Division 1958 Annual Report. page 182.

Pfankuck, Dale. 1975 1 Stream Reach Inventory and Channel Stability Evaluation. USDA, Forest Service, Northern Region. 26 pages.

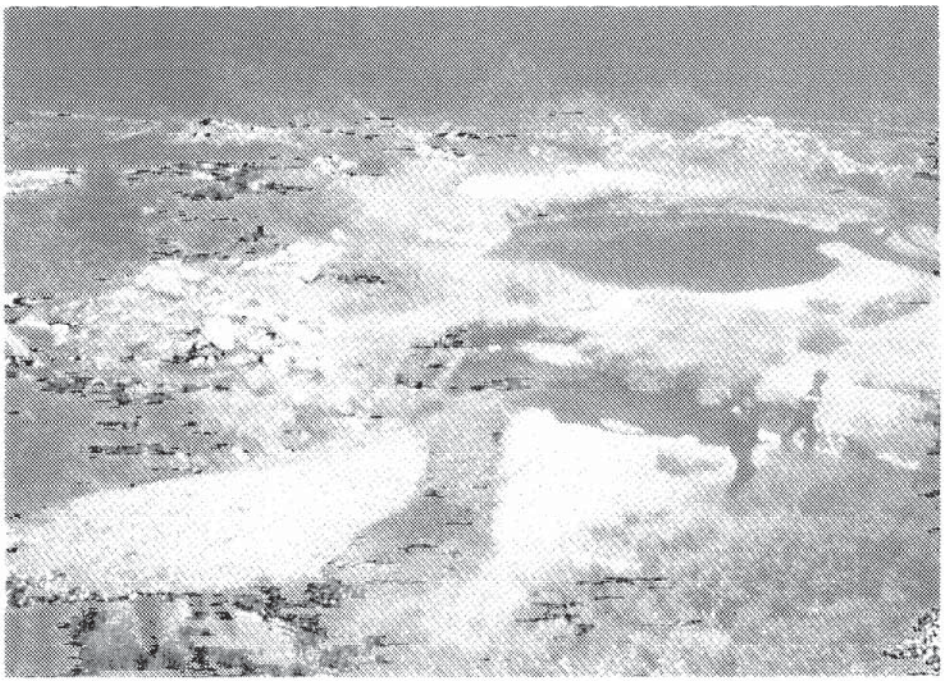
Appendix A: Photographs



Rock weir, boulder placement, and entrance to side channel at the lower end of the project area,

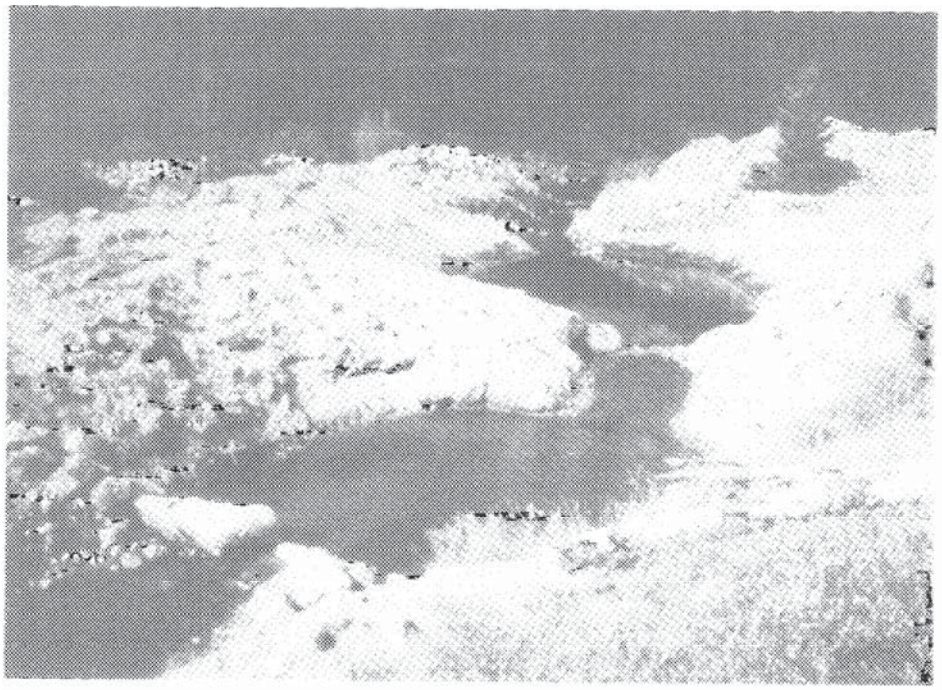


The rock weir, boulder and large log combine to provide complexity.



Side channel in June with adequate flow.

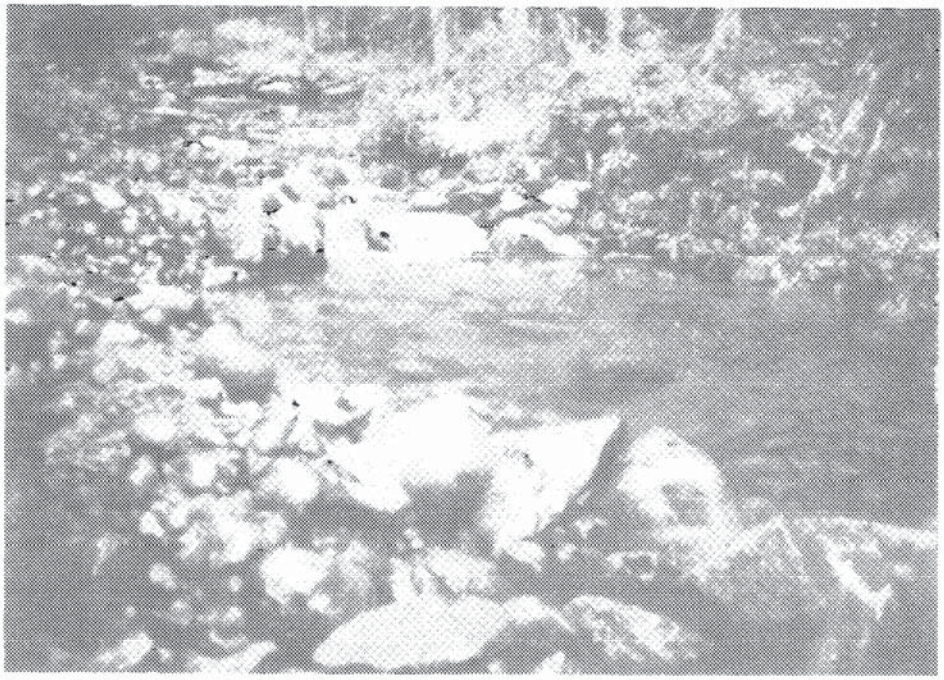
Side channel in August. Notice the damp spot in the large hole where Chinook fry were trapped.



Side channel in September after construction.

Aerial view of side channel in September.

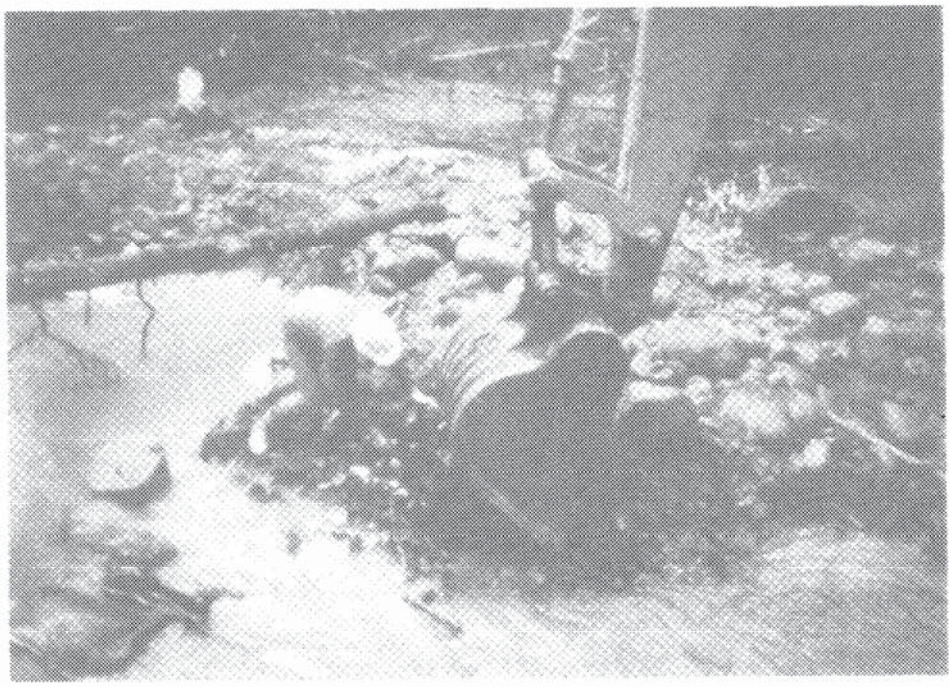
The upper end of the main stem of Desolation Creek prior to construction,



Same view as above after pool construction.

Desolation Creek side channel prior to construction.

The same side channel after construction.



Planting cottonwood cuttings in a Desolation Creek side channel.

A blind channel at the lower end of the Desolation Creek project.

Appendix B: Lower North Fork John Day Sub-basin Survey Summaries

STREAM SUMMARIES	REACH LENGTH (FT.)	REACH LENGTH (MI.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA TOTAL LENGTH (FT.)	POOL AREA SURFACE AREA SQ. FT.)	RIFFLE AREA TOTAL LENGTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	SPAWNING GRAVEL (SQ. FT.
Wall Creek	45,402	8.6	326,054	11,062	89,813	34,340	236,241	28:72	3,342
Indian Creek	2,356	.4	7,936	444	2,132	1,912	5,804	27:73	0
Wilson Creek	34,037	6.4	368,435	11,141	114,967	24,771	253,468	31:69	275
Bull Creek	5,361	1.0	20,956	389	2,421	4,972	18,535	12:88	0
Porter Creek	2,021	.4	12,605	456	5,240	1,565	7,365	41:59	0
Little Wall Creek	26,443	5.0	186,507	9,724	55,502	16,719	131,005	30:70	30
Skookum Creek	48,767	9.2	369,890	10,702	81,917	38,065	287,973	22:78	63
Swale Creek	47,896	9.1	257,855	4,573	35,209	43,323	222,646	14:86	110
Little Bear Creek	2,900	.5	11,724	241	1,862	2,659	9,862	15:85	0
Alder & East Alder Creeks	15,950	3.0	66,261	4,066	20,350	11,884	45,911	12:88	94
Hog Creek	4,198	.8	19,651	209	1,455	3,989	18,196	07:93	0
Bacon Creek	12,060	2.3	37,008	1,137	5,791	10,923	31,217	16:84	150
Three Trough Creek	2,383	0.5	12,328	283	1,998	2,100	10,330	16:19	0
Ditch Creek	51,807	9.8	272,510	5,573	35,705	46,234	236,805	13:87	300
Martin Creek	3,051	.6	9,697	127	3,934	2,924	5,763	40:59	0
Mallory Creek	15,752	3.0	59,269	1,459	11,227	14,293	48,042	19:81	0
Potamus Creek	29,034	5.5	171,038	2,133	27,650	26,901	143,388	16:84	60
Ellis Creek	13,952	2.6	69,484	1,000	6,917	12,952	62,567	10:90	0
Pole Creek	9,345	1.8	31,080	502	2,776	8,843	28,304	09:91	0
Survey Totals	374,590	70.5	2,310,238	69,287	506,866	309,369	1,803,372	22:78	4,424

INDIAN CREEK

REACH	REACH LENGTH (FT.)	REACH LENGTH (MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	2,356	.45	3.37	7,936	444	10	4.80	2,132	1,912	39	3.04	5,804	27:73	5		Flows over bedrock w/angular boulders, 2-3' log jams
T.	2,356	.45		7,936	444			2,132	1,912			5,804	27:73			Flows over bedrock w/angular boulders, 2-3' log jams

WALL CREEK

REACH	REACH LENGTH (FT.)	(MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	1,919	.36	12.7	24,323	452	50.2	16.0	7,238	1,467	122.2	11.6	17,085	28:70	2	0	Algae greater in #16, veg. change also
2	3,350	.63	13.3	44,724	976	48.8	20.3	19,796	2,374	103.2	10.5	24,928	44:56	1	3,300	Bedrock, good fish, gradient changes
3	2,790	.53	12.6	35,052	646	24.8	12.2	7,873	2,144	82.4	12.7	27,179	22:77	4	42	Lots of debris & mass wasting, large log jam
4	1,557	.29	14.4	22,376	467	20.3	11.1	5,193	1,090	49.5	15.8	17,183	23:77	3	0	Shallow slow moving; numerous dace
5	1,115	.21	8.4	9,386.5	377	15.7	8.0	3,020	738.5	30.7	8.6	6,366.5	32:68	3	0	Bedrock, lrg. boulders, pools w/short riffles
6	1,992	.37	14.6	29,201	697	34.8	10.1	7,075	1,295	68.1	17.0	22,126	24:76	1-2	0	Parts of creek on N.F. portions on pvt. land
7	3,655	.69	8.1	29,629	995	18.4	6.4	6,319	2,660	45.1	8.8	23,310	21:78	4-6	0	Little shrubs at begin, picking up more logs
8	7,822	1.5	7.4	57,713	2,088	32.6	8.2	17,191	5,734	85.6	7.1	40,522	30:70	3	0	Starts old bridge, Dark Canyon, dry stretch
9	1,450	2.7	5.5	8,021	349	18.4	8.8	3,071	1,101	55.0	4.5	4,950	38:62	4	0	Begins w/popr on sides, cutting on outside banks
10	1,520	.29	4.1	6,317	205	12.0	5.4	1,118	1,315	65.7	4.0	5,199	18:82	4	0	Creek reduced, fewer large fish, bank cutting
11	8,541	1.6	4.0	34,173	1,387	11.6	5.1	7,079	7,154	56.7	3.8	27,094	20:79	5	0	Start has less algae, larger rocks, steeper grad
12	3,496	.66	4.1	14,315	531	10.2	5.1	2,718	2,965	55.0	4.0	11,597	19:81	5	0	Log jams, diverted stream caused by jams
13	6,195	1.2	1.7	10,824	1,892	47.3	1.1	2,122	4,303	100.0	2.0	8,702	20:80	5	0	Begins at log jam, above jam stream narrower
T.	45,402	11.0	8.5	326,054.5	11,062	19.0	9.0	89,813	34,340	70.7	8.5	236,241.5	28:72		3,342	

WILSON

REACH	REACH LENGTH (FT.)	(MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	5,120	.97	11.97	61,277	1,298	35	13.51	17,532	3,822	98	11.45	43,745	29:71	2	40	Fish plentiful, bedrock, log jam ideal hiding
2	2,646	.50	11.14	29,484	616	56	15.03	9,256	2,030	203	9.96	20,228	31:69	4	85	Big bank spawning gravel contains fish
3	6,879	1.3	11.88	81,699	1,955	59	13.11	25,633	4,969	138	11.28	56,066	31:69	+5	78	Deepest pool island has evidence of hi flow
4	2,382	.45	13.23	31,522	2,744	171	4.57	12,533	1,468	98	12.94	18,989	40:60	+5	0	Big boulders cutting of bank, fallen tree
5	7,058	1.34	11.16	73,025	2,064	25	12.54	25,877	4,994	92	9.44	47,148	36:66	5	10	Culvert here, channel is bedrock
6	5,212	.99	9.16	47,734	1,155	32	9.25	10,687	4,057	94	9.13	37,047	22:78	4	50	Culvert - extensive bank erosion rocks in water
7	3,357	.64	9.88	33,152	1,016	23	10.40	10,562	2,341	50	9.65	22,590	32:68	6	12	Large boulders
8	1,383	.26	7.62	10,542	293	37	9.85	2,887	1,090	121	7.02	7,655	27:73	+3	0	Bedrock channel creates small water fall
T.	34,037	6.4		366,896	11,141			114,967	24,771			253,468	31:69		275	

BULL CREEK

REACH	REACH LENGTH (FT.)	REACH LENGTH (MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	5,361	1.02	3.91	20,956	389	13	6.22	2,421	4,972	151	3.73	18,535	12:88	4		Few fish, few pools-open meadow area, rocky channel bot.
T.	5,361	1.02		20,956	389			2,421	4,972			18,535	12:88			Few fish, few pools-open meadow area, rocky channel bot.

PORTER CREEK

REACH	REACH LENGTH (FT.)	REACH LENGTH (MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	322	.06	14.1	4,541	70	14	24.16	1,691	252	50	11.31	2,850	37:63	5	0	Steep chan. bot. boulders, falls barriers 7-10'
2	1,699	.32	4.46	8,064	386	24	9.19	3,549	1,313	82	3.44	4,515	44:56	3	0	Fish above sect. where water flows underground
T.	2,021	.38		12,605	456			5,240	1,565			7,365	41:59		0	

LITTLE WALL CREEK

REACH	REACH LENGTH (FT.)	REACH LENGTH (MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	3,231	.61	8.8	28,378	571	22.8	8.6	4,917	2,660	85.8	8.9	23,461	17:82	3-4	0	Many boulders, narrow canyon at end of reach
2	1,604	.30	7.7	12,296	607	30.3	10.4	6,322	997	41.5	6.0	5,974	51:49	3	0	3' deep hole near large boulders
3	4,775	.90	9.0	42,780	1,631	25.8	10.4	17,040	3,144	49.1	8.1	25,740	40:60	4	24	Alternating of cover, lots of shrubs, sedge
4	3,288	.62	5.5	18,052	1,909	53.0	3.4	6,554	1,379	47.6	8.3	11,498	36:64	4	0	Lots of 4% gradient, good poold, large boulders
5	829	.16	14.4	11,958	189	21.0	11.5	2,167	640	58.2	15.2	9,791	18:82	2	0	
6	4,647	.88	11.5	53,388	1,145	26.6	12.1	13,883	3,502	68.7	11.3	39,505	26:74	2-4	0	Bedrock bottom, narrow chute at the top
7	3,971	.75	1.8	7,245	2,050	89.1	1.2	2,394	1,921	96.0	2.5	4,851	33:67	3	0	Mostly underground flow, fed by unnamed spring
8	4,098	.78	3.0	12,410	1,622	62.3	1.3	2,225	2,476	124.0	4.1	10,185	17:82	3	6	Little water, stagnant
T.	26,443	5.0		186,507	9,724			55,502	16,719			131,005	30:70		30	

SKOOKUM CK.

REACH	REACH LENGTH (FT.)	(MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	935	.18	4.76	4,455	190	12	5.3	1,025	745	46	4.6	3,430	23:77	2	0	Shallow, 2 deep holes, fair amount of jam debris
2	1,244	.24	3.12	7,102	251	17	5.3	1,346	993	71	5.8	5,756	19:81	2	0	Shallow w/few 1' deep holes, 6" fish, jam debris
3	2,901	.55	14.67	14,539	550	34	5.2	2,870	2,351	145	4.9	11,669	20:80	1	0	Lower half is open area, debris, cranefish
4	350	.07	6.27	2,195	70	18	7	495	280	56	6	1,700	22:77	1	0	Douglas dominant, lots grass, fence parallel ck.
5	1,645	.31	8.09	13,305	410	34	5.9	2,415	1,235	112	8.8	10,890	18:82	1	0	Shallow, lots of 8" fish, bank cutting, grass
6	1,053	.20	9.02	9,496	260	20	8.1	2,120	793	66	9.3	7,376	22:78	1	0	Shallow, lots grass, some debris
7	2,641	.50	9.91	26,173	900	30	9.4	8,475	1,741	58	10.1	17,698	32:68	1	0	2' high bank cutting, lots grass, fence east
8	908	.17	8.58	7,791	331	27.5	9.7	3,226	577	48	7.9	4,565	41:59	1	0	Next to canyon, canyon getting narrower
9	1,836	.35	9.45	17,352	446	29.7	8.9	3,972	1,390	92.6	9.6	13,380	23:77	1	0	1" fish, lots of dry streambed, debris log jams
10	945	.18	10.11	9,552	396	33	10.4	4,148	549	49.9	9.8	5,404	43:56	1	0	Large logs across ck., some debris
11	1,319	.25	9.51	11,495	455	28.4	8.9	4,070	864	54	8.6	7,425	35:65	1	0	Ck. next to canyon west slope, some bank cutting
12	2,176	.41	9.29	20,205	846	52.8	10.1	8,580	1,330	83.1	8.7	11,625	42:57	1	0	Lot debris w/7 big log jams, wide stream bed
13	1,668	.32	9.94	16,580	296	26.9	10.9	3,230	1,372	124.7	9.7	13,350	19:80	1	0	Lot of 1" fish, lot of creek bed, less debris
14	1,536	.29	10.92	16,775	466	33.2	11.1	5,215	1,070	71.3	10.8	11,560	31:69	1	0	Canyon beds are dry, banks good shape, debris
15	1,054	.20	10.62	10,892	259	23.5	9.2	2,382	795	66.2	10.7	8,510	22:77	1	0	Lots debris, lot creek bed, 6-10" fish
16	1,217	.23	3.94	4,793	302	10.0	4.2	1,288	915	29.5	3.08	3,505	27:73	1	0	Lots debris, shallow, some fish, good banks
17	1,897	.36	3.24	6,305	264	8.8	3.7	983	1,633	54.4	3.2	5,322	16:84	2	0	Shallow, few fish, lot debris in lower half
18	465	.09	3.20	1,486	164	16.4	3.7	614	301	33.4	2.9	872	41:59	2	0	Rear is shallow, 1" fish, fair amount debris
19	1,754	.33	2.2	5,394	231	6.4	3.0	690	1,523	351	3.0	4,659	13:87	3	0	Blockage by roadbed, meadow-type veg.
20	3,138	.59	2.3	7,324	500	8	3.2	1,613	2,638	43	2.2	5,711	22:78	4	0	Meadow type to forest type, culvert barrier
21	1,098	.20	3.1	3,434	167	12	4.0	652	931	62	3.0	2,782	19:81	3	6	Channel overgrown marshy, logs could impede pass
22	970	.18	4.15	4,023	221	15	5.5	1,210	749	50	3.7	2,813	30:70	4	6	Large increase of debri causing halt of fish
23	656	.12	4.02	2,638	222	17	5.3	1,188	434	33	3.3	1,450	45:55	8	30	Large amount of debri; narrow canyon trees to
24	2,789	.53	8.80	24,495	324	36	10	3,170	2,465	247	8.6	21,325	13:87	3	0	Some boulders, patches of gravel, woody debris
25	3,010	.57	9.79	25,260	655	66	4.4	2,885	2,355	236	9.5	22,375	11:89	7	0	Swale Ck. runs into Skookum
26	2,369	.44	8.23	20,978	196	15	9.0	1,763	2,173	155	8.8	19,215	08:92	3	0	Bedrock, good flow, falls at pool #27
27	1,795	.34	2.94	14,102	357	22	9.3	3,327	1,438	76	7.5	10,775	24:76	5	0	Constricts around bedrock, boulders block pass
28	2,270	.43	9.26	21,022	417	20	9.3	3,880	1,853	77	9.2	17,142	18:82	4	0	Steeper gradient, falls, boulders, major barrier
29	1,025	.19	7.76	8,110	180	30	11.0	1,972	845	106	7.3	6,138	24:76	2	0	Decrease gradient, boulders end, channel widens
30	1,731	.33	7.64	30,301	339	23	8.3	2,830	1,392	19.7	19.7	27,471	9:91	3	21	Boulders occur, veg. change, lose sedge, narrow
31	372	.07	7.96	2,363	37	19	7.6	283	335	168	12.3	2,080	12:88	3	0	Mass wasting of bank, boulders, spotty sedges
T.	48,767	9.24	7.2	369,890	10,702	24	676	81,917	38,065	93.0	9.0	287,973	22:78		63	

SWALE CREEK

REACH	REACH LENGTH (FT.)	REACH LENGTH (MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	1,886	.36	8.41	15,818	329	24	11	3,740	1,557	11.1	8	12,078	24:76	4	45	Lots willows, big boulders & trees
2	1,670	.32	8.64	14,425	355	30	10	3,590	1,315	101	8	10,835	25:75	5	0	Shrubs thinned
3	2,082	.39	5.46	12,622	327	20	9	2,922	1,755	110	6	9,700	23:77	4	65	Increase of debris in Little Bear & Swale Ck.
4	1,018	.19	5.39	5,490	158	14	8	1,340	860	61	5	4,150	24:76	5	0	
5	1,544	.29	6.41	9,896	126	11	10	1,313	1,418	109	6	8,583	13:87	4	0	Small cobbles w/big cobbe in middle of ck.
6	1,580	.30	5.89	11,424	227	17	8	1,744	1,353	104	7	9,680	15:85	5	0	Increased debris, log jams frequent
7	1,536	.29	6.83	10,484	296	17	7	2,149	1,240	73	7	8,335	21:80	4	0	Large boulders creating nice pools & falls
8	2,456	.47	6.01	14,749	224	14	7	1,564	2,232	140	6	13,185	11:89	7	0	Steep canyon, over hanging shrubs
9	2,182	.41	5.92	12,922	242	13	8	1,880	1,940	97	6	11,042	15:85	6	0	Meets Rd. 2110, heavy debris, tree growth
10	2,328	.44	6.62	15,411	259	14	10	2,568	2,069	99	6	12,843	17:83	7	0	Large rock capped hill to east, willow dominance
11	2,649	.50	6.35	17,215	231	14	10	2,316	2,418	134	6	14,899	13:87	9	0	Mixed stretches of flatter areas
12	2,428	.46	7.47	18,134	283	13	10	2,833	2,145	93	7	15,301	16:84	15	0	Drainage from west, huge boulders create falls
13	2,420	.46	5.91	14,305	20	10	5	100	2,400	240	6	14,205	01:99	5	0	Drainage on west bank, bottom channel widened
14	2,911	.55	3.98	11,577	35	7	4	123	2,876	180	4	11,454	01:99	2-3	0	Stream meanders thru "dry meadow"
15	3,479	.66	3.17	11,044	110	12	6	701	3,369	187	3	10,343	06:94	2	0	Stream w/good overhang of sadges & grasses
16	5,881	1.11	4.03	23,786	128	6	4	555	5,753	164	4	23,231	02:98	3	0	Flows over roadbed rock, culverts barriers
17	980	.19	4.85	3,780				-	980	490	4	3,780	0:100	2	0	Crisscrossed w/lodgepole, serious barrier
18	4,720	.89	3.68	17,318	540	17	5	2,568	4,180	131	4	14,750	15:85	.5-1	0	Bank cutting, major briad, 1/2% gradient
19	4,146	.79	4.48	17,455	683	18	5	3,203	3,463	94	4	14,252	18:82	.5-1	0	4' bank cutting and mass wasting, clay & milky
	47,896	9.1		257,855	4,573			35,209	43,323			222,646	14:86		110	

LITTLE BEAR CREEK

REACH	REACH LENGTH (FT.)	REACH LENGTH (MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	1,724	.33	4.21	7,259	136	10	7.50	1,020	1,588	106	3.93	6,239	14:86	6	0	Few fish, stagnant shallow pools
2	1,176	.22	4.14	4,465	105	12	8.02	842	1,071	134	3.38	3,623	17:74	6	0	Flow seems to come from spring on east side
T.	2,900	.55		11,724	241			1,862	2,659			9,862	15:85		0	

ALDER & EAST ALDER

REACH	REACH LENGTH (FT.)	(MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	1,715	.32	3.03	5,202	742	46.3	3.3	2,496	973	60.8	2.7	2,706	48:52	1	0	Culvert 3' high 35' long - creek crosses.
2	1,791	.34	3.55	6,360	791	24.7	4.2	3,340	1,000	31.2	3.0	3,020	52:47	1	0	Slope on side hills beg. to steep.
3	1,993	.38	5.46	10,881	478	18.3	6.2	2,986	1,515	56.1	5.2	7,895	27:72	M	0	Canyon, cast banks, slopes steep.
4	1,874	.35	8.11	8,277	386	14.3	4.9	1,914	1,488	53.1	4.2	6,363	23:77	2	0	Alder & Skookum Creeks cross, same size.
5	1,207	.23	5.37	6,486	384	23	7.34	2,820	823	41	4.45	3,666	43:57	2	94	Log creates pool possible barrier to fish.
6	4,469	.85	4.63	20,704	740	21	6.55	4,848	3,729	104	4.25	15,856	23:77	3	0	Alder shaded, culvert w/3 ft. drop barrier
7	1,416	.27	3.02	4,271	325	9	3.79	1,233	1,091	29	2.78	3,038	29:71	2-3	0	Few fish barriers 20' apart culvert collapsed
8	1,485	.28	2.75	4,080	220	8	3.24	713	1,265	45	2.66	3,367	17:83	2-3	0	No fish survey discontinued
T.	15,950	3.02	4.5	66,261	4,066	164.6	5.0	20,350	11,884	52.5	3.86	45,911	12:88		94	

HOG CREEK

REACH	REACH LENGTH (FT.)	(MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	2,325	.44	4.30	10,005	151	15.10	7.17	1,082	2,174	181.17	4.10	8,923	11:89	6	0	Reach on side of fence separating Hog & Skookum
2	1,873	.35	5.15	9,646	58	11.60	6.43	373	1,815	363	5.11	9,273	03:96	9	0	Logs w/stacked rocks creating 3' wall
T.	4,198	.80		19,651	209			1,455	3,989			18,196	07:93		0	

BACON

REACH	REACH LENGTH (FT.)	(MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	3,276	.62	3.6	11,830	315	12	5.27	1,659	2,961	110	3.44	10,171	14:86	3	0	Pools formed by log jams, bedrock & boulders
2	2,082	.39	2.22	4,632	167	9	4.36	728	1,915	96	2.04	3,904	16:84	5	0	Numerous boulders, small steelhead & crayfish
2A	4,337	.82	3.51	15,205	515	17	5.01	2,578	3,822	123	3.30	12,627	17:83	6	150	Begin. w/gravel bar in small pond grad. increase
3	204	.04	3.86	787	50	17	5.9	295	154	51	3.19	492	37:63	4	0	Starts w/meadow type ends w/increased gradient
4	2,161	.41	2.11	4,554	90	15	5.9	531	2,071	207	1.94	4,023	12:88	4	0	Deep channel, bank of soil & exposed roots
T.	12,060	2.3		37,008	1,137			5,791	10,923			31,217			150	

THREE TROUGH

REACH	REACH LENGTH (FT.)	REACH LENGTH (MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	2,383	.45	5.17	12,328	283	18	7.06	1,998	2,100	124	4.92	10,330	16:19	4	0	
T.	2,383	.45		12,328	283			1,998	2,100			10,330	16:19		0	

DITCH CREEK

REACH	REACH LENGTH (FT.)	REACH LENGTH (MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	1,329	.25	7.8	10,319	219	16.8	9.7	2,114	1,110	79.2	7.4	8,205	80:20	+4	0	Riparian used by animals, loose soil
2	3,229	.61	6.6	21,178	529	17.6	9.5	5,013	2,700	84.4	6.0	16,165	24:76	6	0	Coverage on side slopes, large debris throughout
3	2,246	.43	7.6	17,162	386	20.3	9.4	3,627	1,860	93.0	7.6	13,535	21:79	4	0	Decreased steepness, less debris, wider riparian
4	1,935	.37	6.0	11,585	135	19.2	6.9	930	1,800	257.1	5.9	10,655	08:92	3	0	Level stream, less debri, more grassy bench
5	3,175	.60	5.8	18,357	280	15.5	7.8	2,182	2,895	152.4	5.6	16,175	12:88	3	0	Available boulders for const., large water flow
6	2,028	.38	5.1	10,348	33	11.0	5.5	183	1,995	399.0	5.0	10,165	01:98	1-2	0	Poor bottom, flat, few pools, needs work
7	3,786	.72	5.6	21,454	211	11.7	7.6	1,599	3,575	143.0	5.5	19,855	07:93	2	0	Begins at end of flat meadow
8	4,347	.82	4.5	19,545	376	9.0	6.4	2,396	3,971	88.2	4.3	17,149	12:88	3	0	Narrow canyon walls, steep slopes, bedrock
9	1,669	.32	4.8	8,085	155	10.3	5.8	907	1,514	94.6	4.7	7,178	11:89	2	300	Boulders, jams with bralds, falls
10	4,157	.78	6.6	22,338	1,200	42.9	3.2	3,857	2,957	98.5	6.2	18,481	17:83	5	0	Bedrock walls at start, wider at bottom
11	1,898	.36	7.6	14,397	93	15.5	8.2	762	1,805	225.6	7.5	13,635	05:95	8	0	Boulders scattered on bottom, increased gradient
12	8,527	1.61	4.6	37,378	894	27.0	6.4	5,752	7,633	272.6	4.1	31,626	15:85	3	0	Canyon opens into meadow, dece thick in bottom
13	9,792	1.85	4.7	45,803	578	18.0	6.5	3,762	9,214	236.2	4.5	42,041	08:91	4	0	Meadows with tall, thick grass, higher banks
14	3,241	.61	4.1	13,545	366	12.2	6.2	2,265	2,875	130.7	3.9	11,280	17:83	.5-1	0	Meanders through meadow, slow water, some bluish
15	448	.08	2.3	1,016	118	7.3	3.0	356	330	55.0	2.0	660	35:65	.5-1	0	Mostly dry, deep holes have water, blue, murky
T.	51,807	9.81		272,510	5,573			35,705	46,234			236,805	13:87		300	

MARTIN CREEK

REACH	REACH LENGTH (FT.)	REACH LENGTH (MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	3,051	0.58	3.18	9,697	127	15.88	30.98	3,934	2,924	209	1.98	5,763	40:59	1	0	Outlet at superpond inadequate, no outflow
T.	3,051	0.58		9,697	127			3,934	2,924			5,763	40:59		0	Outlet at superpond inadequate, no outflow

MALLORY CREEK

REACH	REACH LENGTH (FT.)	REACH LENGTH (MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	4,418	.84	3.52	15,545	388	9	6.00	2,327	4,030	92	3.28	13,218	15:85	3-5+	0	Reach begins @ F.S. boundary gradient 40%+
2	3,286	.62	3.12	10,238	361	8	5.67	2,047	2,925	71	2.80	8,191	20:80	3-5	0	Cascades prevent fish passage large boulders
3	477	.09	3.30	1,576	27	7	6.15	166	450	90	3.13	1,410	11:89	3	0	Boulders - impossible to get machinery in
4	563	.11	3.66	2,061	77	7	7.06	544	486	44	3.12	1,517	26:74	5	0	Majority of reach is on bedrock
5	968	.18	4.81	4,657	43	6	5.40	232	925	132	4.78	4,425	20:01	2	0	Reach begins where large boulders begin
6	1,093	.21	3.13	3,421	276	46	.60	165	817	136	3.99	3,256	21:01	2	0	Accessible w/equipment, needs pools
7	1,806	.34	4.26	7,700	106	12	12.08	1,280	1,700	142	3.78	6,420	17:83	1	0	Mass waste of banks, brown trout, rainbows
8	3,141	.59	4.48	14,071	181	12	24.67	4,466	2,960	211	3.24	9,605	32:68	2	0	Reach ends south of Goshen Cabin
T.	15,752	2.98		59,269	1,459			11,227	14,293			48,042	19:81		0	

POTAMUS CREEK

REACH	REACH LENGTH (FT.)	REACH LENGTH (MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AREA AVE. WIDTH (FT.)	POOL AREA SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AREA AVE. WIDTH (FT.)	RIFFLE AREA SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	1,955	.37	8.2	15,946	425	16.3	10.3	4,398	1,530	56.7	7.5	11,548	28:72	10	0	Steep & rocky with several waterfalls
2	3,189	.60	7.7	24,398	397	17.3	23.0	9,131	2,792	111.7	5.5	15,267	37:63	8	0	Leveling out, canyon narrows
3	2,815	.53	7.4	20,808	200	18.2	10.5	2,103	2,615	261.5	7.2	18,705	10:90	4	0	Number of pools drastically reduced
4	500	.09	10.0	5,000	0			0	500	500	10.0	5,000	0:100	1-2	0	Debris piling up @ mouth of culvert, bar forma.
5	1,970	.37	7.2	14,240	30	15.0	6.7	200	1,940	485	7.2	14,040	1:99	2	0	Needs work - good access off 2105
6	3,524	.67	5.9	20,800	152	11.7	7.2	1,088	3,372	198.4	5.8	19,712	5:95	3	0	Banks need work not many pools
7	4,264	.81	4.9	20,960	76	7.6	9.3	708	4,188	322.2	4.8	20,252	3:97	2	0	Too few pools falls are barrier for fish passage
8	1,376	.26	5.1	7,071	41	8.2	5.4	221	1,335	222.5	5.1	6,850	3:97	3	0	2 seeps putting out water into creek
9	1,973	.37	6.4	12,660	123	30.8	33.7	4,140	1,850	308.3	4.6	8,520	33:67	1	0	Mass wasting common & sloughing too
10	2,357	.45	5.0	11,863	277	19.8	12.2	3,373	2,080	138.7	4.1	8,490	28:72	1	0	Superpond
11	434	.08	3.3	1,437	15	5.0	.21	70	419	104.8	3.3	1,367	05:95	3	0	Meadow type, narrow channel, steep walls
12	1,817	.34	4.0	7,222	104	6.9	.15	714	1,713	142.8	3.8	6,508	10:90	2	60	Partly stable log jams, dams need work, check
13	1,899	.36	3.2	6,097	267	5.2	.19	1,408	1,632	102	2.9	4,689	23:77	1	0	Large loops, numerous rainbow, deep slow water
14	961	.18	2.6	2,536	26	3.7	.27	96	935	187	2.6	2,440	03:96	.5	0	No definite channels, marshy, culverts
T.	29,034	5.48		171,038	2,133			27,650	26,901			143,388	16:84		60	

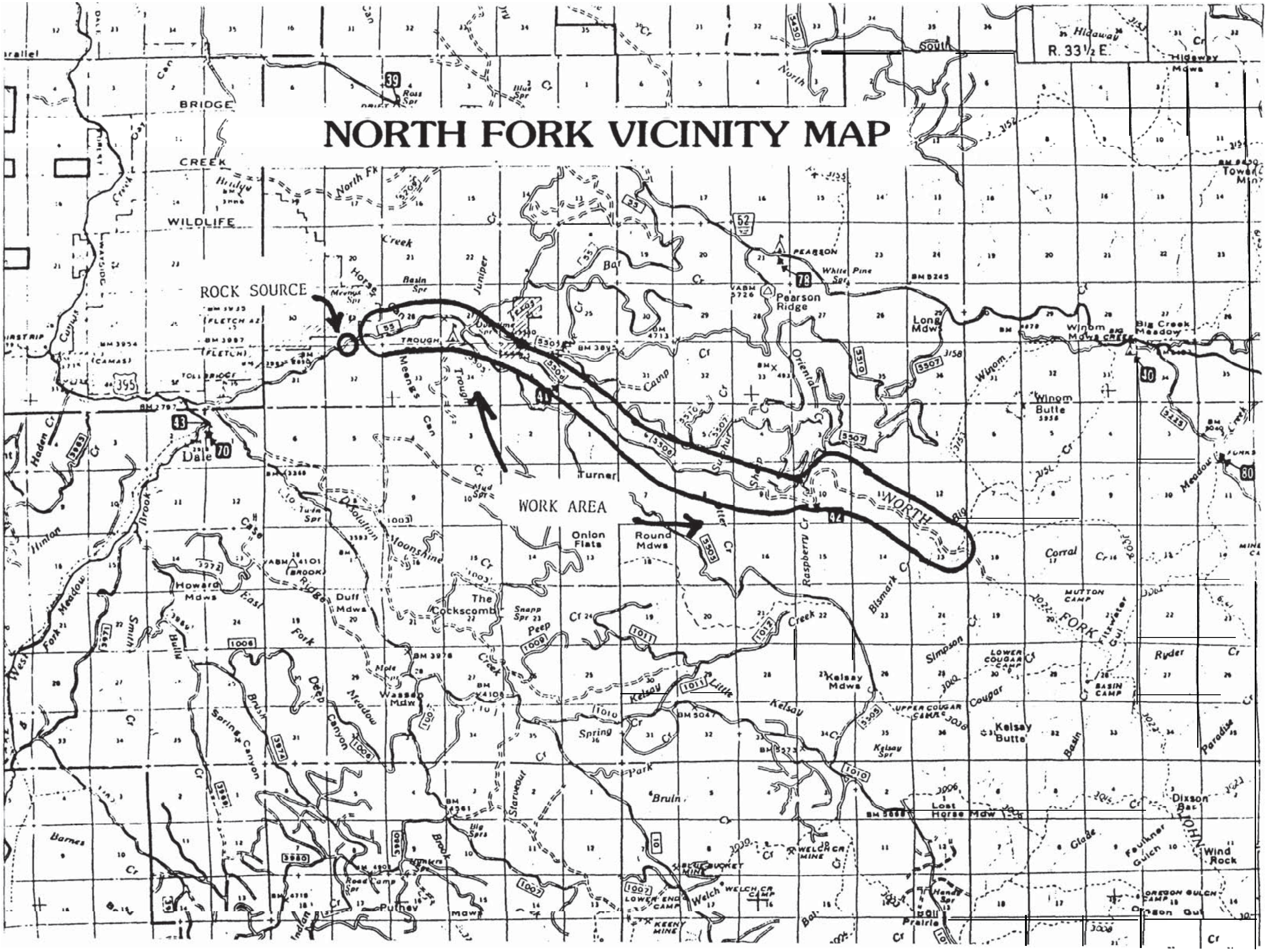
ELLIS CREEK

REACH	REACH LENGTH (FT.)	REACH LENGTH (MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AVE. WIDTH (FT.)	POOL SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AVE. WIDTH (FT.)	RIFFLE SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	4,036	.76	7.2	29,160	548	16.6	6.0	3,337	3,488	96.9	7.4	25,823	11:89	12	0	Large pools & boulders, waterfalls
2	2,998	.57	5.2	15,600	218	11.5	11.9	2,595	2,780	174.0	4.7	13,005	17:83	5	0	Starts above deep canyon, widened bottom
3	2,293	.43	4.7	10,746	73	10.4	4.5	331	2,220	246.6	4.7	10,415	03:97	1-2	0	Culvert N. side Rd. 2105, channel unstable
4	4,625	.88	3.0	13,978	161	7.6	4.0	654	4,464	148.8	3.0	13,324	04:95	2	0	Underground flow, steep upper banks, seeps
T.	13,952	2.6		69,484	1,000			6,917	12,952			62,567	10:90			

POLE CREEK

REACH	REACH LENGTH (FT.)	REACH LENGTH (MI.)	AVE. REACH WIDTH (FT.)	TOTAL SURFACE AREA (SQ. FT.)	POOL AREA LENGTH TOTAL (FT.)	POOL AREA LENGTH AVE. (FT.)	POOL AVE. WIDTH (FT.)	POOL SURFACE AREA (SQ. FT.)	RIFFLE AREA LENGTH TOTAL (FT.)	RIFFLE AREA LENGTH AVE. (FT.)	RIFFLE AVE. WIDTH (FT.)	RIFFLE SURFACE AREA (SQ. FT.)	P/R RATIO N/A	AVE. GRAD. (%)	SPAWNING GRAVEL (SQ. FT.)	COMMENTS
1	3,714	.70	3.63	13,472	182	12.13	5.32	969	3,532	177	3.54	12,503	07:09	4	0	Reach in Potamus in meadow with aspen stand
2	4,601	.87	2.72	12,527	186	11.63	5.36	997	4,415	597	2.61	11,530	08:92	7	0	Reach at drainage on E. side, sporadic flow
3	1,030	.20	4.93	5,061	134	12.18	6.04	810	896	69	4.77	4,271	16:84	4	0	Reach in timbered area, eroded banks (12' high)
T.	9,345	1.77		31,080	502			2,776	8,843			28,304	09:91			

Appendix C: Project Location Maps


NORTH FORK VICINITY MAP
ROCK SOURCE
WORK AREA
NORTH
FORK
JOHN
R. 33½ E.
BRIDGE
CREEK
WILDLIFE
Pearson Ridge
Long Mdws
Winom Butte
Big Creek Meadow
Onion Flats
Round Mdws
Turner
Dale
The Cockscomb
Duff Mdws
Howard Mdws
Kelsay Mdws
Kelsay Butte
Wind Rock
Dixson Bar
Lost Horse Mdw
Prairie
Trough
Meengs Can
Raspberry Cr
Bismark Cr
Corral Cr
Simpson
Oriental
Camp
Moonshine
Desolution
Spring
Bruin
Starveout
Brook
Welch
Pulvey
Hinton
West Fork Meadow
Smith
Ryder
Paradise
Glade
Faulkner Gulch
Oregon Gulch
Upper Cougar Camp
Lower Cougar Camp
Mutton Camp
Basin Camp
Welch Cr Mine
Keeny Mine
Lower End Camp
Snapp Spr
Peep
Little
Kelsay
Park
Deep Canyon
Brush
Spring Canyon
East Fork
Barnes
Haden Cr
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5507
5510
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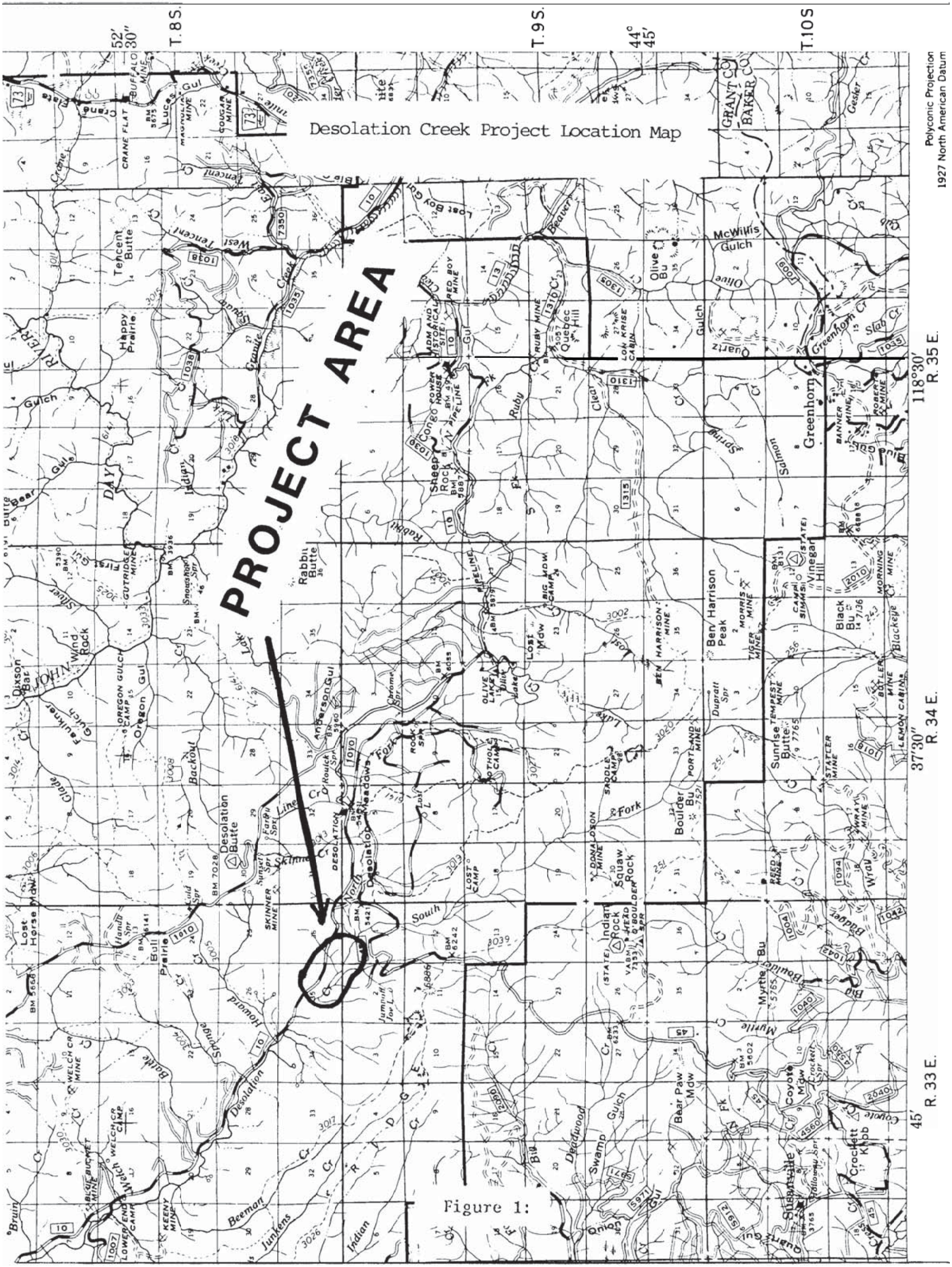
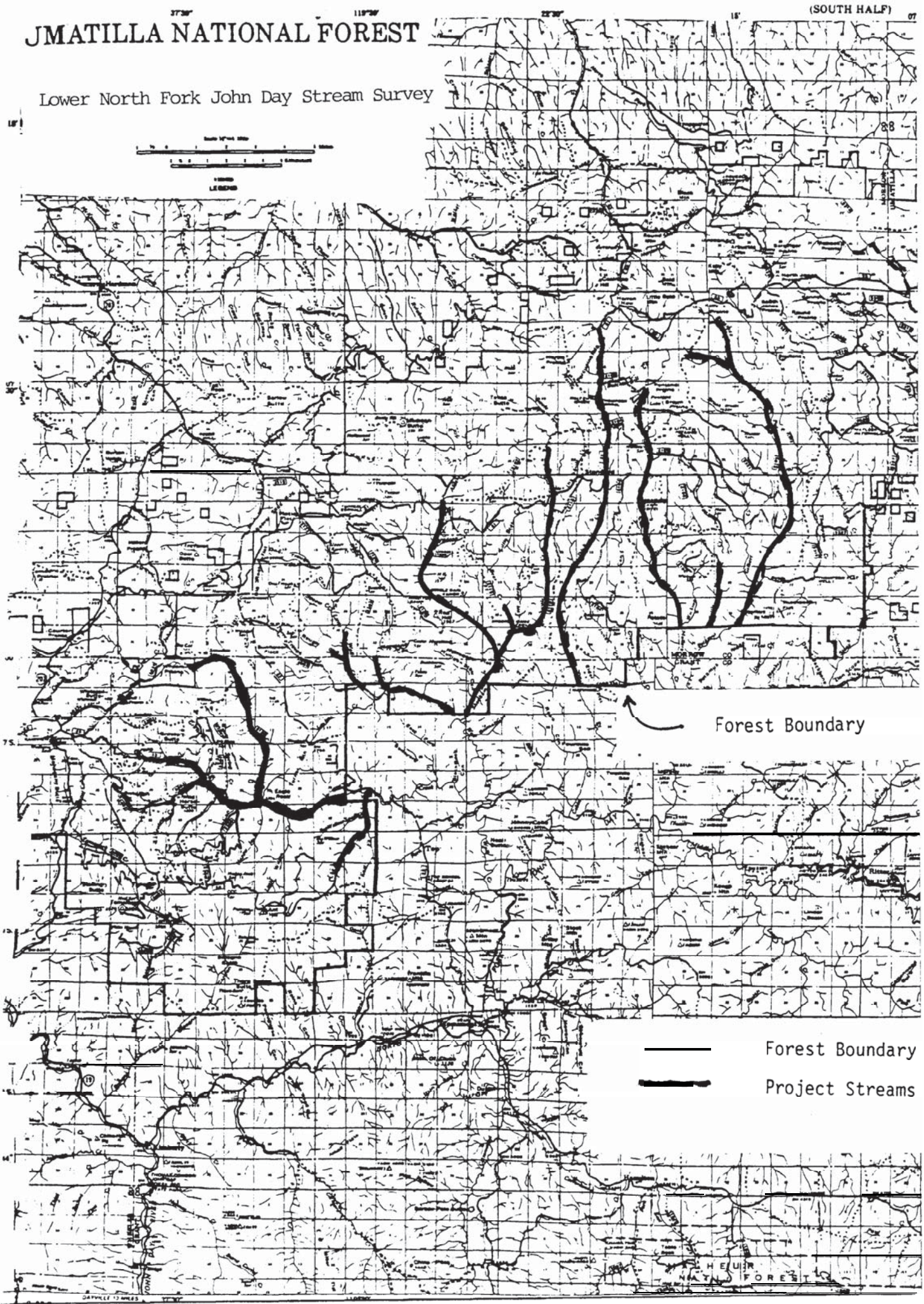
1011
1012
1007
1006
1009


Desolation Creek Project Location Map
PROJECT AREA
T. 8 S.
T. 9 S.
T. 10 S
R. 33 E.
R. 34 E.
R. 35 E.
Polyconic Projection
1927 North American Datum
Figure 1:

JMATILLA NATIONAL FOREST

Lower North Fork John Day Stream Survey



FINAL REPORT TO THE
BONNEVILLE POWER ADMINISTRATION (BPA)

USDA - Forest Service
Malheur National Forest
139 NE Dayton Street
John Day, Oregon 97845

Upper Mainstem John Day River Habitat Improvement Project 84-22

CONTRACT NUMBER DE-AI79-85BP16064

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