Biological and Physical Inventory of the Streams within the Lower Clearwater River Basin, Idaho

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A BIOLOGICAL AND PHYSICAL INVENTORY OF THE STREAMS WITHIN THE LOWER CLEARWATER RIVER BASIN, IDAHO

by

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EXECUTIVE SUMMARY

Juvenile rainbow-steelhead trout were found at varying densities on all stream systems surveyed within the lower Clearwater River Basin with the exception of Cottonwood Creek (SF tributary). Juvenile chinook salmon were found at the mouths of a few creeks, but production was identified only in Lolo Creek.

All systems within the lower basin showed signs of watershed degredation. The primary cause of the stream degredation was variation of annual stream flow. High peaks in flow have scoured stream channels, which has resulted in a lack of instream cover and riparian vegetation; a situation not conducive to salmonid production.

Two streams were identified to have the most enhancement potential. Based on waterflow, general watershed degredation (sedimentation) and number of anadromous fish species present. Lolo Creek, and Big Canyon Creek were identified in order of priority. Clear Creek, Orofino Creek, and Potlatch River also among the largest streams in the lower Clearwater River Basin need additional baseline data to recommend enhancement activities.

INTRODUCTION

Historically, tributaries of the lower Clearwater River supported runs of anadromous salmonids. These fish were utilized by the Nez Perce Tribe for subsistance, trade and religious ceremonies. Fishing was as important to their annual subsistance as -hunting and root gathering (Morrison-Maierle 1979). Both the procurement and consumption of both salmon and steelhead trout comprised an intergal component of the tribes cultural and religious beliefs.

Presently, anadromous salmonid stocks returning to Idaho are greatly reduced from historical levels. Since 55% of all steelhead, 39% of all spring chinook and 45% of summer chinook produced in the Columbia Basin originated in Idaho (Mallet 1974), this reduction impacts the entire basin fishery. Since most anadromous salmonid habitat in Idaho lies within the ceded lands of the Nez Perce Tribe, the tribe is deeply interested in the status and management of these anadromous streams.

There are very little data depicting the magnitude of the anadromous salmonid resource within the lower Clearwater Basin. The majority of these streams flow entirely or in part on the Nez Perce Reservation. The Tribe therefore, undertook a survey of these streams with support by the Bonneville Power Administration (BPA) to generate a da& base for future enhancement and management decisions.

STUDY SITE

The Nez Perce Indian Reservation, located in north central Idaho, is about 3237 km2 in area, and includes a substantial portion of the lower Clearwater River drainage, (the mainstem Clearwater River and portions of the North Fork, Middle Fork and South Fork). This report concludes the second summer of an inventory which included most streams which flow entirely or in part within the reservation, i.e.,the entire lower Clearwater River Basin (Figure 1). Elevations in the lower Clearwater Basin range from 280 m to 1,844 m. Reflecting these elevations, general habitats include semi-arid canyons, agricultural prairie and coniferous forest. Average annual rainfall, recorded in Lewiston, Idaho from 1973 to 1982, averaged 31.6 cm, although considerably greater rainfall occurs in the higher elevations. Air temperatures during the summer low periods range from 37.7 C at the lower elevations to 26.6 C in the forested highlands. Dworshak National Fish Hatchery, located within the Reservation, was established as mitigation for' the construction of Dworshak Dam on the North Fork of the Clearwater River. Dworshak is a source for extensive outplanting of steelhead smolts throughout the drainage. Fish species found in the lower Clearwater Basin are listed in Table 1.

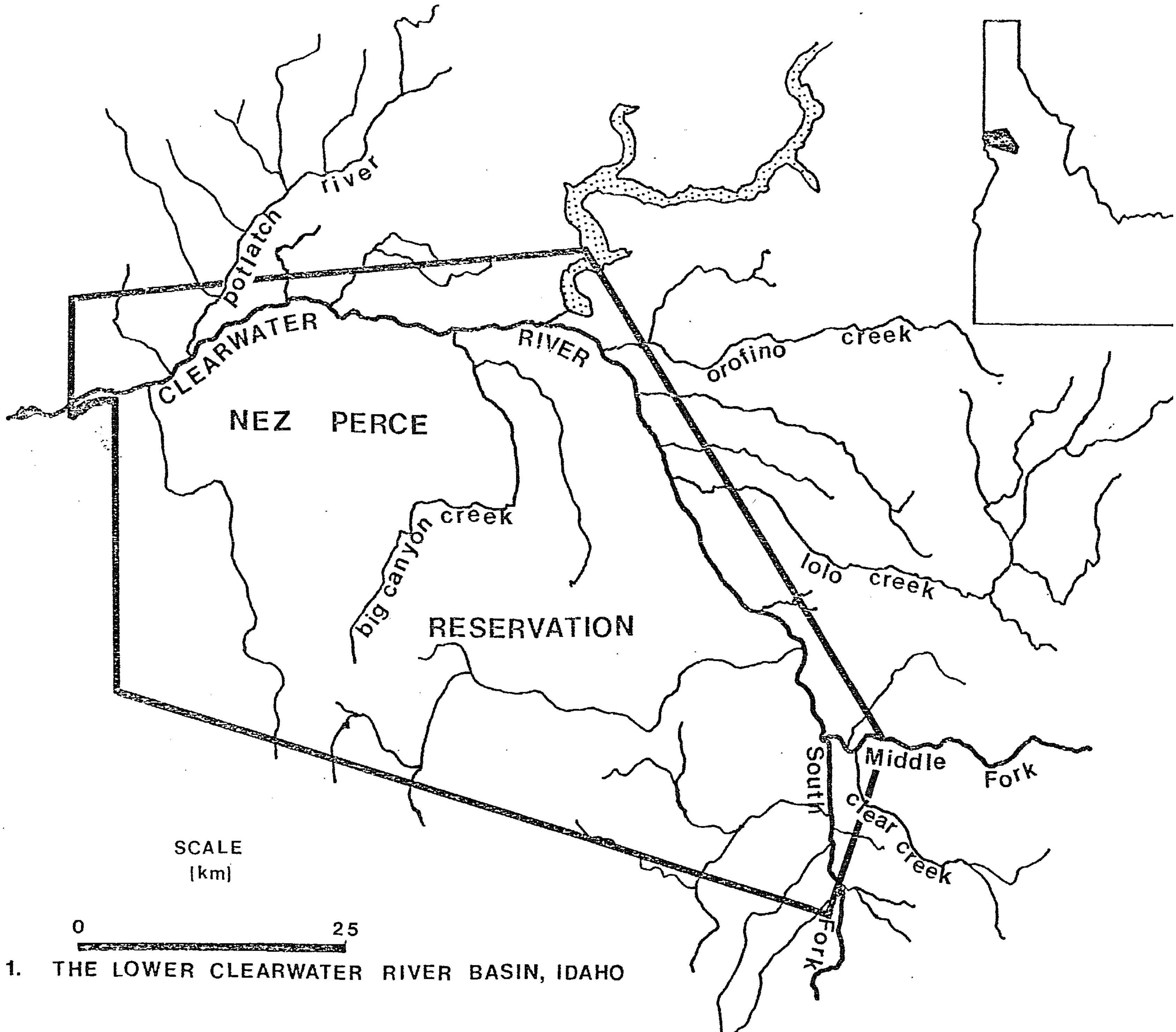

FIGURE 1. THE LOWER CLEARWATER RIVER BASIN, IDAHO

Table 1. List of fish species sampled in the streams within the lower Clearwater River Basin, Idaho, from July to October 15, 1983.

Common Name	Scientific Name
Rainbow-Steelhead Trout	Salmo gairdneri
Chinook Salmon	Oncorhynchus tshawytscha
Kokanee Salmon	Oncorhvnchus nerka
Bull Trout	Salvelinus confluentus
Cutthroat Trout	Salmo clarki
Mountain Whitefish	Prosopium williamsoni
Smallmouth Bass	Micropterus dolomieui
Longnose Dace	Rhinichthys cataractae
Speckled Dace	Rhinichthys osculus
Paiute Sculpin	Cottus beldingi
Torrent Sculpin[a]	Cottus rhotheus
Northern Squawfish	Ptychocheilus oreqonensis
Chiselmouth	Acrocheilus alutaceus
Redside Shiner	Richardsonius balteatus
Bridgelip Sucker	
Largescale Sucker	Catostomus macrocheilus
Pacific Lamprey (ammocoete)[a]	Entosphenus tridentatus

[a] Probable species identification.

METHODS

All streams selected for evaluation were visually surveyed for barriers to fish migration, water diversions and general habitat types. The entire length of each stream was surveyed on foot where it was practical. Once general habitat types were identified (i.e., canyon, meadow and forest), a representative station was established in each of these habitats where access permitted. These stations were identified by their stream mile location and labeled 1, 2, 3, etc. from the lowest station to the uppermost station on each stream. Each station consisted of a discrete 60 to 100 m section of Stream, from which, population estimates of salmonid fishes and an assessment of stream habitat were recorded.

Population Determination

To assess populations of salmonids it was necessary to utilize two schemes. In waters with sufficient conductivity, a Georator portable generator (Model 31-002) with single electrode set at 230 volts direct current was used to collect fish. Fish population estimates were conducted at each location using the removal method (Zippin 1958: Seber and LeCren 1967). The specific program utilized for population estimates can be found in Platts (1983). During the removal procedure fish were shocked from down to upstream, in a discrete section with block nets in place at both ends. Between passes fish were kept in large plastic garbage cans. All salmonids were weighed to the nearest gram and measured (total length and fork length), to the nearest millimeter.

In streams where the conductivity was too low to enable efficient capture of salmonids, population estimates were made by direct observation using a snorkling technique (Platts 1983). These observations, while accurately depicting the populations, did not provide biomass information. For this reason the snorkler identified salmonid fishes as subyearling, or overyearling fish (Griffith and Fuller 1979). Two observation runs were made from down to upstream. The average of the two counts was used to make a conservative population estimate. A sample of fish was collected with the Georator and mean lengths and weights were determined for the size groups identified by the observer.

These population data were then used to generate standing crop estimates (Biomass k/ha) and density (fish/m2) for each of the two size groups (i.e., subyearling and overyearling).

In addition to the biological data concerning the biomass and abundance of rainbow-steelhead trout, each station surveyed was characterized by measuring twelve physical parameters and thirteen chemical parameters. The physical attributes were chosen as those most likely to affect production of rainbow-steelhead trout either singularly or synergistically as described by Binns and Eiserman (1979) and the U.S.D.I. Forest Service Ocular Method.

Physical Attributes

Late Summer Stream Flow

Estimate of flow (m3/sec) taken during low flow periods associated with late summer conditions. This attribute, considering depth is an indicator of the space available to fish during the critical low flow period. Chapman (1964) identified space as one of the two-critical elements regulating salmonid populations in streams.

Annual Stream Flow Variation

A subjective estimate of variation in flow as observed from flood damage, channel scouring and water flow records. This parameter describes the consistency found in a stream environment. Extreme annual fluctuations in flow can displace eggs, and subyearling fish, and erode adjacent stream banks and cover (Meeham 1974).

Maximum Summer Temperature

Maximum water temperature C recorded with Taylor Min-Max thermometers during the low flow period. Temperature is a prime regulator of natural processes within the aquatic environment+ It limits physiological functions of not only fish but all biological constituents of the ecosystem. Temperatures greater than 22.2 C have been shown to inhibit salmonid production (Mackenthun 1969), therefore this value was used to provide the upper lethal limit for rainbow-steelhead trout in this report. Temperatures greater than 22.2 C were considered lethal to salmonids.

Instream Cover

Total measured surface area of cover for overyearling rainbow-steelhead trout (surface turbulence, overhanging vegetation, depth, submerged objects and undercut banks, (Binns and Eiserman 1979). Recorded as % of total stream area.

Water Velocity

Average stream velocity was calculated from the timing of dye (Binns and Eiserman 1979). The velocity of water movement is extremely important to aquatic organisms in a number of ways including the transport of nutrients and organic food pass those organisms attached to stationary surfaces or feeding locations. In addition, the amount of oxygen available and the speed which sediments can be transported down stream are related to this parameter (Mackenthun 1969). Velocity determines those species of stream bed organisms that may be present and the size and species of fish that utilize a stream. Bovee (1978) identified the optimum range of velocities utilized by juvenile rainbow-steelhead using probability-of-use methodology. Water velocities identified in this study are related to these curves.

Stream Width

Width of stream at the water surface (m). This parameter, considered with stream depth, describes the potential habitat within a stream.

Stream Depth

Mean stream depth from multiple transects (cm). Past research within the Clearwater system (Everest and Chapman 1972) have shown utilization of specific water depths by rainbow-steelhead. Bovee (1978) identified optimum depths for juvenile rainbow-steelhead trout using probability of use methodology which included work by Everest and Chapman (1972). Water depths identified in this study are related to these curves.

Cobble Embeddedness

The extent to which the cobble in the substrate is covered by silt or sand (%). Deposition of sediments in streams can and often does destroy aquatic insect populations (Mackenthun 1969) Bjornn et al (1977)found that sediment in the substrate can limit salmonid production in streams and Meehan (1974) indicated that not only the sediment present in the substrate but also the transport of such sediment can decrease the production of salmonids. This study is limited to the sediment present in the substrate during the low flow period and will be compared to the quantitative work describes by Bjornn et al (1977).

Major Substrate

The primary substrate size present by precent (Lane 1947) (American Geophysical Union). Everest and Chapman (1972) found that rainbow-steelhead trout tended to utilize specific sizes of substrate within the Clearwater Basin. Bovee (1978) identified optimum substrate sizes for rainbow-steelhead juveniles using probability of use methodology. The substrates identified in this study are compared to the curves developed by Bovee (1978).

Periphyton Coverage

Coverage (% of total area) of substrate by periphyton. The presence of periphyton (algae in and around the substrate) is an indicator of the quantity of primary productivity and related nutrient sources available within a stream.

Pool Riffle Ratio

Percentage of total area of stream habitat which is either of a pool or riffle nature. In a well balanced stream it is generally recognized that a ratio between 60:40 to 40:60 provides adequate zones of production for aquatic insects and areas with sufficient depth to be utilized by fish. This report uses this ratio as a general indicator of pool habitat quantity for rearing juvenile rainbow-steelhead.

Water Quality samples were collected in one quart plastic containers and immediately labeled, cooled in ice and transported to the Analytical Services Laboratory at the University of Idaho the same day. Parameters measured, methodology and detection are presented in Table 2.

Streams reported in this paper were inventoried during the summer 1983 from mid July to October. This was accomplished by sampling stream of lower elevation and smaller watershed earliest and the higher elevation streams toward the seasons end. Data is also reported from stream surveys that were originated in 1982 and completed in 1983 (Kucera et al 1983). As orginally proposed and reported in Kucera et al (1983) the Habitat Quality Index (HQI) of Binns and Eiserman (1979) was not used as an analytical tool. The inability to produce a model appropriate to the anadromous fish and their&elation to habitat parameters has limited the value of that method in this application.

Table 2. Water sample analysis outlining constituents measured, methods of detection and detection limits for samples taken from the streams on the lower Clearwater River Basin, Idaho, from July to October, 1983.

Constituent	Detection Method	Detection Limit
Carbonate, CO_3	Titrimetric-H_2SO_4 and phenolphthalein	0.22 mg/l
Bicarbonate, HCO_3	Titrimetric-H_2SO_4 and methyl orange	0.09 mg/l
Sulfate, SO_4	Turbidimetric	1.0 mg/l
Nitrate, NO_3	Colorimetric, automated, cadmium reduction	0.01 mg/l
Orthophosphate, PO_4	Colorimetric, automated, ascorbic acid	0.01 mg/l
Chloride, Cl	Titrimetric-Silver nitrate and potassium chromate	0.01 mg/l
Calcium, Ca	Inductively Coupled Plasma-Atomic Emission Spectrometer	0.15 mg/l
Magnesium, Mg	Inductively Coupled Plasma-Atomic Emission Spectrometer	0.25 mg/l
Sodium, Na	Inductively Coupled Plasma-Atomic Emission Spectrometer	0.10 mg/1
Potassium, K	Inductively Coupled Plasma-Atomic Emission Spectrometer	0.50 mg/l
Total Dissolved Solids	Gravimetric	10.0 mg/l
pH	Colorimetric	0.1 unit

All biological and habitat data for each station were collected on a single day. Water quality samples were collected in groups due to logistal restraints of the water quality laboratory.

STREAM NARRATIVES

Bedrock Creek

Bedrock Creek is approximately 14.5 km long, the lower 4.8 km of which flows within the Nez Perce Reservation. The stream flows in a southeasterly direction and discharges into the mainstem Clearwater River at river kilometer (rk) 32.2. Two major drainages contribute to this stream; Louse Creek, which is 8.4 kilometers long, provides the majority of flow during the summer months, and upper Bedrock Creek, which is 7.4 kilometers in length. The two streams converge to form mainstem Bedrock Creek, which flows for 4.8 kilometers to the mouth. Both upper Bedrock and Louse Creeks arise in agricultural environments with limited watershed capacity and flow through steep canyon terrain to their confluence. Louse Creek is relatively inaccessible and its steep slopes provide limited grazing. However, the upper Bedrock Creek canyon widens approximately 2.4 kilometers above the confluence with Louse Creek and provides relatively good access for grazing. The riparian zones on these two creeks reflect this differential grazing pressure. Approximately 0.9 kilometers below the confluence, the canyon narrows, limiting access, and has a well developed riparian zone. The last 2.4 kilometers above the mouth the stream is braided and has been heavily grazed with poor riparian habitat';: Signs of past flooding indicate that the stream channel in this section is not adequate to contain high flows. Logging has occurred in the past throughout the basin and many old logging roads remain in various states of disrepair. South and east facing slopes are heavily grazed and support few trees. High runoff following precipitation is a problem in this drainage. Water quality conditions found during low flow in 1982 and 1983 reflect near neutral conditions and indicate no limiting factors to salmonid production (Table 3).

Two stations were established on Bedrock Creek: station #l, located at stream kilometer (SK) 2.4 was sampled. in 1982; and station #2, located at SK 6.4, was sampled in 1983.

Station #l

Species present include rainbow-steelhead trout, speckled dace, paiute sculpin, bridgelip sucker, largescale sucker and redside shiner. The standing crop and density of overyearling rainbow-steelhead trout were 35.6 kg/ha and 0.2 fish/m2, respectively. Estimates for subyearling rainbow were 23.1 kg/ha and 1.6 fish/m2, respectively (Table 4).

Late summer stream flow was taken on July 8 and was 0.20 m3/sec. However, due to the heavy sampling schedule, actual low flow was not measured and would be less. Annual stream flow variation was extreme. Maximum water temperature was 20 C, approaching the lethal limits for salmonids. Little instream cover for overyearling rainbow-steelhead was identified at this station, 4% of the total area measured. Bank erosion was 15%. The average water velocity was 26 cm/sec, within the optimum range found by Bovee (1978). Average stream width was 3.79 m. Mean water depth was 18 cm, shallower than the optimum range found by Bovee (1978). Cobble embeddedness was approximately 25%, a point at which Bjornn et al (1978) indicates salmonid production can decline.

The major substrate type was gravel, which was smaller than the optimum sizes identified by Bovee (1978). Periphyton coverage was 50%, indicating good productivity. Pool riffle ratio was 30:70, indicating limited holding area for juvenile steelhead. In general, the channel integrity is poor due to inadequate bank structure for the present flow regime (Table 5).

Station #2

The upper reaches of the system support rainbow-steelhead trout, speckled dace paiute sculpin and bridgelip sucker. Estimates of standing crop and density for overyearling rainbow-steelhead were 35.6 kg/ha and 0.6 fish/m2, respectively. Estimates for subyearling rainbow-steelhead were 3.9 kg/ha and 0.2 fish/m2, respectively (Table 4).

Late summer stream flow was 0.05 m3/sec. Annual stream flow variation is extreme. Maximum water temperature was 16 C well below lethal limits for salmonids. Instream cover was 19% of the total area. No seriously eroding banks were seen, 0%. Water velocity was 10 cm/sec, slower than the optimum velocities identified by Bovee (1978). Mean water depth was 15 cm, shallower than the optimum values identified by Bovee (1978). Cobble embeddedness was 25% which can limit salmonid production

(Bjornn et al 1977). The major substrate type was small rubble, which is among the optimum sizes for rainbow-steelhead juveniles (Bovee 1978). Periphyton coverage was 100% indicating good productivity. The pool riffle ratio of 33:67 indicated almost twice as much riffle as pool area. Channel integrity was good, in general, due to cobble and small boulders established in the stream banks (Table 5).

Table 3. Water sample analysis from two stations on Bedrock Creek, tributary of lower Clearwater River Basin, Idaho, 1982, 1983.

Constituent	Station 1 Value	Station 2 Value
Calcium, Ca, mg/l	17.16	14.14
Magnesium, Mg, mg/l	7.35	5.41
Sodium, Na, mg/l	6.29	7.98
Potassium, K, mg/l	2.70	2.84
Chloride, Cl, mg/l	0.06	0.04
Carbonate, CO_3 mg/l	<0.22	0.08
Bicarbonate, HCO_3, mg/l	1.85	1.10
Sulfate, SO_4, mg/l	1.2	1.0
Nitrate, NO_3, mg/l	0.04	0.29
Orthophosphate, PO_4, mg/l	0.09	0.09
Total Residue, mg/l	126.0	148
Non-Filtered Residue, mg/l	1.8	<1
pH	7.8	7.8

Table 4. Fish population statistics for rainbow-steelhead trout on Bedrock Creek, tributary of lower Clearwater River Basin, Idaho, 1982, 1983.

Biological Parameter	Units	Station 1 Value	Station 2 Value
Age 0+ Rainbow-Steelhead			
Density	fish/m^2	1.6	.2
Standing Crop	kg/ha	23.1	3.9
Mean Weight	gm	1.5	1.6
Mean Length (TL-FL)	mm	NA	56-54
Age l+ Rainbow-Steelhead			
Density	fish/m^2	0.2	0.6
Standing Crop	kg/ha	35.6	35.6
Mean Weight	gm	25.0	14.7
Mean Length (TL-FL)	mm	NA-129	122-113

Table 5. Measured physical parameters from two stations on Bedrock Creek, tributary of lower Clearwater River Basin, Idaho, 1982, 1983.

Physical Parameter	Station 1 Value	Station 2 Value
Late Summer Stream Flow (m^3/sec)	0.20	0.05'
Annual Stream Flow Variation	Extreme	Extreme
Maximum Summer Temp. (C)	20	16
Instream Cover (%)	4	19
Eroding Banks (% of banks)	15	0
Water Velocity (cm/sec)	26	10
Stream Width (m)	3.79	3.72
Stream Depth (cm)	18	15
Cobble Embeddedness (%)	25	25
Major Substrate Type	Loose Gravel	Small Rubble
Periphyton Coverage (%)	50	100
Pool Riffle Ratio	30:70	33:66

Big Creek

Big Creek is approximately 10.5 kilometers in length, the lower 5.6 kilometers of which flows within the Nez Perce Reservation. The creek flows in 'a southwesterly direction and enters the Clearwater River at RK 59.2. Tributaries to Big' Creek are **small**, numerous, and generally unnamed. The creek arises in farmland west of Weippe, Idaho and quickly drops into steep canyon terrain for the remainder of its length. Accessibility is extremely limited, except at the origin and the mouth.. Cattle grazing occurs over most of the **stream** bottom, but is accentuated near the mouth and a wide area in the canyon **at** SK 4.8. The predominance of large and **small** boulders indicate extreme high annual flows. As in **most** of these canyons, the south and east facing slopes exhibit a lack of vegetation, which increases the rate of runoff. Riparian vegetation was good the entire length of 'stream, except in those areas where heavy grazing occurs. No chemical limitations to salmonid production were identified by the water quality analysis (Table 6).

One station was established on Big Creek, near SK 0.40. Low summer flow is characterized by an intermittent aquatic habitat in the upper reaches during the summer of 1983.

Rainbow-steelhead and paiute sculpin co-exist in Big Creek. Overyearling rainbow standing crop and density were 26.7 kg/ha and 0.08 fish/m2, respectively, but only one subyearling rainbow trout was captured (Table 7).

Late summer water flow was 0.05 m3/sec, with extreme annual variation. Maximum summer water temperature was 15.6 C, which is below lethal limits for trout. Overyearling rainbow-steelhead cover was 21% of the total stream area. No eroding banks were observed. Water velocity was 9 cm/sec, lower than optimum for rainbow-steelhead juveniles (Bovee 1978). Average stream width was 3.2 m at low flow. Mean water depth was 18 cm, which is shallower than the optimum estimated by Bovee (1978) for these fish. Cobble embeddedness was 50%, indicating probable limitations to salmonid production (Bjornn et al 1977). Large rubble was found to be the most common substrate type, this size was found optimal for juvenile rainbow-steelhead (Bovee 1978). Periphyton coverage was 100% indicating excellent productivity. The pool riffle ratio was 70:30, providing good invertebrate production and abundant cover for overyearling steelhead. The banks were very stable, as they had been scoured in the past to a cobble-boulder marl (Table 8).

Table 6. Water sample analysis from one station on Big Creek, tributary of lower Clearwater River Basin, Idaho, 1983.

Constituent	Station 1 Value
Calcium, Ca, mg/l	0.76
Magnesium, Mg, mg/l	0.55
Sodium, Na, mg/l	0.29
Potassium, K, mg/l	0.06
Chloride, Cl, mg/l	0.07
Carbonate, CO3, mg/l	0
Bicarbonate, HC03, mg/l	1.14
Sulfate, S04, mg/l	3.0
Nitrate, N03, mg/l	2.04
Orthophosphate, P04, mg/l	0.07
Total Residue, mg/l	130
Non-Filtered Residue, mg/l	4
pH	7.8

Table 7. Fish population statistics for rainbow-steelhead trout on Big Creek, tributary of lower Clearwater River Basin, Idaho, 1982, 1983.

Biological Parameter	Units	Station 1 Value
Age 0+ Rainbow-Steelhead		
Density	fish/m^2	0
Standing Crop	kg/ha	0
Mean Weight	gm	0
Mean Length (TL-FL)	mm	0
Age 1+ Rainbow-Steelhead		
Density	fish/m^2	.08
Standing Crop	kg/ha	26.7
Mean Weight	gm	32.91
Mean Length (TL-FL)	mm	151-142

Table 8. Measured physical parameters from one station on Big Creek, tributary of lower Clearwater River Basin, Idaho, 1983.

Physical Parameter	Station 1 Value
Late Summer Stream Flow (m3/sec)	.0'5
Annual Stream Flow Variation	Extreme
Maximum Summer Temp. (C)	15.6
Instream Cover (%)	21
Eroding Banks (% of banks)	0
Water Velocity (cm/sec)	9
Stream Width (m)	3.2
Stream Depth (cm)	18
Cobble Embeddedness (%)	50
Major Substrate Type	Large Rubble
Periphyton Coverage (%)	100
Pool Riffle Ratio	70:30

Butcher Creek

Butcher Creek is about 19.1 kilometers long, 1.9 of which flows within the Nez Perce Reservation. The stream flows in a northeasterly direction and discharges into the South Fork of the Clearwater River at RK 11. Several small tributaries drain the watershed which is comprised mainly of agricultural land and wood lots. The stream flows through a moderately steep canyon from the town of MT. Idaho to the mouth. Cattle grazing occurs over the entire length of the creek, but predominantly in the extreme upper and lower reaches. Riparian vegetation was sparse at the two extremities but dense in the canyon proper. High annual runoff was evident and indications of past flooding were identified in the lower reaches. Logging has occurred in the past throughout the drainage. Water quality parameters measured at summer flow indicate no chemical limitations to salmonid production (Table 9).

Three stations were established on Butcher Creek: station #l at SK 0.4, sampled during the summer 1982; station #2, at SK 7.1, sampled during the summer 1983; and station #3, at SK 18.7 also sampled during summer 1983.

Station #1

Species composition consisted of one juvenile chinook salmon, northern squawfish, redside shiner, bridgelip sucker, specked date and sculpin. No rainbow-steelhead trout were captured (Table 10). Late summer stream flow was 0.07 m3/sec. Annual stream flow variation is extreme and large sized.substrate indicate that the lower reaches are susceptible to high rates of scouring. The maximum summer water temperature during low flow was 22.2 C, which can inhibit salmonid production. Cover for overyearling rainbow-steelhead was 5% of the total area measured. Bank erosion was '11% of the total bank length. Water velocity was 22 cm/sec, within the range of optimum values for overyearling rainbow-steelhead (Bovee 1978). Stream width was 3.11 meters at low flow. Mean water depth was 10 cm, which was below optimum for overyearling rainbow-steelhead (Bovee 1978). Cobble embeddedness was 60%, which can severely limit salmonid production (Bjornn et al 1977). The major substrate type was small rubble, a substrate found optimum by Bovee (1978) for these fish. Periphyton coverage was 60%, indicating good productivity. The pool riffle ratio of 10:90 indicates large riffle areas which would benefit invertebrate production but limit habitat for overyearling steelhead trout. Channel integrity was relatively stable, as the banks had been scoured to rubble and small boulders in the past (Table 11).

Station #2

Only speckled dace and rainbow-steelhead trout were captured at this station. The estimated standing crop of overyearling rainbow-steelhead trout was 23.1 kg/ha, with a density of 0.06 fish/m2. No subyearling rainbow-steelhead were captured (Table 10).

Late summer stream flow was calculated to be 0.06 m3/sec, with moderate annual variation in flow. The maximum water temperature during low flow was 16.7 C, well within the lethal limit of salmonids. Instream cover was 11% of the total area surveyed and eroding banks were 29% of the total length. The mean water velocity was 16 cm/sec, near optimum for juvenile rainbow-steelhead (Bovee 1978); The average stream width was 2.19 m during the low flow. Mean stream depth was 5 cm, a depth which Bovee (1978) identified to be less than optimal. Cobble embeddedness was 25%, which could be limiting to salmonid production (Bjornn et al 1977). The major substrate was large rubble which was identified by Bovee (1978) as optimal for rainbow-steelhead juveniles. Periphyton coverage was 80%, indicated good productivity. The pool riffle ratio of 10:90 indicates a lack of holding area for overyearling rainbow-steelhead. The general stability of the channel and the stream banks was fair (Table 11).

Station #3

Rainbow-steelhead and speckled dace were captured at this station. The estimated standing crop of overyearling rainbow-steelhead was 2.0 kg/ha, with a density of 0.01 fish/m2. No subyearling rainbow-steelhead were captured (Table 10).

The late summer stream flow was 0.06 m3/sec, with moderate variation in annual flow. The maximum stream temperature was 20.5 C, approaching the maximum lethal limit for salmonid production. Instream cover for overyearling rainbow-steelhead was 4% and 44% of the toal stream banks showed signs of erosion.

Mean water velocity was 32 cm/sec, an optimum velocity for juvenile rainbow-steelhead (Bovee 1978). The mean stream width at low flow was 1.88 m. Mean stream depth was 11 cm, which is below optimum for these fish (Bovee 1978). Cobble embeddedness was 25% which should not limit salmonid production (Bjornn et al 1977). The major substrate identified was small rubble, which is near optimum for juvenile rainbow-steelhead (Bovee 1978). Periphyton coverage was 50%, indicating good productivity. The pool riffle of 20:80 indicates a lack of holding area for overyearling steelhead trout. The overall bank and stream channel stability was good in the upper reaches of the stream (Table 11).

Table 9. Water sample analysis from three stations on Butcher Creek, tributary of S.F. Clearwater River Basin, Idaho, 1982, 1983.

Constituent	Station 1 Value	Station 2 Value	Station 3 Value
Calcium, Ca, mg/l	18.5	18.52	9.50
Magnesium, Mg, mg/l	8.6	7.25	3.30
Sodium, Na, mg/l	9.7	11.91	3.31
Potassium, K, mg/l	3.9	3.98	1.65
Chloride, Cl, mg/l	0.05	0.09	0.16
Carbonate, C03, mg/l	<0.22	0.33	NIL
Bicarbonate, HC03, mg/l	2.07	1.38	1.14
Sulfate, S04, mg/l	2.4	2	3
Nitrate, N03, mg/l	0.18	0.14	0.01
Orthophosphate, P04, mg/l	0.12	0.11	0.12
Total Residue, mg/l	236.6	250	124
Non-Filtered Residue, mg/l	21.2	3	18
pH	7.4	7.76	8.08

Table 10. Fish population statistics for rainbow-steelhead trout on Butcher Creek, tributary of S.F. Clearwater River Basin, Idaho, 1982, 1983.

Biological Parameter	Units	Station 1 Value	Station 2 Value	Station 3 Value
Age 0+ Rainbow-Steelhead				
Density	fish/m^2	0	0	0
Standing Crop	kg/ha	0	0	0
Mean Weight	gm	0	0	0
Mean Length (TL-FL)	mm	0	0	0
Age l+ Rainbow-Steelhead				
Density	fish/m^2	0	0.06	0.01
Standing Crop	kg/ha	0	23.1	2.0
Mean Weight	gm	0	37	22
Mean Length (TL-FL)	mm	0	55-146	122-115

Table 11. Measured physical parameters from three stations on Butcher Creek, tributary of S.F. Clearwater River Basin, Idaho, 1982, 1983.

Physical Parameter	Station 1 Value	Station 2 Value	Station 3 Value
Late Summer Stream Flow (m3/sec)	0.07	4.06	0.06
Annual Stream Flow Variation	Extreme	Moderate	Moderate
Maximum Summer Temp. (C)	22.2	16.7	20.5
Instream Cover (%)	5	11	4
Eroding Banks (% of banks)	11	29	44
Water Velocity (cm/sec)	22	16	32
Stream Width (m)	3.11	2.19	1.88
Stream Depth (cm)	10	15	11
Cobble Embeddedness (%)	60	25	25
Major Substrate Type	Small Rubble	Small Rubble	Small Rubble
Periphyton Coverage (%)	60	80	50
Pool Riffle Ratio	10:90	10:90	20:80

Catholic Creek

Catholic Creek is approximately 16.1 kilometers long, of which 14.5 kilometers are within the Nez Perce Reservation. The stream arises in farmland east of Genesee, Idaho and flows southeasterly for 9.7 kilometers through. a moderately steep walled canyon to its confluence with the Clearwater River at RK 18.5. The lower two miles of the canyon is relatively wide and is utilized for various ranching activities. Riparian vegetation is scarse in the upper and lower reaches of the creek where agricultural activities are most intense, but relatively dense in the canyon reach. Approximately 0.4 KM upstream from the mouth the stream flows through a cattle feed lot which is used during the winter months. Water quality analysis indicated no chemical limitations to salmonid production (Table 12).

Two stations were established on Catholic Creek: station #l at SK 0.40 and station #2 at SK 1.9, both sampled during summer 1983.

Station #l

Speckled date, redside shiner and rainbow-steelhead trout were captured at station #l. One subyearling steelhead was found but a population estimate was not made. Overyearling steelhead standing crop and density were 13.3 kg/ha and 0.03 fish/m2, respectively (Table 13)

Late summer stream flow was 0.08 m3/sec, with a moderate annual variation. Occasional flooding has occurred, although it doesn't seem to be a perennial occurrence. Maximum water temperature was 20 C, which is approaching the upper lethal limits for salmonids. Instream cover for rainbow-steelhead juveniles was 45% of the total area surveyed. This cover was mostly annual grasses, which would be absent during the winter months. Forty percent of the stream banks were eroding, indicating an unstable environment.Mean water velocity was 25 cm/sec, which is within the optimum range for steelhead juveniles (Bovee 1978). The stream width was 2.7 m at low summer flow. Mean water depth was.11 cm, below the optimum range for steelhead juveniles (Bovee 1978). Cobble embeddedness was 253, a value approaching a point which could limit salmonid production (Bjornn et al 1977). The major substrate type was small rubble, which is within the optimum size range for rainbow-steelhead juveniles (Bovee 1978). Periphyton coverage was 60%, indicating good productivity. The pool riffle ratio was 10:90, revealing a lack of holding area for juvenile steelhead. Channel stability was poor, as the banks consisted of gravel and sand (Table 14).

Station #2

Rainbow-steelhead trout and speckled dace were the only species captured at this station. Standing crop and density estimates for overyearling rainbow-steelhead were 6.2 kg/ha and 0.01 fish/ha, respectively. Subyearling estimates were 0.29 kg/ha and 0.7 fish/m2, respectively (Table 13).

Late summer flow was 0.05 m3/sec, with moderate annual variation.

Maximum water temperature during low flow was 15.5 C, within the lethal limits to salmonid production. Three percent of the total area surveyed contained cover suitable to juvenile steelhead. Mean stream width was 2.3 m at low summer stream flow. Average stream depth was 28 cm, which is close to optimum for juvenile steelhead rearing (Bovee 1978). Cobble embeddedness was 15%, which is probably not limiting to salmonid production (Bjornn et al 1977). The major substrate type was small rubble, which is among the optimum sizes for juvenile rainbow-steelhead identified by Bovee (1978). Periphyton covered 80% of the substrate, indicating good productivity. The pool riffle ratio was 10:90, and does not provide adequate cover for juvenile steelhead. Channel integrity was not good at this location (Table 14).

Table 12. Water sample analysis from two stations on Catholic Creek, tributary of lower Clearwater River Basin, Idaho, 1983.

Constituent	Station 1 Value	Station 2 Value
Calcium, Ca, mg/l	31.16	31.35
Magnesium, Mg, mg/l	11.67	11.61
Sodium, Na, mg/l	16.92	17.48
Potassium, K, mg/l	3.73	3.26
Chloride, C1, mg/l	0.07	0.07
Carbonate, C03, mg/l	0.33	0.24
Bicarbonate, HC03, mg/l	2.60	2.65
Sulfate, S04, mg/l	2.0	3.0
Nitrate, NO3, mg/l	0.84	0.97
Orthophosphate, P04, mg/l	0.25	0.22
Total Residue, mg/l	248	214
Non-Filtered Residue, mg/l	34	7
pH	8.3	8.7

Table 13. Fish population statistics for rainbow-steelhead trout on Catholic Creek, tributary of lower Clearwater River Basin, Idaho, 1982.

Biological Parameter	Units	Station 1 Value	Station 2 Value
Age 0+ Rainbow-Steelhead			
Density	fish/m^2	0	8.7
Standing Crop	kg/ha	0	.29
Mean Weight	gm	0	4
Mean Length (TL-FL)	mm	0	77-74
Age 1+ Rainbow-Steelhead			
Density	fish/m^2	0.03	0.01
Standing Crop	kg/ha	13.3	6.2
Mean Weight	gm	43.6	43.5
Mean Length (TL-FL)	mm	155-147	170-158

Table 14. Measured physical parameters from two stations on Catholic Creek, tributary of lower Clearwater River Basin, Idaho, 1983.

Physical Parameter	Station 1 Value	Station 2 Value
Late Summer Stream Flow (m3/sec)	.08	.05
Annual Stream Flow Variation	Extreme	Extreme
Maximum Summer Temp. (C)	20	15.5
Instream Cover (%)	45	3
Eroding Banks (% of banks)	40	42
Water Velocity (cm/sec)	25	22
Stream Width (m)	2.7	2.34
Stream Depth (cm)	11	28
Cobble Embeddedness (%)	25	15
Major Substrate Type	Small Rubble	Small Rubble
Periphyton Coverage (%)	60	80
Pool Riffle Ratio	10:90	10:90

Corral Creek

Corral Creek is a small, south flowing tributary of the mainstem Clearwater River, located west of Kamiah, Idaho, and is not named on area maps. The stream arises'in farmland wood lot habitat. Two major forks, one flowing through Idaho State land and the other through Nez Perce Tribal land, converge and flow approximately 1.6 kilometers to the Clearwater River. Access to the lower stream is through private land or railroad easement. Riparian overstory is present throughout the drainage although understory is lacking in the lower reaches due to high spring runoff. Water quality analysis indicate no limiting factors to salmonid production (Table 15). One station was established at SK 1.2 'during summer 1983.

The standing crop estimate for overyearling rainbow was 5.2 kg/ha, with a density of 0.03 fish/m2. One underyearling rainbow was captured. Sculpins and speckled dace were plentiful at this station (Table 16).

Late summer stream flow was 0.04 m3/sec, and annual stream flow variation is moderate with indications of some past flooding. The maximum summer water temperature was 20 C, which is approaching lethal limits for salmonids. Instream cover for overyearling rainbow-steelhead trout was 12% of the total stream area. No eroding banks were identified. Average water velocity was 12 cm/sec, a value found to be near optimum for rainbow-steelhead juveniles (Bovee 1978). Mean stream width was 2.68 meters at low flow. Mean water depth was 13 cm, which is shallower than optimal for rainbow-steelhead juveniles (Bovee 1978). Cobble embeddedness was zero, indicating negligable sedimentation. The major substrate was small rubble, which is optimal for juvenile rainbow-steelhead trout (Bovee 1978). Periphyton coverage was rated 100% indicating good productivity. The pool riffle ratio was 30:70, indicated a lack of pool habitat for steelhead. The stream channel was relatively stable due to banks aonsisting of large cobble, small boulders, and organic debris (Table 17).

Table 15. Water sample analysis from one station on Corral Creek, tributary of lower Clearwater River Basin, Idaho, 1983.

Constituent	Station 1 Value
Calcium, Ca, mg/l	0.88
Magnesium, Mg, mg/l	0.52
Sodium, Na, mg/l	Q.34
Potassium, K, mg/l	0.10
Chloride, Cl, mg/l	0.11
Carbonate, C03, mg/l	
Bicarbonate, HC03, mg/l	1.43
Sulfate, S04, mg/l	2.0
Nitrate, N03, mg/l	0.64
Orthophosphate, P04, mg/l	0.07
Total Residue, mg/l	114
Non-Filtered Residue, mg/l	22
pH	8.1

Table 16. Fish population statistics for rainbow-steelhead trout on Corral Creek, tributary of lower Clearwater River Basin, Idaho, 1983.

Biological Parameter	Units	Station 1 Value
Age 0+ Rainbow-Steelhead		
Density	$fish/m^2$	0
Standing Crop	kg/ha	0
Mean Weight	gm	0
Mean Length (TL-FL)	mm	0
Age 1+ Rainbow-Steelhead		
Density	$fish/m^2$	.03
Standing Crop	kg/ha	5.2
Mean Weight	gm	20.9
Mean Length (TL-FL)	mm	136-129

Table 17. Measured physical parameters from one station on Corral Creek, tributary of lower Clearwater River Basin, Idaho, 1983.

Physical Parameter	Station 1 Value
Late Summer Stream Flow (m3/sec)	0.04
Annual Stream Flow Variation	Moderate
Maximum Summer Temp. (C)	20
Instream Cover (%)	12
Eroding Banks (% of banks)	0
Water Velocity (cm/sec)	12
Stream Width (m)	2.68
Stream Depth (cm)	13
Cobble Embeddedness (%)	0
Major Substrate Type	Small Rubble
Periphyton Coverage	100%
Pool Riffle Ratio	30:70

Cottonwood Creek

Cottonwood Creek (Idaho County) is 25.7 kilometers long and originates near Cottonwood, Idaho on the Camas prairie. The stream flows easterly and enters the South Fork of the Clearwater River at RK 9.7. The major tributaries are Redrock Creek, Shebang Creek, and South Fork Cottonwood Creek. Constant flow during August was identified beginning about 12.9 kilometers east of Cottonwood,Idaho. Heavy farming and grazing has taken place on these tributaries resulting in a severe lack of riparian vegetation and bank erosion. The majority of these tributaries receive heavy silt deposition. From the point identified with summer flow, the stream begins to descend through additional pasture land, which has better developed riparian areas and slightly less silt deposition. The stream then plunges into a steep bouldered canyon, dominated by deep pools. The riparian zone improves as the stream enters the canyon. Approximately 1.2 kilometers upstream from the lower end of this canyon is a sheer 9.1 meter falls (SK) precluding upstream movement of any fish. Below this canyon the stream flows into a heavily grazed, open, flat bottomed basin. From this point to the confluence with the South Fork Clearwater River, the channel is braided and/or channelized. Riparian vegetation is lacking throughout the lower system. Water quality analysis indicates no chemical 1 im-itations to salmonid production (Table 18).

Two stations were established on Cottonwood Creek: station #1 was located at SK 1.6 and station #2, located at SK 9.6.

Station #l

Redside shiners, speckled dace, sculpin, bridgelip sucker, northern squawfish and chiselmouth were found and no salmonids were captured at this 'location (Table 19).

Late summer flow was 0.7 m3/sec and signs indicated extreme annual variation in flow and frequent flooding. Maximum s'ummer water temperature was 21.1 c, which can limit salmonid production. Twelve percent of the total area surveyed provided cover for juvenile rainbow-steelhead. All of the banks were eroding, adding silt to the system. Mean water velocity was 52 cm/sec, an optimum value for juvenile rainbow-steelhead (Bovee 1978). Stream width was 10.1 m at low summer flow. Mean stream depth was 14 cm, shallower than optimum for rainbow-steelhead juveniles (Bovee 1978). Cobble embeddedness was 25%, probably not limiting to salmonid production (Bjornn et al 1977). The major substrate was large cobble, a size optimum for juvenile rainbow-steelhead (Bovee 1978). Periphyton covered 90% of the substrate, indicating good productivity. The pool riffle ratio of 0:100 indicated a severe lack of pool habitat and holding areas for overyearling rainbow-steelhead. The stream channel stability in this area was very poor (Table 20).

Station #2

No salmonids were captured at this station,however redside shiners were abundant (Table 19).

The late summer stream flow was 0.22 m3/sec and annual flow variation was moderate with occasional flooding, as seen, by the dry side channels. Maximum water temperature was 16.1 C, well within the lethal limits for salmonid fishes. Instream cover for juvenile rainbow-steel'head was identified as 6% of the area surveyed. Practically all of the stream banks were eroding, indicating a significant source of sedimentation. Mean water velocity was 25 cm/sec, below the optimum for rainbow-steelhead juveniles (Bovee 1978). Average stream width was 4.7 m at low summer stream flow. Mean water depth was 22 cm, below the optimum for juvenile rainbow-steelhead (Bovee 1978). Cobble embeddedness was 25%, which should not limit salmonid production (Bjornn et al 1977). The major substrate was small boulder, which is an optimum size for rainbow-steelhead juveniles (Bovee 1978). Periphyton coverage was 100% indicating good productivity. The pool riffle ratio was 30:70, indicating a lack of pool habitat. Stream channel stability in this area was poor due to a bank composition of loose soil with intermittent boulders (Table 20).

Table 18. Water sample analysis from three stations on Cottonwood Creek, tributary of S.F. Clearwater River Basin, Idaho, 1982, 1983.

Constituent	Station 1 Value	Station 2 Value
Calcium, Ca, mg/l	32.11	31.21
Magnesium, Mg, mg/l	11.82	10.97
Sodium, Na, mg/l	22.66	23.91
Potassium, K, mg/l	3.54	3.74
Chloride, Cl, mg/l	0.24	0.21
Carbonate, C03, mg/l	0.49	0.57
Bicarbonate, HC03, mg/l	3.17	1.67
Sulfate, S04, mg/l	4.0	4.0
Nitrate, N03, mg/l	0.01	0.71
Orthophosphate, P04, mg/l	0.36	0.29
Total Residue, mg/l	230	256
Non-Filtered Residue, mg/l	45	52
pH	8.4	8.4

Table 19. Fish population statistics for rainbow-steelhead trout on Cottonwood Creek, tributary of S.F. Clearwater River Basin Idaho, 1983.

Biological Parameter	Units	Station 1 Value	Station 2 Value
Age 0+ Rainbow-Steelhead,			
Density	fish/m^2	0	0
Standing Crop	kg/ha	0	.0
Mean Weight	gm	0	0
Mean Length (TL-FL)	mm	0	0
Age l+ Rainbow-Steelhead			
Density	fish/m^2	0	0
Standing Crop	kg/ha	0	0
Mean Weight	gm	0	0
Mean Length (TL-FL)	mm	0	0

Table 20. Measured physical parameters from two stations on Cottonwood Creek, tributary of S.F. Clearwater River Basin, Idaho, 1983.

Physical Parameter	Station 1 Value	Station 2 Value
Late Summer Stream Flow (m3/sec)	0.70	0.22
Annual Stream Flow Variation	Extreme	Moderate
Maximum Summer Temp. (C)	21.1	16.1
Instream Cover (%)	12	6
Eroding Banks (% of banks)	100'	83
Water Velocity (cm/sec)	52	25
Stream Width (m)	10.1	4.7
Stream Depth (cm)	14	22
Cobble Embeddedness (%)	25	25
Major Substrate Type	Large Cobble	Small Boulder
Periphyton Coverage (%)	90	100
Pool Riffle Ratio	0:100	30:70

Jim Ford Creek

Jim Ford Creek flows for 38.6 kilometers, the lower 5.15 kilometers flow through the Nez Perce Reservation. The stream -flows southwesterly and enters the mainstem Clearwater River at RK 54.9. The stream originates northeast of Weippe, Idaho. The watershed consists of many intermittent tributaries with minimal riparian vegetation. Major tributaries of Jim Ford Creek are Meadow Creek, Snake Meadow Creek, Winter Creek, and Grasshopper Creek. From Weippe, the stream drops into a very steep canyon with very little access for approximately six miles. It then plunges over a sheer, 19.8 m falls, preventing any upstream migration. From this point to the mouth, the canyon broadens and is used for light grazing activity. Side channels and large substrate indicate yearly flooding. The riparian zone does not generally shade the stream at low flow due to the shallow, wide nature of the stream. Heavy periphyton growth was observed in the lower section of the stream, which may indicate organic pollution. The stream also has bacterial, turbidity, and iron levels which were found to exceed recommended criteria (Idaho Dept. of Health and Welfare 1980b). The city of Weippe and Timberline High School both discharge effluent into the drainage (Kucera et al 1983). Water quality analysis indicated no limiting factors to salmonid production (Table 21).

Two stations were established on Jim Ford Creek below the falls: station #l, located at SK 1.3 was surveyed during summer 1982;

and station #2, located at SK 17.7 was surveyed during the summer of 1983.

Station #l

Fish population surveys showed the presence of rainbow-steelhead trout, smallmouth bass, northern squawfish, chiselmouth, bridgelip sucker, sculpin and dace. Standing crop of overyearling rainbow-steelhead was 3.5 kg/ha, with a density of 0.02 fish/ha. Subyearling steelhead were captured in small numbers but not included in the calculations (Table 22).

Late summer stream flow was 0.4 m3/sec, with moderate variation in annual flow. Maximum water temperature was 27.8 C, which exceeds the lethal limits for trout production. Instream cover was 8% of the area surveyed. Eroding banks were minimal, with only 7.8% affected. Mean water velocity was 22.1 cm/sec, which is slightly lower than optimum for juvenile rainbow-steelhead (Bovee 1978). Stream width was 6.9 m at low flow. Stream depth averaged 23 cm, which is slightly lower than that most preferred by juvenile rainbow-steelhead (Bovee 1978). Cobble embeddedness was 40%, which may limit salmonid production (Bjornn et al 1977). The major substrate was large rubble, which is among the most preferred by juvenile steelhead (Bjornn et al 1977). The periphyton coverage of 80% indicated good primary production. The pool riffle ratio of 30:70 indicated some limited pool habitat and a majority of riffle area which are not condusive to juvenile steelhead rearing. Stream banks in this section were moderately stable and held together by large cobble and boulder (Table 23).

Station #2

Longnose dace, speckled dace and both are groups of rainbow-steelhead were captured at station #2. Estimated standing crop of overyearling rainbow-steelhead was 21.8 kg/ha, with a density of 0.07 fish/m2. Estimated subyearling standing crop was 9.6 kg/ha, with a density of 0.43 fish/m2 (Table 22).

Late summer stream flow was 0.3 m3/sec, with moderate variation in annual stream flow. Maximum water temperature recorded during low flow was 16.1 C, which is within the lethal limits for salmonid production. Thirty percent of the total stream area provided cover for juvenile rainbow-steelhead. No eroding stream banks were observed. Mean water velocity was 25 cm/sec, within the optimum range for juvenile steelhead trout (Bovee 1978). Stream width was 7.9 m at low flow. Average stream depth was 13 cm, which is below the optimum range for juvenile rainbow-stee'lhead (Bovee 1978). Cobble embeddedness was 0%, indicating no limitations to salmonid production by sedimentation (Bjornn et al 1977). The major substrate was a combination of small boulder and large cobble which is within the optimum size range for juvenile steelhead trout (Bovee 1978). Periphyton coverage was 100% indicating good productivity. The pool riffle ratio was 5:95, which indicated a lack of suitable pool habitat for juvenile rainbow-steelhead. Stream channel integrity was good at low flow, although at high flow the banks are unstable due to an abundance of loose soil with little infrastructure (Table 23).

Table 21. Water sample analysis from one station on Jim Ford Creek, tributary of lower Clearwater River Basin, Idaho, 1982.

Constituent	Station 1 Value	Station 2 Value
Calcium, Ca, mg/l	10.6	8.8
Magnesium, Mg, mg/l	4.2	3.5
Sodium, Na, mg/l	5.2	5.2
Potassium, K, mg/l	2.2	2.2
Chloride, Cl, mg/l	<0.01	0.04
Carbonate, C03, mg/l	<0.22	0
Bicarbonate, HC03, mg/l	2.98	0.73
Sulfate, S04, mg/l	2.6	1.0
Nitrate, N03, mg/l	0.15	0.05
Orthophosphate, P04, mg/l	0.16	<0.0l
Total Residue, mg/l	206	152
Non-Filtered Residue, mg/l	6	<l
pH	7.5	8.1

Table 22. Fish population statistics for rainbow-steelhead trout on Jim Ford Creek, tributary of lower Clearwater River Basin, Idaho, 1983.

Biological Parameter	Units	Station 1 Value	Station 2 Value
Age 0+ Rainbow-Steelhead			
Density	fish/m^2	0	0.43
Standing Crop	kg/ha	0	9.6
Mean Weight	gm	0	2.23
Mean Length (TL-FL)	mm	0	64-61
Age 1+ Rainbow-Steelhead			
Density	fish/m^2	0.02	0.07
Standing Crop	kg/ha	3.5	21.8
Mean Weight	gm	22	32
Mean Length (TL-FL)	mm	NA-133	138-130

Table 23. Measured physical parameters from two stations on Jim Ford Creek, tributary of lower Clearwater River Basin, Idaho, 1983.

Physical Parameter	Station 1 Value	Station 2 Value
Late Summer Stream Flow (m3/sec)	0.4	0.3
Annual Stream Flow Variation	Moderate	Moderate
Maximum Summer Temp. (C)	27.8	16.1
Instream Cover (%)	8	30
Eroding Banks (% of banks)	7.8	0
Water Velocity (cm/sec)	22.1	25
Stream Width (m)	6.9	7.9
Stream Depth (cm)	23	13
Cobble Embeddedness (%)	40	0
Major Substrate Type	Large Rubble	Small Boulder
Periphyton Coverage (%)	80	100
Pool Riffle Ratio	30:70	5:95

Lawyers Creek

The following information is a description of the source of Lawyers Creek, not surveyed by Kucera et al (1983). The data collected at this station does not affect or modify the findings and recommendations of Kucera and will be reported hereas an appendurn.

The headwaters of Lawyers Creek, during summer low flow, was a spring located at SK 67.6. This water source is impounded adjacent to the spring proper and used for stock watering. Water overflowing from this pond forms Lawyers Creek. The stock pond has been planted with resident rainbow trout which have moved out of the pond and into the stream in the past. The stream flows through pastureland and riparian vegetation is lacking. Water quality analysis indicated no limiting factors to salmonid production (Table 24).

Speckled dace as well as rainbow trout were captured at this station. Estimated standing crop of overyearling rainbow trout was 91.0 kg/ha, with a density of 0.3 fish/m2. The estimated standing crop for subyearling rainbow trout was 0.7 kg/ha, with a density of 0.1 fish/m2 (Table 25).

Late summer stream flow was 0.01 m3/sec, with very little annual variation in flow. Maximum water temperature was 15.5 C, nearly optimal for salmonid production. Instream cover for juvenile rainbow-steelhead was 41% of the area surveyed. Forty percent of the total stream banks were eroding. Average water velocity was too low to record, which is well below the preferred range of rainbow-steelhead trout (Bovee 1978). Stream width during low flow averaged 2.0 m. Mean stream depth was 14 cm, below the optimum range for juvenile rainbow-steelhead (Bovee 1978). Cobble embeddedness was 50%, indicating a siltation problem which could reduce salmonid production (Bjornn et al 1977). The major substrate was sand, which is below optimum for rainbow-steelhead juveniles (Bovee 1978). Periphyton covered 60% of the substrate, indicating good productivity. The pool riffle ratio was 80:20, indicating an abundance of juvenile steelhead cover but possibly limiting invertebrate production. In general, the stream channel is not stable. The top soil is about two feet deep and subject to erosion, accentuated by the lack of riparian vegetation (Table 26).

Table 24. Water sample analysis from one station on Lawyers Creek, tributary of lower Clearwater River Basin, Idaho, 1983.

Constituent	Station: Headwaters Value
Calcium, Ca, mg/l	14.50
Magnesium, Mg, mg/l	4.22
Sodium, Na, mg/l	5.22
Potassium, K, mg/l	'2.25
Chloride, Cl, mg/l	0.09
Carbonate, C03, mg/l	
Bicarbonate, HC03, mg/l	1.10
Sulfate, S04, mg/l	2.0
Nitrate, N03, mg/l	0.02
Orthophosphate, P04, mg/l	0.05
Total Residue, mg/l	190
Non-Filtered Residue, mg/l	1.0
pH	7.72

Table 25. Fish population statistics for rainbow-steelhead trout on Lawyers Creek, Lower Clearwater River Basin, Idaho, 1983.

Biological Parameter	Units	Station 1 Value
Age 0+ Rainbow-Steelhead		
Density	$fish/m^2$	0.1
Standing Crop	kg/ha	0.7
Mean Weight	gm	1.0
Mean Length (TL-FL)	mm	53-52
Age 1+ Rainbow-Steelhead		
Density	$fish/m^2$	0.3
Standing Crop	kg/ha	91.0
Mean Weight	gm	27.15
Mean Length (TL-FL)	mm	140-133

Table 26. Measured physical parameters from one station on Lawyers Creek, tributary of Lower Clearwater River Basin, Idaho, 1983.

Physical Parameter	Station: Headwaters — Value
Late Summer Stream Flow (m3/sec)	.Ol
Annual Stream Flow Variation	Small
Maximum Summer Temp. (C)	15.5
Instream Cover (%)	42
Eroding Banks (% of banks)	40
Water Velocity (cm/sec)	0
Stream Width (m)	2.0
Stream Depth (cm)	14
Cobble Embeddedness (%)	50
Major Substrate Type	Sand
Periphyton Coverage (%)	60
Pool Riffle Ratio	80:20

Lolo Creek System

Lolo Creek is approximately 67.1 kilometers in length. The stream originates in the Clearwater National Forest, southeast of Weippe, Idaho, and flows westerly to its confluence with the Clearwater River near Greer, Idaho. The watershed includes approximately 196 kilometers of streams on and off the Clearwater National Forest. Major tributaries to Lolo Creek are Yakus, Eldorado, Musselshell, Browns, and Yoosa Creeks. The system isatypical, in respect to the other 'streams in this report. Differences include its large size, granitic watershed influence, diversity of habitat, and dominant affects of logging. In addition, Lolo Creek has an elevation loss of 1200 meters, originating at 1597 meters and dropping to 396 meters at the confluence with the Clearwater River (Espinosa 1975).

Erosion from road construction has been identified as the major contributor of sediment to the stream system (Espinosa 1975). Generally, roads follow portions of all streams at stream level or on directly adjacent slopes. In addition to the sedimentation originating from roads, several mining claims contribute to both sedimentation and degradation of stream channel integrity on upper Lolo Creek.

Lolo Creek

Lolo Creek is approximately 67.1 kilometers in length, 37.6 kilometers of which are within the Clearwater National Forest. The stream within the forest can be characterized by granitic substrate, cedar, yellow pine, grand fir, hemlock forest, a willow alder riparian belt, and a medium gradient with intermittent cascades. Logging on this stream has occurred since the late 1930's (Space 1964). Both old deteriorating roads and well maintained roads parallel the entire stream channel. That portion of stream flowing from the forest boundary to the Clearwater River has a lower gradient and is influenced by deep canyon terrain and semi arid watershed. Sections of this canyon widen, which are occupied by small farms and provide possible salmonid spawning areas. Access to this region is difficult, and is restricted to a few deteriorating private roads. Water quality analysis did not identify any limiting factors to salmonid production (Tables 27a, 27b).

Seven stations were established on mainstem Lolo Creek: station #1, located at SK 0.8; station #2, located at SK 25.7 near a bridge crossing; station #3, located at SK 43.4, just below the National Forest boundary; station #4, located at SK 49.8, above the confluence of Musselshell Creek; stations #5 & #6, located in tandem, at SK 57.8 prior to instream improvements by forest service personnel; and station #7, located at SK 62.6 below the mouth of Yoosa Creek.

Station #1

Fish species composition included rainbow-steelhead trout, chinook salmon, smallmouth bass, northern squawfish, chiselmouth, redside shiner, long nose dace, speckled dace sculpin, and possibly Pacific lamprey, (Entosthenus tritatus) ammocoetes. Insufficient numbers of individual fish species were collected to generate population estimates (Table 28a).

Late summer stream flow was 4.4 m3/sec, with moderate annual variation in stream flow. The maximum water temperature during summer low flow was 21.7 C, approaching lethal limits for salmonid production. Instream cover for overyearling salmonids was 28% and bank erosion was 11.1% of the habitat measured. Mean water velocity was 65 cm/sec, above the optimum values for rainbow-steelhead juveniles (Bovee 1978). The average stream width during summer low flow was 11.2 m. Mean water depth was 60 cm, deeper optimum values for rainbow-steelhead juveniles (Bovee 1978). Cobble embeddedness was 60%, which can severely limit salmonid production (Bjornn et al 1977).

The major substrate identified was large rubble, an optimum size for rainbow-steelhead juveniles (Bovee 1978). Periphyton coverage of the substrate was 50%, indicating moderate productivity. The estimated pool riffle ratio of 35:65 indicated a lack of pool habitat. In general, the stability of the lower Lolo Creek channel is very good due to large substrate, large, well established riparian vegetation, and a constricted canyon environment (Table 29a).

Station #2

Fish species observed included juvenile rainbow-steelhead trout, mountain whitefish, bridgelip suckers, longnose dace, speckled dace, and sculpins. One underyearling steelhead was seen and, due to the uneveness of the substrate which made counting of small fish difficult, a population count was not done. Overyearling steelhead density was 0.2 fish/m2 with a standing crop estimate of 3.20 kg/ha. Nineteen overyearling whitefish were counted at this station (Table 28a).

Late summer stream flow was 4.1 m3/sec, with moderate variation in annual stream flow, Maximum water temperature during summer low flow was 16 C, well below the lethal limits for salmonid production. Instream cover for juvenile salmonids was 26% of available habitat. There were no eroding stream banks. Mean water velocity was 65 cm/sec, slightly above the optimum values identified by Bovee (1978). The average stream width was 11.8 m. Mean water depth was 53 cm, slightly above optimum values (Bovee 19783. Cobble embeddedness was 25%, which approach levels which can limit salmonid production (Bjornn et al 1977). The major substrate was large rubble, an optimum size for juvenile rainbow-steelhead (Bovee 1978). Periphyton coverage was 40%; indicating moderate productivity. The pool riffle ratio 30:70 indicated a lack of pool habitat and holding areas for juvenile steelhead. General channel stability was good with the exception of fill associated with bridge construction (Table 29a).

Station #3

Rainbow-steelhead trout and mountain whitefish were collected at this station. Subyearling rainbow-steelhead numbers were negligible. Standing crop of overyearling rainbow-steelhead was 0.62 kg/ha, with a density'of .004 fish/m2 (Table 28a). Mountain whitefish was the dominant species in terms of biomass and numbers.

Late summer stream flow was 4.3 m3/sec, with moderate annual variation in flow. The maximum water temperature during low flow was 21 C, approaching the lethal limits for salmonid production. Instream cover for juvenile rainbow-steelhead was 8% of the total area surveyed. No bank erosion was identified in this area. Mean water velocity was 58 cm/sec, slightly above the optimum values determined by Bovee (1978). Average stream width was 18.7 m during low summer flow. Mean water depth was 49 cm, an optimum value for juvenile rainbow-steelhead (Bovee 1978). Cobble embeddedness was 75%, which can be a limiting factor to salmonid production (Bjornn et al 1977). The major substrate identified was sand, a size considerably smaller than optimum for rainbow-steelhead (Bovee 1978). Periphyton coverage was 100% indicating excellent productivity. The estimated pool riffle ratio was 30:70, indicating a lack of pool habitat. Stream channel stability was good, due to the presence of bedrock in the stream banks. Adjacent to the station, however, a widening of the canyon enabled peak flow to scour a small floodplain (Table 29a).

Station #4

Fish species collected included rainbow-steelhead trout, chinook salmon, and speckled dace. Standing crops of subyearling and overyearling rainbow-steelhead trout were 0.93 and 2.9 kg/ha, respectively, with densities of 0.03 and 0.2 fish/m2 (Table 28b). Standing crops of subyearling and overyearling chinook salmon were 3.1 and 12.2 kg/ha, respectively. Densities were 0.9 and 0.5 fish/m2 for subyearling and overyearling, respectively.

Late summer stream flow was 1.3 m3/sec, with moderate annual variation in stream flow. Maximum water temperature during low flow was 18 C. Instream cover for juvenile rainbow-steelhead was 21% of the available area. Bank erosion was 23% of stream bank surveyed. Mean water velocity was 85 cm/sec, well above optimum values (Bovee 1978). Average stream width during low summer flow was 6.9m. Mean water depth was 22 cm, slightly below the optimum values identified by Bovee (1978). Estimated cobble embeddedness was 20%, below levels which can inhibit salmonid production (Bjornn et al 1977). The major substrate was small rubble,an optimum size for rainbow-steelhead juveniles (Bovee 1978). Periphyton coverage of the substrate was 100% indicating excellent productivity. The pool riffle ratio was 40:60, indicating a lack of pool habitat. Stream channel integrity was good due to well established **small** and large woody riparian vegetation and large woody debris (Table 29b).

Station #5

Rainbow-steelhead trout was the only species observed at this station. Subyearling standing crop was 3.0 kg/ha, and overyearling standing crop was 22.2 kg/ha. Density estimates for subyearling and overyearling trout were 0.27 and 0.13 fish/m2, respectively (Table 28b).

Late summer stream flow was 1.3 m3/sec, with moderate annual variation in stream flow. The maximum water temperature during low summer stream flow was 14 c, below the lethal limits for salmonid production. Instream cover for juvenile rainbow-steelhead was 23% of the available area. Bank erosion was 6% of the banks surveyed. Mean water velocity was 46 cm/sec, an optimum value for juvenile rainbow-steelhead trout (Bovee 1978). The average stream width during the low flow period was 9.5 m. Mean water depth was 30 cm, an optimum depth for rainbow-steelhead trout (Bovee 1978). Cobble embeddedness was 15%, well below those values identified by Bjornn et al 1977, which limit salmonid production. The major substrate was large rubble, an optimum size for rainbow-steelhead trout (Bovee 1978). The estimated periphyton coverage of 100% indicated excellent productivity. The pool riffle ratio was 50:50, near optimum for salmonid fishes. The general stream channel integrity was good due to the presence of large substrate, woody debris, and well established riparian vegetation (Table 29b).

Station #6

Subyearling rainbow-steelhead trout were observed at this location but could not be quantified due to shallow depth and great width. In addition to trout, sculpins were moderately abundant at this station (Table 28b).

Late summer stream flow was 1.3 m3/sec, with moderate variation in annual stream flow. The maximum summer water temperature was 14 C. Instream cover was 7% of available area. Bank erosion was not identified at this station. Mean water velocity was 43 cm/sec, which was near optimum for juvenile rainbow-steelhead(Bovee 1978). Average stream width was 12.7 m. Mean water depth was 34 cm, an optimum value for rainbow-steelhead trout (Bovee 1978). Cobble embeddedness was 25%, close to a value which may limit the production of juvenile'salmonids (Bjornn et al 1977).The major substrate was small rubble,which is among the optimum sizes for juvenile steelhead (Bovee 1978). Coverage of the substrate by periphyton was 100%, indicating excellent productivity. The pool riffle ratio was 10:90, indicating a severe lack of pool habitat. The stream channel integrity was excellent due to good riparian habitat and well established overstory (Table 29b).

Station #7

Similar to station 6, subyearling rainbow-steelhead trout were observed at this location but were not quantified. In addition, overyearling rainbow-steelhead and rainbow-cutthroat hybrids were observed (Table 28b).

Late summer stream flow was 1.6 m3/sec, with a small annual variation in that flow. The maximum water temperature recorded during low flow was 14 C. Instream cover for juvenile rainbow-steelhead was 68% of the available area. No eroding stream banks were identified at this location. Mean water velocity was 83 cm/sec, well above the optimum values identified by Bovee (1978). The average stream width during low flow was 8.8 m. Mean water depth was 36 cm, an optimum depth for rainbow-steelhead juveniles (Bovee 1978). Cobble embeddedness was 25%, a value near the point which Bjornn et al (1977) found could limit salmonid production. The major substrate was small boulders, an optimum size for juvenile rainbow-steelhead (Bovee 1978). Periphyton coverage was 100%, indicating excellent production. The estimated pool riffle ratio was 10:90, indicating a severe lack of pool habitat. The general stream channel stability was excellent due to large substrate embedded in stream banks, well established woody overstory, and the presence of woody debris (Table 29b).

Table 27a. Water sample analysis from seven stations on Lolo Creek, tributary of lower Clearwater River Basin, Idaho, 1983.

Constituent	Station 1 Value	Station 2 Value	Station 3 Value	Station 4 Value
Calcium, Ca, mg/l	3.93	3.37	3.70	2.06
Magnesium, Mg, mg/l	1.08	0.90	0.70	0.28
Sodium, Na, mg/l	3.26	2.53	3.19	2.51
Potassium, K, mg/l	0.94	0.53	0.63	<0.50
Chloride, Cl, mg/l	0.02	0.07	0.07	0.18
Carbonate, CO_3, mg/l	<0.22	0	0	0
Bicarbonate, HCO_3, mg/l	0.44	0.36	0.49	0.33
Sulfate, SO_4, mg/l	1	1	<l	1
Nitrate, NO_3, mg/l	<0.01	0.01	<0.01	<0.01
Orthophosphate, PO_4, mg/l	<0.01	<0.01	0.01	0.01
Total Residue, mg/l	65	72	54	6
Non-Filtered Residue, mg/1	<l	<l	2	1
pH	7.3	7.8	8.1	7.4

Table 27b. Water sample analysis from seven stations on Lolo Creek, tributary of lower Clearwater River Basin, Idaho, 1983.

Constituent	Station 5 Value	Station 6 Value	Station 7 Value
Calcium, Ca, mg/l	2.29	2.29	1.76
Magnesium, Mg, mg/l	0.34	0.34	0.29
Sodium, Na, mg/l	2.63	2.63	1.94
Potassium, K, mg/l	<0.50	0.50	<0.50
Chloride, Cl, mg/l	0.11	0.11	0.18
Carbonate, CO_3, mg/l	0	0	0
Bicarbonate, HCO_3, mg/l	0.33	0.33	0.24
Sulfate, SO_4, mg/l	1	1	1
Nitrate, NO_3, mg/l	0.02	0.02	0.03
Orthophosphate, PO_4, mg/1	0.01	0.01	0.01
Total Residue, mg/l	4	4	4
Non-Filtered Residue,mg/l	1	1	<1
pH	7.4	7.4	7.5

Table 28a. Fish population statistics for rainbow-steelhead trout on Lolo Creek, tributary of lower Clearwater River Basin, Idaho, 1982, 1983.

Biological Parameter	Units	Station 1[1] Value	Station 2 Value	Station 3 Value
Age 0+ Rainbow-Steelhead				
Density	fish/m^2		0	0
Standing Crop	kg/ha		0	0
Mean Weight	gm		0	0
Mean Length (TL-FL)	mm		0	0
Age 1+ Rainbow-Steelhead				
Density	fish/m^2		0.2	.004
Standing Crop	kg/ha		3.20	.62
Mean Weight	gm		17.2	17.2
Mean Length (TL-FL)	mm			

[1] Insufficient number of rainbow trout were collected to generate population estimates.

Table 28b. Fish population statistics for rainbow-steelhead trout on Lolo Creek, tributary of lower Clearwater River Basin, Idaho, 1982, 1983.

		Station			
Eiological Parameter	Units	4	5	6	7
		Value	Value	Value	Value
Age 0+ Rainbow-Steelhead					
Density	$fish/m^2$	0.03	0.27	RB Present	RB Present
Standing Crop	kg/ha	0.9	3.0		
Mean Weight	gm	3.0	1.1		
Mean Length (TL-FL)	mm				
Age 1+ Rainbow-Steelhead					
Density	$fish/m^2$	0.2	0.13	RB Present	RB Prese 2
Standing Crop	kg/ha	2.9	22.2		
Mean Weight	gm	17.2	11.2		
Mean Length (TL-FL)	mm				

Table 29a. Measured physical parameters from seven stations on Lolo Creek, tributary of lower Clearwater River Basin, Idaho, 1982, 1983.

Physical Parameter	Station 1 Value	Station 2 Value	Station 3 Value
Late Summer Stream Flow (m^3/sec)	4.4	4.1	4.3
Annual Stream Flow Variation	Moderate	Moderate	Moderate
Maximum Summer Temp. (C)	21.7	16	21
Instream Cover (%)	28	26	8
Eroding Banks (% of banks)	11.1	0	0
Water Velocity (cm/sec)	65	65	58
Stream Width (m)	11.2	11.8	18.7
Stream Depth (cm)	60	53	49
Cobble Embeddedness (%)	60	25	75
Major Substrate Type	Large Rubble	Large Rubble	Sand
Periphyton Coverage	50%	40%	100%
Pool Riffle Ratio	35:65	30:70	30:70

Table 29b. Measured Physical Parameters from seven stations on Lolo Creek, tributary of lower Clearwater River Basin, Idaho, 1982, 1983.

Physical Parameter	Station 4 Value	Station 5 Value	Station 6 Value	Station 7 Value
Late Summer Stream Flow (m3/sec)	1.3	1.3	1.3	1.6
Annual Stream Flow Variation	Moderate	Moderate	Moderate	Small
Maximum Summer Temp. (C)	18	14	14	14
Instream Cover (%)	21	23	7	68
Eroding Banks (% of banks)	23	6	0	0
Water Velocity (cm/sec)	85	46	43	83
Stream Width (m)	6.9	9.5	12.7	8.8
Stream Depth (cm)	22	30	34	36
Cobble Embeddedness (%)	20	15	25	25
Major Substrate Type	Small Rubble	Large Rubble	Small Rubble	Small Boulder
Periphyton Coverage (%)	100	100	100	100
Pool Riffle Ratio	40:60	50:50	10:90	10:90

Yakus Creek

Yakus Creek originates in the Clearwater National Forest just east of the western forest boundary. The stream flows north for 8.9 kilometers before entering Lo10 Creek. This stream has a relatively steep gradient except for the lower 3.2 kilometers. A well maintained road parallels the stream at stream level and riparian buffer zones are relatively intact. Impact to the stream has been kept to a minimum. Water quality analysis did not identify any limiting factors to salmonid production (Table 30).

Two stations were selected on Yakus Creek: station #l, located 2.4 kilometers from the mouth, and station #2, established below the confluence of the two major tributaries at SK 4.9.

Station #l

Rainbow trout and sculpins were collected at this lower station. The standing crop of subyearling rainbow-steelhead trout was 6.7 kg/ha, with a density of 0.6 fish/m2. Overyearling estimates were 31.6 kg/ha, with a density of 0.2 fish/m2 (Table 31).

Late summer stream flow was 0.33 m3/sec, with moderate annual stream flow variation. The maximum water temperature was 14 c, well below the lethal limits for salmonids. Instream cover for juvenile rainbow-steelhead was 12% of available area. Erosion of stream banks was 86%. Mean water velocity was 53 cm/sec, slightly above optimum for juvenile rainbow-steelhead (Bovee

1978). The average width during low flow was 5.97 m. Mean water depth was 11 cm, below the optimum values for juvenile rainbow-steelhead (Bovee 1978). Cobble embeddedness was 0. The major substrate type was small rubble, an optimum size for juvenile rainbow-steelhead (Bovee 1978). Coverage of the substrate by periphyton was 60%, indicating moderate productivity. The pool riffle ratio of 10:90 indicated a severe lack of pool habitat. The general channel stability was fair due to bank erosion and lack of large substrate (Table 31).

Station #2

Rainbow and cutthroat trout were collected at this station. In addition, sculpins were found *in* moderate numbers. No subyearling rainbow-steelhead trout were collected. Standing crop of overyearling rainbow steelhead trout was 12.0 kg/ha, with a density of 0.7 fish/m2 (Table 31).

Late summer stream flow was 0.24 m3/sec, with moderate annual stream flow variation. The maximum water temperature during low flow was 11 C, well below the lethal limits for salmonids. Instream cover was 27% of available area. No bank erosion was identified. Mean water velocity was 41 cm/sec, an optimum value for juvenile rainbow-steelhead (Bovee 1978). The average stream width at low flow was 3.93 m. Mean water depth was 15 cm, shallower than optimal for juvenile rainbow-steelhead (Bovee 1978). Cobble embeddedness was 40%, a value which could limit salmonid production (Bjornn et al 1977). The major substrate was small rubble, an optimal substrate size for steelhead juveniles

(Bovee 1978). Periphyton coverage of the substrate was 25%, indicating moderate productivity. The estimated pool riffle ratio of 20:80 indicated a lack of pool habitat for overyearling fish. The channel integrity in this reach was excellent due to well developed riparian vegetation and large substrate in the bank structure (Table 32).

Table 30. Water sample analysis from one station on Yakus Creek, tributary of Lolo Creek, Idaho, 1983.

Constituent	Station 1 Value
Calcium, Ca, mg/l	5.70
Magnesium, Mg, mg/l	1.49
Sodium, Na, mg/l	3.46
Potassium, K, mg/l	0.88
Chloride, Cl, mgll	0.15
Carbonate, C03, mg/l	0
Bicarbonate, HC03, mg/l	0.53
Sulfate, 504, mg/l	1
Nitrate, N03, mg/l	0.01
Orthophosphate, P04, mg/l	0.03
Total Residue, mg/l	20
Non-Filtered Residue, mg/l	1
pH	7.60

Table 31. Fish population statistics for rainbow-steelhead trout on Yakus Creek, tributary of Lolo Creek, Idaho, 1982, 1983.

Biological Parameter	Units	Station 1 Value	Station 2 Value
Age 0+ Rainbow-Steelhead			
Density	fish/m^2	0.6	0
Standing Crop	kg/ha	6.7	0
Mean Weight	gm	1.1	0
Mean Length (TL-FL)	mm	53-51	0
Age 1+ Rainbow-Steelhead			
Density	fish/m^2	0.2	0.7
Standing Crop	kg/ha	31.6	12.0
Mean Weight	gm	17.2	17.2
Mean Length (TL-FL)	mm	118-111	135-128

Table 32. Measured physical parameters from two stations on Yakus Creek, tributary of Lolo Creek, Idaho, 1983.

Physical Parameter	Station 1 Value	Station 2 Value
Late Summer Stream Flow (m3/sec)	0.33	0.24
Annual Stream Flow Variation	Moderate	Moderate
Maximum Summer Temp. (C)	14	11
Instream Cover (%)	12	27
Eroding Banks (% of banks)	86	0
Water Velocity (cm/sec)	53	41
Stream Width (m)	5.97	3.93
Stream Depth (cm)	11	15
Cobble Embeddedness (%)	0	40
Major Substrate Type	Small Rubble	Small Rubble
Periphyton Coverage (%)	60%	25%
Pool Riffle Ratio	10:90	20:80

Musselshell Creek

Musselshell Creek is approximately 23.6 kilometers long. The stream flows in the southwesterly direction to its confluence with Lolo Creek at SK 42.6. The major tributary to lower Musselshell Creek is Browns Creek. The stream originates in the Clearwater National Forest east of Weippe, Idaho. Logging activity, past and present, is found throughout the upper tributary system. The stream flows through Musselshell Meadows, adjacent to a USFS work camp. At this point a large pond and spawning channel are present but in degraded condition. From this point downstream to the confluence of Browns Creek, the riparian habitat has been degraded by grazing activities. From the confluence of Browns Creek to Lolo Creek the stream flows through a canyon environment with very little access. The Musselshell drainage is subject to intensive sedimentation and has deposits of large sand the entire length of the stream. Water quality analysis did not identify any limiting factors to salmonid production (Table 33).

One station was located adjacent to the Musselshell work station, representing the majority of the lower system at SK 9.7.

Station #l

Several brook trout and dace were captured at this station and no rainbow-steelhead trout were seen (Table 34).

Late summer stream flow was 0.22 m3/sec, with moderate annual stream flow variation. The maximum water temperature was 19.4 C, approaching the lethal limits for salmonid production. Instream cover for juvenile rainbow-steelhead was 10% of the available area. Bank erosion was 55% of the banks surveyed. Mean water velocity was 8.5 cm/sec slightly below optimum values for juvenile rainbow-steelhead trout (Bovee 1978). The average stream width was 5.58 m. Mean water depth was 47 cm, an optimum depth for juvenile rainbow-steelhead trout (Bovee 1978). Cobble embeddedness was 40%, which can limit salmonid production (Bjornn et al 1977). The major substrate was deep'sand, which is a sub-optimum substrate size for these fish (Bovee 1978). Coverage of the substrate by periphyton was 608, indicating good productivity. A pool riffle ratio of 80:20 indicated plentiful pool habitat (Table 35).

Table 33. Water sample analysis from one station on Musselshell Creek, tributary of Lolo Creek, Idaho, 1983.

Constituent	Station 1 Value
Calcium, Ca, mg/l	7.48
Magnesium, Mg, mg/l	1.93
Sodium, Na, mg/l	3.36
Potassium, K, mg/l	0.78
Chloride, Cl, mg/l	0.20
Carbonate, CO_3, mg/l	0
Bicarbonate, HCO_3, mg/l	0.65
Sulfate, SO_4, mg/l	2
Nitrate, NO_3, mg/l	<0.01
Orthophosphate, PO_4, mg/l	0.02
Total Residue, mg/l	38
Non-Filtered Residue, mg/l	1
pH	7.65

Table 34. Fish population statistics for rainbow-steelhead trout on Musselshell Creek, tributary of Lolo Creek, Idaho, 1982, 1983.

Biological Parameter	Units	Station 1 Value
Age 0+ Rainbow-Steelhead		
Density	$fish/m^2$	0
Standing Crop	kg/ha	0
Mean Weight	gm	0
Mean Length (TL-FL)	mm	0
Age 1+ Rainbow-Steelhead		Brook Trout
Density	$fish/m^2$	
Standing Crop	kg/ha	
Mean Weight	gm	
Mean Length (TL-FL)	mm	

Table 35. Measured Physical Parameters from one station on Musselshell Creek, tributary of Lolo Creek, Idaho 1983.

Physical Parameter	Station 1 Value
Late Summer Stream Flow (m^3/sec)	0.22
Annual Stream Flow Variation	Moderate
Maximum Summer Temp. (C)	19.4
Instream Cover (%)	10
Eroding Banks (% of banks)	55
Water Velocity (cm/sec)	8.5
Stream Width (m)	5.58
Stream Depth (cm)	47
Cobble Embeddedness (%)	40
Major Substrate Type	Sand
Periphyton Coverage (%)	60
Pool Riffle Ratio	80:20

Browns Creek

Browns Creek originates east of Weippe, Idaho and flows 13.8 kilometers in a southerly direction and enters Musselshell Creek at SK 4.8. This drainage has been extensively and intensively logged and roaded (Espinosa 1975). Road construction and skid trail operation in intermittent stream channels and little or no buffer strips along streams have also been observed (Espinosa 1975). In addition, range and farming practices on the eastern portion of the Weippe prairie, including' riparian zone destruction and overstory cutting, have contributed to the sediment load into this creek. The entire mainstem creek, to its confluence with Musselshell Creek, has a degraded riparian zone. "The Browns Creek watershed appears to be the most significant, chronic source of sediment that impacts lower Lolo below the Musselshell confluence" (Espinosa 1975). Water quality analysis did not identify any limiting factors to salmonid production (Table 36).

Due to the intermittent nature of the tributaries and general condition of this stream only one station was established, approximately 1.9 kilometers above the confluence with Musselshell Creek. Redside shiners were the most abundant species captured.

Station #1

Sculpins and speckled dace, brook trout and 2 subyearling rainbow cutthroat hybrids were present. The field size of the generator and the lack of visibility for snorkling precluded a quantitative evaluation of fish populations (Table 37).

Low summer stream flow was 0.33 m3/sec, with moderate variation in annual stream flow. The maximum water temperature during low flow was 16 C, which is below the lethal limits for salmonid production. Instream cover for salmonids was 7% of the total area available. Stream bank erosion was 53%. Mean water velocity was 21 cm/sec, an optimum value for juvenile rainbow-steelhead (Bovee 1978).The average width of Browns Creek during low flow was 5.2 m. The mean water depth was 28 cm, slightly below optimum for juvenile rainbow-steelhead (Bovee 1978). Cobble embeddedness was 100% which can limit salmonid production (Bjornn et al 1977). The major substrate type was sand, silt and clay. The coverage of the substrate by periphyton was 20%, indicating poor productivity due to constant silt deposition. The pool riffle ratio was 80:20,indicating plentiful pool habitat. The channel integrity was poor due to excessive bank erosion and lack of bank structure (Table 38).

Table 36. Water sample analysis from one station on Browns Creek, tributary of Lo10 Creek, Idaho, 1983.

Constituent	Station 1 Value
Calcium, Ca, mg/l	6.54
Magnesium, Mg, mg/l	1.69
Sodium, Na, mg/l	3.30
Potassium, K, mg/l	0.89
Chloride, Cl, mg/1	0.20
Carbonate, C03, mg/l	0
Bicarbonate, HC03, mg/l	0.65
Sulfate, S04, mg/1	2
Nitrate, N03, mg/1	<0.0l
Orthophosphate, P04, mg/l	0.02
Total Residue, mq/l	38
Non-Filtered Residue, mg/l	1
pH	7.65

Table 37. Fish population statistics for rainbow-steelhead trout on Brown's Creek, tributary to Lolo Creek, Idaho, 1983.

Biological Parameter	Units	Station 1 Value
Age 0+ Rainbow-Steelhead		
Density	fish/m^2	0
Standing Crop	kg/ha	0
Mean Weight	gm	0
Mean Length (TL-FL)	mm	0
Age 1+ Rainbow-Steelhead		Brook Trout
Density	fish/m^2	
Standing Crop	kg/ha	
Mean Weight	gm	
Mean Length (TL-FL)	mm	
Condition Factor (XK)		

Table 38. Measured physical parameters from one station on Browns Creek, tributary of Lolo Creek, Idaho, 1983.

Physical Parameter	Station 1 Value
Late Summer Stream Flow (m^3/sec)	0.33
Annual Stream Flow Variation	Moderate
Maximum Summer Temp. (C)	16
Instream Cover (%)	7
Eroding Banks (% of banks)	53
Water Velocity (cm/sec)	21
Stream Width (m)	5.2
Stream Depth (cm)	28
Cobble Embeddedness (%)	100
Major Substrate Type	Sand, Silt, Clay
Periphyton Coverage (%)	20
Pool Riffle Ratio	80:20

Eldorado Creek

Eldorado Creek is approximately 26.5 kilometers in length. The stream flows in a northwesterly direction and enters Lolo Creek at SK 41.8. Several major barriers to upstream movement were identified in the lower 3.2 kilometers of stream. These included a series of cascades with bedrock substrate, a sheer falls of approximately 3.1 meters, and a jumble of large boulders above the falls of natural origin with the addition of some large boulders from adjacent road construction. The middle reach of Eldorado Creek has moderately steep gradient characterized by good riparian habitat and tall overstory. The upper reaches of the stream have less gradient and less velocity. Meadowland with abundant top soil is common in this area. The stream has abundant pool habitat and plentiful woody debris, although the riparian habitat is not always present. Water quality analysis did not identify any chemical limitations to salmonid production (Table 39).

Three stations were established on Eldorado Creek: station #l, located at SK 3.7; station #2, located at SK 7.6: and station #3, located at SK 11.3, adjacent to Salmon Trout Camp.

Station #1

Cutthroat trout was the only species of fish found at this location (Table 40). Few individuals were seen at this location and visibility precluded an accurate population estimate.

Late summer stream flow was 0.93 m^3/sec, with moderate annual stream flow variation. The maximum summer water temperature was 16 C, well below the lethal limits for salmonids. Instream cover was 6% of the total area available and no bank erosion was observed. Mean water velocity was 34 cm/sec, which is optimum for juvenile rainbow-steelhead (Bovee 1978). The average stream width during low flow was 11.84 m. The water depth was 23 cm, below that identified as optimum for juvenile rainbow-steelhead (Bovee 1978). Cobble embeddedness was 0. The major substrate was small rubble, an optimum size for juvenile steelhead (Bovee 1978). Periphyton coverage was 100%, indicating qood productivity. The pool riffle ratio was 80:20, indicating an abundance of pool habitat (Table 41).

Station, #2

Cutthroat trout was the only species of fish found at this location but population estimates were not made (Table 40).

Late summer stream flow was 0.93 m^3/sec, with moderate annual stream flow variation. The maximum summer water temperature was 15 c, well below the lethal limits for salmonid production. Instream cover for juvenile rainbow-steelhead was 12% of the available area and no bank erosion was identified. Mean water velocity was 30 cm/sec, an optimum value for juvenile rainbow-steelhead (Bovee 1978). The average stream width during low flow was 8.02 m. Mean water depth was 40 cm, an optimum value for juvenile rainbow-steelhead trout (Bovee 1978). Cobble embeddedness was 50% which could possibly limit salmonid production at this location. The major substrate was large rubble, an optimum size for these fish (Bovee 1978). Periphyton coverage of the substrate was 70%, indicating good productivity. The pool riffle ratio was 60:40, an optimal ratio for salmonid streams (Table 41).

Station #3

Cutthroat trout was the only species of fish found at this location. Densities of subyearling and overyearling cutthroat trout were 0.23/m2 and 0.39/m2, respectively (Table 40).

Late summer stream flow was 0.41 m3/sec, with practically no annual stream flow variation. The maximum water temperature was 16 C, well below the lethal limits for salmonid production. Instream cover for juvenile rainbow-steelhead was 31% of the available area and all banks showed signs of erosion. Mean water velocity was 10 cm/sec, slightly below the optimum value for juvenile rainbow-steelhead (Bovee 1978). The average stream width during low flow was 10.02 m. Mean water depth was 43 cm, an optimum value for juvenile rainbow-steelhead (Bovee 1978). Cobble embeddedness was 100% which can limit salmonid production (Bjornn et al 1977). The major substrate was sand, a sub-optimum substrate size for these fish (Bovee 1978). Periphyton coverage was 0% and the pool riffle ratio was 100:0, indicating plentiful pool habitat but a lack of riffle area (Table 41).

Table 39. Water sample analysis from three stations on Eldorado Creek, tributary of Lolo Creek, Idaho, 1983.

Constituent	Station 1 Value	Station 2 Value	Station 3 Value
Calcium, Ca, mg/1	3.11	2.75	2.10
Magnesium, Mq, mq/l	0.46	0.29	<0.25
Sodium, Na, mg/1	3.11	3.82	3.10
Potassium, K, mg/1	<0.5	0.52	0.50
Chloride, Cl, mg/1	0.16	0.18	0.14
Carbonate, C03, mg/l	NIL	NIL	NIL
Bicarbonate, HC03, mg/l	0.41	0.33	0.28
Sulfate, SO4, mg/1	1	1	1
Nitrate, N03, mg/l	>0.0l	>0.0l	0.01
Orthophosphate, P04, mg/1	0.01	0.01	0.01
Total Residue, mg/1	20	16	6
Non-Filtered Residue, mg/1	1	2	>l
pH	7.54	7.45	7.28

Table 40. Fish population statistics for cutthroat trout on Eldorado Creek, tributary of Lolo Creek, Idaho, 1982, 1983.

Biological Parameter	Units	Station 1 Value	Station 2 Value	Station 3 Value
Age 0+ Rainbow-Steelhead				
Density	$fish/m^2$	*		0.23
Standing Crop	kg/ha			
Mean Weight	gm			
Mean Length (TL-FL)	mm			
Age l+ Rainbow-Steelhead				
Density	$fish/m^2$			0.30
Standing Crop	kg/ha			
Mean Weight	gm			
Mean Length (TL-FL)	mm			

* Information not collected by visual observation techniques.

Table 41. Measured physical parameters from three stations on Eldorado Creek, tributary of Lolo Creek, Idaho, 1983.

Physical Parameter	Station 1 Value	Station 2 Value	Station 3 Value
Late Summer Stream Flow (m3/sec)	0.93	0.93	0.41
Annual Stream Flow Variation	Moderate	Moderate	Slight
Maximum Summer Temp. (C)	16	15	16
Instream Cover (%)	6	12	31
Eroding Banks (% of banks)	0	0	100
Water Velocity (cm/sec)	34	30	10
Stream Width (m)	11.84	8.02	10.02
Stream Depth (cm)	23	40	43
Cobble Embeddedness (%)	0	50	100
Major Substrate Type	Small Rubble	Large Rubble	Sand
Periphyton Coverage (%)	100	70	0
Pool Riffle Ratio	80:20	60:40	loo:o

Yoosa Creek

Yoosa Creek is approximately 10.6 kilometers in length. The stream flows in a northwesterly direction and enters Lolo Creek at SK 56.6. Degredation within this watershed is less than other Lolo Creek subdrainages surveyed. Yoosa Creek flows for most of its length through forested terrain. The overall gradient of the stream is moderate 3.6% (Espinosa 1975). Generally the stream has good habitat for salmonid rearing with abundant pool habitat and good riparian cover.The primary concern would be forest road (103) which parallels the stream and could potentially provide a source of erosion and sediment input into the stream. Water quality analysis did 'not identify any chemical limitations to salmonid production (Table 42).

One station was located on Yoosa Creek at SK 3.3 to represent the lower reaches. The densities of subyearling and overyearling rainbow-steelhead were 0.03 fish/m2 (Table 43). Standing crop estimates were not calculated since weights were not recorded. One cutthroat trout overyearling was observed.

Late summer stream flow was 0.7 m3/sec, with moderate annual stream flow variation. The maximum water temperature was 8.9 C, well below the lethal limits to salmonid production. Cover for rainbow-steelhead juveniles was 53% of the total area surveyed. No eroding banks were observed. Mean water velocity' was 32 cm/sec, an optimum value for rainbow-steelhead juveniles (Bovee

1978). Average stream width during low flow was 7.6 m. Mean water depth was 28 cm, slightly below optimum values for rainbow-steelhead juveniles (Bovee 1978). Cobble embeddedness was 60%, which can limit salmonid production (Bjornn et al 1977). The major substrate type was small boulder, an optimum size for rainbow-steelhead juveniles (Bovee 1978). Periphyton coverage was 80%, indicating good productivity. The pool riffle ratio was 50:50, indicating a good balance of pool and riffle habitat (Table 44).

Table 42. Water sample analysis from one station on Yoosa Creek, tributary of Lolo Creek, Idaho, 1983.

Constituent	Station 1 Value
Calcium, Ca, mg/l	2.49
Magnesium, Mg, mg/l	0.45
Sodium, Na, mg/l	2.69
Potassium, K, mg/l	<0.50
Chloride, Cl, mg/1	0.16
Carbonate, C03, mg/l	0
Bicarbonate, HC03, mg/l	0.20
Sulfate, S04, mg/1	1
Nitrate, N03, mg/l	0.08
Orthophosphate, P04, mg/l	0.01
Total Residue, mg/l	6
Non-Filtered Residue, mg/l	<1
pH	7.42

Table 43. Fish population statistics for rainbow-steelhead trout on Yoosa Creek, tributary of Lolo Creek, Idaho, 1982, 1983.

Biological Parameter	Units	Station 1 Value
Age 0+ Rainbow-Steelhead		
Density	fish/m^2	0.03
Standing Crop	kg/ha	
Mean Weight	cm	
Mean Length (TL-FL)	mm	
Age l+ Rainbow-Steelhead		
Density	fish/m^2	0.03
Standing Crop	kg/ha	
Mean Weight	gm	
Mean Length (TL-FL)	mm	

Table 44. Measured physical parameters from one station on Yoosa Creek, tributary of Lolo Creek, Idaho, 1983.

Physical Parameter	Station 1 Value
Late Summer Stream Flow (m3/sec)	0.7
Annual Stream Flow Variation	Moderate
Maximum Summer Temp. (C)	8.9
Instream Cover (%)	53
Eroding Banks (% of banks)	0
Water Velocity (cm/sec)	32
Stream Width (m)	7.6
Stream Depth (cm)	28
Cobble Embeddedness (%)	60
Major Substrate Type	Small Boulder
Periphyton Coverage (%)	80%
Pool Riffle Ratio	50:50

Maggie Creek

Maggie Creek flows for approximately 23.5 kilometers, of which 5.5 kilometers flow through the Nez Perce Reservation, and flows southwesterly to its, confluence with the Middle, Fork Clearwater River. Maggie Creek originates in Idaho State forest land and flows for its entire length through steep canyon terrain. The riparian zone is good throughout the system with the exception of the lowest 3.2 kilometers. Water quality analysis indicates no limitation to salmonid production (Table 45).

Two stations were established on this stream: station #l, located at SK 1.3 during 1982 to represent the lower reaches, and station #2 located at SK 1.63 during the summer 1983 to represent the upper reaches.

Station #l

Rainbow-steelhead trout, northern squawfish, bridgelip sucker, redside shiner, dace, and sculpin were collected. Estimated standing crop for overyearling rainbow-steelhead was 15.9 kg/ha, with a density Of 0.07 fish/m2. Subyearling steelhead were not captured in sufficient numbers to calculate estimates of abundance (Table 46).

Late summer flow was 0.05 m3/sec, with an extreme variation in annual stream flow. The maximum water temperature recorded was 24.4 C, which can limit the production of juvenile salmonids. Instream cover was 3% of the total area surveyed. Twelve percent of the stream banks showed signs of erosion. Mean water velocity was 13 cm/sec, which is at the lower range of water velocities most preferred by juvenile rainbow-steelhead(Bovee 1978). The stream width averaged 3.25 m at low flow. Mean water depth was 10 cm, which is below the preferred depth of juvenile rainbow-steelhead (Bovee 1978). Cobble embeddedness was 40%, which may reduce salmonid production (Bjornn et al 1977). The major substrate was small rubble, which is near optimum size for juvenile rainbow-steelhead (Bovee 1978). Periphyton covered 70% of the substrate, indicating good productivity. A pool riffle ratio of 10:90 indicated a lack of holding area for juvenile rainbow-steelhead. The general stability of the stream banks was moderate (Table 47).

Station #2

Rainbow-steelhead and dace were the only species captured. Estimated overyearling rainbow-steelhead standing crop was 17.1 kg/ha, with a density of 0.09 fish/m2. The subyearling rainbow-steelhead standing crop estimate was 3.3 kg/ha, with a density of 0.25 fish/m2 (Table 46).

LOW summer flow was 0.11 m3/sec, with moderate variation in annual stream flow. The maximum water temperature recorded was 16.7 C, within the tolerance of salmonids. Thirteen percent of the area surveyed provided cover for juvenile rainbow-steelhead. Forty nine percent of stream banks surveyed showed signs of erosion. Mean water velocity was 25 cm/sec, which is within the optimum range preferred by juvenile rainbow-steelhead (Bovee 1978). The stream width averaged 4.28 m at low flow. Mean water depth was 10 cm, which is less than the preferred depth of juvenile steelhead (Bovee 1978). Cobble embeddedness was 25% which should not limit salmonid production (Bjornn et al 1978).The major substrate was small rubble, near optimum size for juvenile steelhead (Bovee 1978)'. Periphyton coverge of the substrate was 100% indicating good primary productivity. The pool riffle ratio of 20:80 identified a lack of holding area for overyearling salmonids. In general, the stability of this stream was good except that the riparian zone has no influence on the channel at low flow (Table 47).

Table 45. Water sample analysis from two stations on Maggie Creek, tributary of M.F. Clearwater River Basin, Idaho, 1982, 1983.

Constituent	Station 1 Value	Station 2 Value
Calcium, Ca, mg/1	7.5	7.9
Magnesium, Mq, mg/l	3.0	2.6
Sodium, Na, mg/1	4.9	4.1
Potassium, K, mg/l	2.8	2.3
Chloride, Cl, mg/l	<0.01	0.07
Carbonate, CO_3, mg/1	<0.22	0.24
Bicarbonate, HCO_3, mg/1	0.88	2.65
Sulfate, SO_4, mg/1	1.0	1.0
Nitrate, NO_3, mg/1	<0.01	0.01
Orthophosphate, PO_4, mg/l	0.02	0.03
Total Residue, mg/l	95	114
Non-Filtered Residue, mg/l	<1	7
pH	7.6	7.6

Table 46. Fish population statistics for rainbow-steelhead trout on Maggie Creek, tributary of M.F. Clearwater River Basin, Idaho, 1982, 1983.

Biological Parameter	Units	Station 1 Value	Station 2 Value
Age 0+ Rainbow-Steelhead			
Density	Fish/m2		0.25
Standing Crop	kg/ha		3.3
Mean Weight	gm		1.3
Mean Length (TL-FL)	mm		55-43
Age 1+ Rainbow-Steelhead			
Density	Fish/m2	0.07	0.09
Standing Crop	kg/ha	15.9	17.1
Mean Weight	gm	22.0	18.9

Table 47. Measured physical parameters from two stations on Maggie Creek, tributary of M.F. Clearwater River Basin, Idaho, 1982, 1983.

Physical Parameter	Station 1 Value	Station 2 Value
Late Summer Stream Flow (m3/sec)	0.05	0.11
Annual Stream Flow Variation	Extreme	Moderate
Maximum Summer Temp. (C)	24.4	16.7
Instream Cover (%)	3	13
Eroding Banks (% of banks)	12	49
Water Velocity (cm/sec)	13	25
Stream Width (m)	3.25	4.28
Stream Depth (cm)	10	10
Cobble Embeddedness (%)	40	25
Major Substrate Type	Small Rubble	Small Rubble
Periphyton Coverage	70%	100%
Pool Riffle Ratio	10:90	20:80

Mission Creek

Although the vast majority of Mission Creek was surveyed in 1982 (Kucera et al 1983), the uppermost reach of this stream was surveyed during the summer of 1983. The upper reaches are heavily grazed by cattle and subject to degradation by road construction and heavy equipment use. The stream flows through intermittent forest and meadow habitats. The sampling station was located 3.2 km north of Forest, Idaho at SK 31.9. The following survey results are an appendum to the 1983 report. Water analysis did not indicate any limitations to salmonid production (Table 48).

Headwaters Station (#5)

Rainbow-steelhead trout and speckled dace were captured during the summer of 1983. Estimated standing crop of overyearling rainbow-steelhead was 15.53 kg/ha, with a density of 0.03 fish/m2. No subyearling salmonids were captured (Table 49).

Late summer stream flow was 0.03 m3/sec, with moderate annual variation in flow. The maximum water temperature recorded was 21.1 C, which is close to the upper lethal limit for salmonids. Two percent of the area surveyed provided cover for overyearling rainbow-steelhead and 41% and of the stream banks showed signs of erosion. Mean water velocity was 17 cm/sec, which is near optimum for this species (Bovee 1978). The average stream width was 1.5 m during low flow. Mean stream water depth was 12 cm, below the optimum value described by Bovee (1978).

Cobble embeddedness was 25%, which should not impair salmonid production (Bjornn et al 1977). The major substrate was small rubble near the optimum size for juvenile rainbow-steelhead (Bovee 1978). Periphyton coverage was 80%, indicating good productivity. The pool riffle ratio was 20:80, indicating a lack of pool or holding area for overyearling rainbow-steelhead. Bank and stream stability was poor due to the lack of riparian vegetation and surrounding soil substrate (Table 50).

Table 48. Water sample analysis from one station on Mission Creek, Tributary of Lapwai Creek, Idaho, 1983.

Constituent	Station 5 Value
Calcium, Ca, mg/l	7.27
Magnesium, Mg, mg/l	2.44
Sodium, Na, mg/l	3.87
Potassium, K, mg/1	2.26
Chloride, Cl, mg/l	0.05
Carbonate, CO_3, mg/l	0.08
Bicarbonate, HCO_3, mg/l	0.53
Sulfate, SO_4, mg/l	3
Nitrate, NO_3, mg/l	0.01
Orthophosphate, PO_4, mg/l	0.02
Total Residue, mg/l	192
Non-Filtered Residue, mg/l	1
pH	8.07

Table 49. Fish population statistics for rainbow-steelhead trout on Mission Creek, Tributary of Lapwai Creek, Idaho, 1983.

Biological Parameter	Units	Station 5 Value
Age 0+ Rainbow-Steelhead		
Density	fish/m^2	0
Standing Crop	kg/ha	0
Mean Weight	gm	0
Mean Length (TL-FL)	mm	0
Age 1+ Rainbow-Steelhead		
Density	fish/m^2	0.03
Standing Crop	kg/ha	15.53
Mean Weight	gm	15.25
Mean Length (TL-FL)	mm	176-168

Table 50. Measured physical parameters from one station on Mission Creek, tributary of Lapwai Creek, Idaho, 1983.

HQI Attribute	Station 5 Value
Late Summer Stream Flow (%) (m3/sec)	0.03
Annual Stream Flow Variation	Moderate
Maximum Summer Temp. (C)	21.1'
Cover (% area)	2
Eroding Banks (% of banks)	41
Water Velocity (cm/sec)	17
Stream Width (m)	1.5
Stream Depth (cm)	12
Cobble Embeddedness (%)	25
Major Substrate Type	Small Rubble
Periphyton Coverage	80
Pool Riffle Ratio	20:80

Pine Creek

Pine Creek flows for approximately 22.5 kilometers of which 4.0 kilometers flow within the Nez Perce Reservation boundary. At low summer flow the stream is reduced to about 11.3 kilometers in length. The stream arises in farmland adjacent to Leland, Idaho, flows intermittently for about 6.4 kilometers, and then drops into a moderately steep sided canyon, meeting the mainstem Clearwater River at RK 28.8. The lower two miles of this canyon provide grazing and agricultural activities. The riparian vegetation appears to be in good shape, with the exception of the upper agricultural reaches and near the mouth. Water quality analysis showed no indication of factors limiting salmonid production (Table 51).

Two stations were established on Pine Creek to represent the two main habitats present: station #l, located at SK 1.6;and station #2, located at SK 6.4. Beyond this point upstream movement of adult fish would be impaired by channel size and a series of small falls.

Station #l

Speckled dace and rainbow-steelhead trout were the only species captured. Estimated standing crop for overyearling rainbow-steelhead was 17.3 kg/ha, with a density of 0.10 fish/m2. The estimated standing crop of subyearling steelhead was 0.9 kg/ha, with a density of 0.03 fish/m2 (Table 52).

Late summer stream flow was 0.05 m^3/sec, with moderate annual stream flow variation. The maximum water temperature recorded during low flow was 16 C, which is within the tolerance of of rainbow-steelhead trout. Nine percent of the area surveyed provided cover for overyearling rainbow-steelhead and 94% of the stream banks showed erosion problems. The mean water velocity was 11 cm/sec, lower than that most preferred velocities by rainbow-steelhead (Bovee 1978). The mean stream width was 3.34 m during low flow. The average stream depth was 13 cm, less than that most preferred depth of juvenile rainbow trout (Bovee 1978). Cobble embeddedness was 25%, which is probably not limiting to salmonid production (Bjornn et al 1977). The major substrate identified was large rubble, the most preferred by juvenile rainbow trout (Bovee 1978). Periphyton coverage was 80%, indicating good productivity. The pool riffle ratio of 20:80 indicated a lack of holding area for overyearling steelhead trout. The general stability of this section of stream was fair (Table 53).

Station #2

Speckled dace, sculpin, and rainbow-steelhead trout were the only species captured. The estimated standing crop of overyearling rainbow-steelhead was 37.8 kg/ha, with a density of 0.25 fish/m^2. Standing crop of subyearling rainbow-steelhead was 18.4 kg/ha, with a density of 0.98 fish/m^2 (Table 52).

Late summer stream flow was 0.04 m^3/sec, with moderate annual variation in flow. The maximum water temperature recorded during low flow was 16 C, within the tolerances of rainbow-steelhead trout. Twenty two percent of the area surveyed provided cover for overyearling steelhead trout. Erosion was identified on 66% of the stream banks. Mean water velocity was 9 cm/sec, below the optimum velocities identified by Bovee (1978) for this species. The mean stream width was 2.61 m at low flow. Mean stream depth was 16 cm, below the optimum for rainbow-steelhead juveniles (Bovee 1978). Cobble embeddedness was 50%, a point at which Bjornn et al (1977) indicated salmonid production could be inhibited. Major substrate identified was large rubble, which is optimum for juvenile rainbow-steelhead (Bovee 1978). Periphyton coverage was 80%, indicating good productivity. The pool riffle ratio was 50:50, providing both cover and food production for juvenile rainbow-steelhead. The stability of the banks and the general stability of the stream was good due to the large substrate (boulders, ect.) reinforcing the banks and stream channel (Table 53).

Table 51. Water sample analysis from two stations on Pine Creek, tributary to lower Clearwater River Basin, Idaho, 1983.

Constituent	Station 1 Value	Station 2 Value
Calcium, Ca, mg/l	28.59	32.64
Magnesium, Mg, mg/1	9.72	10.74
Sodium, Na, mg/l	11.80	12.57
Potassium, K, mg/l	5.05	4.09
Chloride, Cl, mg/l	0.08	0.06
Carbonate, C03, mg/1	0.16	0.33
Bicarbonate, HC03, mg/1	2.04	2.24
Sulfate, S04, mg/1	1	1
Nitrate, N03, mg/1	0.13	0.51
Orthophosphate, P04, mg/l	0.17	0.18
Total Residue, mg/1	218	266
Non-Filtered Residue, mg/l	<l	<l
Ph	7.93	8.27

Table 52. Fish population statistics for rainbow-steelhead trout on Pine Creek, tributary of lower Clearwater River Basin, Idaho, 1983.

Biological Parameter	Units	Station 1 Value	Station 2 Value
Age 0+ Rainbow-Steelhead			
Density	fish/m^2	0.03	0.98
Standing Crop	kg/ha	0.9	18.4
Mean Weight	cm	3.0	1.8
Mean Length (TL-FL)	mm	66-61	64-62
Age 1+ Rainbow-Steelhead			
Density	fish/m^2	0.10	0.25
Standing Crop	kg/ha	17.3	37.8
Mean Weight	gm	17.1	15.2
Mean Length (TL-FL)	mm	121-114	119-104

Table 53. Measured physical parameters from two stations on Pine Creek, tributary of lower Clearwater River Basin, Idaho, 1983.

Physical Parameter	Station 1 Value	Station 2 Value
Late Summer Stream Flow (m3/sec.)	0.05	0.04
Annual Stream Flow Variation	Moderate	Moderate
Maximum Summer Temp. (C)	16	16
Instream Cover (%)	9	22
Eroding Banks (% of banks)	94	66
Water Velocity (cm/sec.)	11	9
Stream Width (m)	3.34	2.61
Stream Depth (cm)	13	16
Cobble Embeddedness (%)	25	50
Major Substrate Type	Large Rubble	Large Rubble
Periphyton Coverage (%)	80	80
Pool Riffle Ratio	80:20	50:50

Rabbit Creek

Rabbit Creek is an intermittent stream that flows into the South Fork Clearwater River at RK 11.3. The stream flows in a westerly direction through farmland and occasional steep canyon terrain. Riparian vegetation is good in most sections of this stream, except where the stream flows through a pasture at SK 5.1. When surveyed during August 1983, this stream was completely dry in the lower 4.8 kilometers and intermittent the rest of its length. One subyearling rainbow-steelhead was'captured in the upper reaches of the creek at SK 5.5 (Table 55) and several possible hatchery fish were found in a pool at SK 5.6. Since only a trickle of water was available during the low flow period, attributes are reported but not elaborated on (Table 56). Water quality analysis indicated no major limitations to salmonid production (Table 54).

Table 54. Water sample analysis from one station on Rabbit Creek, tributary of S.F. Clearwater River Basin, Idaho, 1983.

Constituent	Station 1 Value
Calcium, Ca, mg/l	6.19
Magnesium, Mg, mg/l	1.99
Sodium, Na, mg/l	3.14
Potassium, K, mg/l	2.54
Chloride, Cl, mg/l	0.07
Carbonate, CO_3, mg/l	Nil
Bicarbonate, HCO_3, mg/l	0.53
Sulfate, SO_4, mg/l	1
Nitrate, NO_3, mg/l	0.01
Orthophosphate, PO_4, mg/l	0.05
Total Residue, mg/l	118
Non-Filtered Residue, mg/l	1
pH	7.65

Table 55. Fish population statistics for rainbow-steelhead trout on Rabbit Creek, tributary of S.F. Clearwater River Basin, Idaho, 1983.

Biological Parameter	Units	Station 1 Value
Age 0+ Rainbow-Steelhead		
Density	fish/m^2	0.01
Standing Crop	kg/ha	0.38
Mean Weight	gm	3
Mean Length (TL-FL)	mm	59-57
Age l+ Rainbow-Steelhead		
Density	fish/m^2	0
Standing Crop	kg/ha	0
Mean Weight	gm	0
Mean Length (TL-FL)	mm	0

Table 56. Measured physical parameters from one station on Rabbit Creek, tributary of S.F. Clearwater River Basin, Idaho, 1983.

Physical Parameter	Station 1 Value
Late Summer Stream Flow (m3/sec)	0.001
Annual Stream Flow Variation	0
Maximum Summer Temp. (C)	15
Instream Cover (%)	0.5
Eroding Banks (% of banks)	15
Water Velocity (cm/sec)	5
Stream Width (m)	1.56
Stream Depth (cm)	1
Cobble Embeddedness (%)	25
Major Substrate Type	Small Rubble
Periphyton Coverage (%)	100
Pool Riffle Ratio	40:60

Sally Ann Creek

Sally Ann Creek flows for 2.6 kilometers, of which 0.5 kilometers flow within the Nez Perce Reservation boundaries.This stream flows in a westerly direction to its confluence with the South Fork Clearwater River at RK 19. The stream originates in a wood lot and pasture environment and flows parallel to a county road for most of its length. A barrier exists at SK 1.8, which prevents upstream movement of adult anadromous fish. The major tributary of Sally Ann Creek is Wall Creek, which provides the majority of flow to the system during periods of low flow. Riparian vegetation is generally good except where .the stream enters fenced pasture land. The sample station was located at SK 0.5. Results of the water quality analysis indicated no limiting factors for salmonid production (Table 57).

Station #l

One station was established on Sally Ann Creek to represent the reach below the barrier. This station was located at stream km, 0.5. The creek above the barrier tends to be intermittent and is not associated with the anadromous fishery.

Cutthroat trout, rainbow trout and sculpins were captured at station #l. The estimated standing crop of overyearling rainbow-trout was 38.63 kg/ha, with a density of 0.4 fish/m2. The estimated standing crop of subyearling rainbow-steelhead was 14.69 kg/ha, with a density of 1.0 fish/m2 (Table 58). Cutthroat trout were captured in small numbers.

Late summer stream flow was 0.21 m3/sec,with moderate variation in annual stream flow. The maximum water temperature recorded was 16.7 C, which is below the lethal limit for trout production. Instream cover for overyearling rainbow-steelhead was 25% of the total area surveyed and 13% of the banks showed signs of erosion. Mean water velocity was 41 cm/sec, which is the value most preferred by overyearling rainbow-steelhead. The average stream width at low flow was 3.2 m. Mean water depth was 16 cm, slightly less than that preferred by juvenile rainbow-steelhead (Bovee 1978). Cobble embeddedness was 40%, which is probably limiting to salmonid production (Bjornn et al 1977). The major substrate was small boulder, which is preferred by juvenile rainbow-steelhead (Bovee 1978). Periphyton covered 100% of the substrate, indicating a productive stream. The pool riffle ratio of 40:60 indicated holding area present for juvenile salmonids. This reach of Sally Ann Creek was quite stable, with very good low riparian vegetation. Tall woody vegetation was lacking in some areas, although the understory vegetation generally formed a complete canopy over the stream (Table 59).

Table 57. Water sample analysis from one station on Sally Ann Creek, S.F. Clearwater River, Idaho, 1983.

Constituent	Station 1 Value
Calcium, Ca, mg/l	8.01
Magnesium, Mg, mg/1	2.38
Sodium, Na, m/g1	3.17
Potassium, K, mg/l	0.99
Chloride, Cl, mg/1	0.14
Carbonate, C03, mg/l	0
Bicarbonate, HC03, mg/l	0.73
Sulfate, S04, mg/1	1
Nitrate, N03, mg/l	<0.0l
Orthophosphate, P04, mg/l	0.05
Total Residue, mg/l	70
Non-Filtered Residue, mg/l	1
pH	8.05

Table 58. Fish population statistics for rainbow-steelhead trout on Sally Ann Creek, tributary of S.F. Clearwater River Basin, Idaho, 1983.

Biological Parameter	Units	Station 1 Value
Age 0+ Rainbow-Steelhead		
Density	fish/m^2	1.0
Standing Crop	kg/ha	14.69
Mean Weight	gm	1.4
Mean Length (TL-FL)	mm	52-49
Age 1+ Rainbow-Steelhead		
Density	fish/m^2	0.4
Standing Crop	kg/ha	38.63
Mean Weight	gm	15
Mean Length (TL-FL)	mm	117-109

Table 59. Measured physical parameters from one station on Sally Ann Creek, tributary of S.F. Clearwater River Basin, Idaho, 1983.

Physical Parameter	Station 1 Value
Late Summer Stream Flow (m3/sec)	.21
Annual Stream Flow Variation	Moderate
Maximum Summer Temp. (C)	16.7
Instream Cover (%)	25
Eroding Banks (% of banks)	13
Water Velocity (cm/sec)	41
Stream Width (m)	3.2
Stream Depth (cm)	16
Cobble Embeddedness (%)	40
Major Substrate Type	Small Boulder
Periphyton Coverage (%)	100
Pool Riffle Ratio	40:60

Wall Creek

Wall Creek flows for approximately 11.1 kilometers and is entirely off the reservation. Since the stream contributes the majority of flow ta the Sally Ann system, a survey of this stream was undertaken. Wall Creek flows in a northwesterly direction and meets Sally Ann Creek at SK 1.4. The stream originates in pristine forest land and flows through a steep sided valley with grazing land intermixed. Water is diverted from the extreme upper reaches for stock water and irrigation by the Clearwater Water Assn. Several small dams could potentially hinder upstream movement of adult anadromous salmonids. However, the survey indicates that they are not within the zone of anadromous fish production. Above SK 3.2 only cutthroat trout were collected. Results of the water quality analysis indicated no limitations to salmonid production (Table 60).

Two stations were established on Wall Creek: station #l, representing the lower reaches of the creek, was located at SK 0.02, and station #2, representing the predominantly cutthroat trout habitat in the upper reaches, was located at SK 3.1.

Station #1

Bull trout, cutthroat trout, rainbow trout and sculpins were captured at this station. The estimated standing crop for overyearling rainbow-steelhead trout was 24.3 kg/ha, with a density of 0.2 fish/m2/ Subyearling rainbow-steelhead standing crop was 5.2 kg/ha, with a density of 0.5 fish/m2 (Table 61).

Late summer stream flow was 0.13 m3/sec, with moderate annual variation in flow. The maximum water temperature was 18.9 c, below the lethal limit for salmonid production. Instream cover for overyearling rainbow-steelhead was 14% of the total area. Erosion of stream banks was 6% of the total bank length. Mean water velocity was 31 cm/sec, preferred by juvenile rainbow-steelhead trout (Bovee 1978). The average stream width at low flow was 3.56 m. Mean water depth was 12 cm, shallower than the optimum depths identified by Bovee (1978). Cobble embeddedness was 40%, a value which can affect salmonid production (Bjornn et al 977). Large boulders were the predominate substrate, identified as that most preferred by juvenile rainbow-steelhead (Bovee 1978). Periphyton coverage was 20%, indicating lower primary productivity than most other streams on the reservation. The pool riffle ratio was 80:20, indicating abundanct pool habitat. This stream has excellent riparian over and understory and has excellent stability due to the large substrate in both the banks and the stream bottom (Table 62).

Station #2

Only cutthroat trout and sculpin were captured at station #2. The range for anadromous salmonids seems to end between these two stations,probably due to a lack of water for passage (Table 61).

Late summer flow was 0.12 m3/sec, with a moderate annual variation in flow. The maximum water temperature was 12.2 C, well within the limits for salmonid production. Thirteen percent of the area surveyed provided cover suitable for juvenile rainbow-steelhead trout. Only 11% of the banks showed signs of erosion. Mean water velocity was 28 sm/sec, an optimum value for juvenile rainbow-steelhead (Bovee 1978). The mean stream width at low flow was 2.95 m. Mean stream depth was 14 cm, below that which Bovee (1978) reported as most preferred by juvenile rainbow-steelhead. Cobble embeddedness was 40%, approaching that level which can limit salmonid production (Bjornn et al 1977). The major substrate available was large rubble, a size preferred by juvenile rainbow-steelhead trout (Bovee 197%). Periphyton coverage was 50%, indicating adequate productivity. Riffle habitat was predominant, indicated by a 10:90 pool riffle ratio. The habitat at this site is good with excellent tall riparian cover. However, there is a lack of low riparian vegetation since cattle graze in this area. The stream at this point is quite stable due to the extensive woody structure within the stream banks (Table 62).

Table 60. Water sample analysis from two stations on Wall Creek, Tributary to Sally Ann Creek, Idaho, 1983.

	Station 1	Station 2
	Value	Value
Calcium, Ca, mg/l	7.4%	7.21
Magnesium, Mg, mg/l	1.93	2.03
Sodium, Na, mg/l	3.36	3.01
Potassium, K, mg/l	0.78	0.88
Chloride, Cl, mg/l	0.15	0.18
Carbonate, C03, mg/1	Nil	Nil
Bicarbonate, MCO3, mg/1	0.69	0.61
Sulfate, S04, mg/l	1	1
Nitrate, N03, mg/l	0.01	0.01
Orthophosphate, P04, mg/l	0.05	0.05
Total Residue, mg/l	62	66
Non-Filtered Residue, mg/l	3	3
pH	7.82	7.94

Table 61. Fish population statistics for rainbow-steelhead trout on Wall Creek, tributary of Sally Ann Creek, Idaho, 1983.

Biological Parameter	Units	Station 1	Station 2
		Value	Value
Age 0+ Rainbow-Steelhead			Cutthrout Trout Only
Density	$fish/m^2$	0.5	
Standing Crop	kg/ ha	5.2	
Mean Weight	gm	1.0	
Mean Length (TL-FL)	mm	54-52	
Age 1+ Rainbow-Steelhead			
Density	$fish/m^2$	0.2	
Standing Crop	kg/ha	24.3	
Mean Weight	gm	13.6	
Mean Length (TL-FL)	mm	114-110	

Table 62. Measured physical parameters from two stations on Wall Creek, tributary of Sally Ann Creek, Idaho, 1983.

Physical Parameter	Station 1 Value	Station 2 Value
Late Summer Stream Flow (m3/sec)	0.13	0.12
Annual Stream Flow Variation	Moderate	Moderate
Maximum Summer Temp. (C)	18.9	12.2
Instream Cover (%)	14	13
Eroding Banks (% of banks)	6	11
Water Velocity (cm/sec)	31	28
Stream Width (m)	3.56	2.95
Stream Depth (cm)	12	14
Cobble Embeddedness (%)	40	40
Major Substrate Type	Large Boulder	Large Rubble
Periphyton Coverage (%)	20	50
Pool Riffle Ratio	80:20	10:90

Three Mile Creek

Three Mile Creek flows approximately 28.5 kilometers of which 6.9 kilometers are within the Nez Perce Reservation. The stream flows in a southeasterly direction and meets the South Fork of the Clearwater River at RK 14.5. The stream originates south of Grangeville, Idaho in forested land and flows north through Grangeville and adjacent agricultural land. Discharge from the Grangeville reclamation plant enters Three Mile Creek north of the town.The lower eight kilometers flow through a moderately steep canyon with limited access. A series of 2 m falls presents a potential barrier to upstream migration of adult anadromous salmonids at SK 9.5. Water quality analysis indicated no limitations to salmonid production, althrough elevated nutrients were noted (Table 63).

Three stations were established on Three Mile Creek: station #l, located at SK 1.3 and surveyed during summer 1982; station #2, located at SK 10.3 and sampled during summer 1983; and, station #3, located at SK 18 and also sampled during summer 1983.

Station #l

Fish species present included rainbow-steelhead trout, juvenile chinook salmon, northern squawfish, chiselmouth, redside shiner, bridgelip sucker, speckled dace, and pauite sculpin. Northern squawfish was the most abundant species present and insufficient numbers of rainbow-steelhead were collected to estimate population size (Table 64).

Late summer flow was 0.09 m2/sec, with extreme annual variation in stream flow. The maximum water temperature was 24.4 C, which would be limiting for salmonid production. Instream cover for overyearling rainbow-steelhead was 1%. Approximately 15% of the stream banks showed signs of erosion. The mean water velocity was 15 cm/sec, which Bovee (1978) indicated to be optimum for juvenile rainbow-steelhead. The average stream width was 4.25 m at low flow. Mean water depth was 13 cm, which Bovee (1978) found to be below optimum for this species. Cobble embeddedness was 60% which Bjornn et al (1977) found could severely limit salmonid production. The major substrate was small rubble, which is near the optimal size for juvenile rainbow-steelhead (Bovee 1978). Periphyton coverage was 703, indicating good productivity. The pool riffle ratio of 20:80 indicated a lack of holding area for overyearling rainbow-steelhead trout. The overall stability of this section of stream was poor due to flooding and constant erosion (Table 65).

Station #2

Rainbow-steelhead trout and speckled dace were the only species captured. Four overyearling rainbow-steelhead trout were collected but the sample was insufficient to calculate a population estimate. These fish were identified as hatchery fish due to their eroded fins and the fact that they were above the identified barrier to migration (Table 64).

Late summer stream flow was 0.16 m3/sec, with high variation in annual stream flow. The maximum water temperature was 21.1 C, near the maximum lethal temperature for salmonids. Instream cover for overyearling rainbow-steelhead was 26% of the area surveyed. Three percent of the stream banks surveyed exhibited erosional problems. The mean water velocity was 23 cmlsec, an optimal value as determined by Bovee (1978). Average stream width was 4.51 m at low flow. The mean stream depth was 16 cm, slightly less than optimal for juvenile rainbow-steelhead (Bovee 1978). Cobble embeddedness was 40%, possibly limiting salmonid production (Bjornn et al 1977). The major substrate was small boulder, an optimal size for rainbow-steelhead juveniles (Bovee 1978). Periphyton coverage was 0%, which indicated low productivity. The pool riffle ratio of 40:60 indicated a deficiency of pool habitat. The stability of the banks and the stream in general was very good since riparian vegetation was well developed and the cobble-boulder substrate provided a sturdy stream bed (Table 65).

Station #3

Only speckled dace were captured and no salmonids were seen (Table 64).

The low summer flow was 0.18 m3/sec, with high variation in annual stream flow. The maximum water temperature was 12.2 c, well within the limits for rainbow-steelhead. Instream cover was 68% of the area surveyed and 63% of the stream banks observed showed signs of erosion. Mean water velocity was 33 cm/sec, an optimal value for rainbow-steelhead juveniles (Bovee stream depth was 16 cm, a depth Bovee (1978) found to be less than optimal. Cobble embeddedness was 40%, indicating a potential problem with salmonid production (Bjornn et al 1977). The major substrate was loose gravel, which would make qood spawning substrate, but was below optimum size for rearing of juvenile rainbow-steelhead (Bovee 1978). Periphyton coverage was 80%, indicating good productivity. The pool riffle ratio of 30:70 indicated a lack of holding area for juvenile rainbow-steelhead. The general stability of the stream, and its banks, was good due to grasses and woody plants even though the surrounding substrate was soil (Table 65).

Table 63. Water sample analysis from three stations on Threemile, S.F. Clearwater River, Idaho, 1982, 1983.

Constituent	Station 1	Station 2	Station 3
	Value	Value	Value
Calcium, Ca, mg/1	18.7	16.6	16.5
Magnesium, Mq, mg/1	7.2	6.0	5.8
Sodium, Na, mg/1	14.6	19.12	19.7
Potassium, K, mg/1	3.9	3.6	4.5
Chloride, Cl, mg/1	0.24	0.48	0.42
Carbonate, CO3, mg/1	<0.22	0	0
Bicarbonate, HC03, mg/1	1.81	1.63	1.47
Sulfate, S04, mg/1	3	4	3
Nitrate, N03, mg/1	0.08	4.70	4.48
Orthophosphate, P04, mg/1	0.50	1.72	2.14
Total Residue, mg/1	451	222	180
Non-Filtered Residue, mg/1	16	16	16
pH	7.4	8.1	7.9

Table 64. Fish population statistics for rainbow-steelhead trout on Threemile Creek, tributary of S.F. Clearwater River Basin, Idaho, 1982, 1983.

Biological Parameter	Units	Station 1 Value	Station 2 Value	Station 3 Value
Age 0+ Rainbow-Steelhead		RB Present	RB Present	
Density	fish/m^2			0
Standing Crop	kg/ha			0
Mean Weight	gm			0
Mean Length (TL-FL)	mm			0
Age l+ rainbow-Steelhead		RB Present	RB Present	
Density	fish/m^2			0
Standing Crop	kg/ha			0
Mean Weight	gm			0
Mean Length (TL-FL)	mm			0

Table 65. Measured physical parameters from three stations on Threemile Creek, tributary of S.F. Clearwater River Basin, Idaho, 1982, 1983.

Physical Parameter	Station 1 Value	Station 2 Value	Station 3 Value
Late Summer Stream Flow (m3/sec)	0.09	0.16	0.18
Annual Stream Flow Variation	Extreme	Extreme	Extreme
Maximum Summer Temp. (C)	24.4	21.1	12.2
Instream Cover (%)	7	26	68
Eroding Banks (% of banks)	15	3	63
Water Velocity (cm/sec)	15	23	33
Stream Width (m)	4.25	4.51	3.41
Stream Depth (cm)	13	16	16
Cobble Embeddedness (%)	60	40	40
Major Substrate Type	Small Rubble	Small Boulder	Loose Gravel
Periphyton Coverage (%)	70	0	80
Pool Riffle Ratio	20:80	40:60	30:70

Whiskey Creek

Whiskey Creek is 37.9 kilometers long, of which 1.2 kilometers flow within the Nez Perce Reservation. The stream flows in a southerly direction to its confluence with Orofino Creek at RK 6.4. The stream originates in mixed forest and grazing land east of Orofino, Idaho and flows parallel to a highway for 2.4 kilometers where it drops quickly into an extremely steep walled canyon of steep gradient. Access to the creek in the canyon is limited, but several barriers to anadromous salmonid migration were identified. These barriers consisted of several falls and cataracts located within the canyon proper. The lower 1.5 km of the stream flows through residential and commercial property. Major tributaries of Whiskey Creek are Deer Creek, Falls Creek and Crooked Creek. The headwaters of Whiskey Creek and Crooked Creek exhibit the effects of logging and grazing. Water quality analysis did not indicate any limiting factors to salmonid production (Table 66).

Three stations were sampled on Whiskey Creek during the summer of 1983: station #l, #2, and #3, located at SK 0.8, 17.7 and 20.9, respectively.

Station #l

Rainbow-steelhead trout, sculpin and speckled dace were captured at this station. The overyearling rainbow-steelhead standing crop was 39.8 kg/ha, with a density of 0.2 fish/m2. Estimated subyearling rainbow-steelhead standing crop was 14.9 kg/ha, with a density of 0.7 fish/m2 (Table 67).

Late summer stream flow was 0.46 m3/sec, with moderate annual variation in stream flow. The maximum water temperature was 15.5 c, well below the lethal limit for salmonid production. lnstream cover for overyearling rainbow-steelhead was 19% of the total area surveyed and 14% of the stream banks exhibited signs of erosion. Mean water velocity was 37 cm/sec, which is among the optimum values for juvenile rainbow-steelhead (Bovee 1978). The average stream width at low flow was 5.0 m. Mean water depth was 25 cm, slightly below that most preferred by rainbow-steelhead juveniles (Bovee 1978). Cobble embeddedness was 40%, possibly limiting to salmonid production (Bjornn et al 1977). The major substrate was small boulder, a size preferred by juvenile rainbow-steelhead (Bovee 1978). Periphyton coverage was 100%, indicating good stream productivity. The pool riffle ratio was 40:60, indicating available holding area for juvenile rainbow-steelhead. The general stability of Whiskey Creek was good due to good overstory riparian vegetation and banks composed of large substrate (Table 68).

Station #2

Rainbow-steelhead trout, brook trout, and speckled dace were captured at station #2, above the migration barriers. Estimated standing crop of overyearling rainbow-steelhead was 9.18 kg/ha, with a density of 0.04 fish/m2. No subyearling rainbow trout were collected at this station (Table 67).

Late summer stream flow was 0.13 m3.sec,with moderate variation in annual stream flow. Maximum water temperature during low flow was 17.2 C, below the lethal limits for rainbow trout. Cover for overyearling rainbow-steelhead trout was 73% and bank erosion was 3%. Mean water velocity was 18 cm/sec, less than that most preferred by juvenile rainbow-steelhead trout (Bovee 1978). The average stream width at low flow was 3.8 m. The mean water depth was 20 cm, slightly less than optimum for this species (Bovee 1978). Cobble embeddedness was 40%, which can limit salmonid production (Bjornn et al 1977). The major substrate was small rubble, which is near optimum for juvenile rainbow-steelhead (Bovee 1978). Periphyton coverage was 75%, indicating good productivity. The pool riffle ratio was 80:20, indicating substantial holding area for juvenile rainbow-steelhead. Considering the excellent riparian cover and large substrate present in the stream banks, the stability of the stream at this station was excellent (Table 68).

Station #3

Rainbow-steelhead trout, brook trout, and speckled dace were captured at this station. Insufficient numbers of rainbow trout were caught to generate a population estimate (Table 67).

Late summer stream flow was 0.13 m3/sec, with moderate variation in annual stream flow. The maximum water temperature was 16.7 c, below the lethal limit for salmonids. Instream cover for overyearling rainbow-steelhead was 29% of the available habitat. Twenty percent of the stream bank surveyed showed signs of erosion. Mean water velocity was 16 cm/sec, a value most preferred by rainbow-steelhead trout (Bovee 1978). The average stream width during low flow was 3.8 m. Mean water depth was 22 cm, slightly less than that preferred by the species (Bovee 1978). Cobble embeddedness was 60%, which can limit salmonid production (Bjornn et al 1977). The major substrate was sand, which is not preferred by juvenile rainbow-steelhead trout (Bovee 1978). Periphyton coverage was 40%, indicating less' productivity than the two stations. The pool riffle ratio of 80:20, indicated an abundance of holding area for larger fish. The stability of this station was good due to thick riparian growth. Road construction has produced erosion just upstream from this station (Table 68).

Table 66. Water sample analysis from three stations on Whiskey Creek, Tributary to Orofino Creek, 1983.

Constituent	Station 1 Value	Station 2 Value	Station 3 Value
Calcium, Ca, mg/l	22.0	19.9	18.2
Magnesium, Mg, mg/l	8.2	7.4	6.3
Sodium, Na, mg/l	12.3	11.5	9.8
Potassium, K, mg/l			
Chloride, Cl, mg/1	0.86	0.09	0.08
Carbonate, C03, mg/1	0	0	0
Bicarbonate, HCO3, mg/l	0.86	0.61	0.94
Sulfate, S04, mg/l	1	1	1
Nitrate, N03, mg/l	0.33	0.01	0.01
Orthophosphate, P04, mg/1	0.03	0.01	0.01
Total Residue, mg/1	96	92	126
Non-Filtered Residue, mg/1	<l	<l	1
pH	7.98	7.74	7.61

Table 67. Fish population statistics for rainbow-steelhead trout on Whiskey Creek, tributary to Orofino Creek, Idaho, 1983.

Biological Parameter	Units	Station 1 Value	Station 2 Value	Station 3 Value
Age 0+ Rainbow-Steelhead				
Density	fish/m2	0.7	0	RB Present
Standing Crop	kg/ha	14.9	0	
Mean Weight	gm	2.3	0	
Mean Length (TL-FL)	mm	59-56	0	
Age 1+ Rainbow-Steelhead				
Density	fish/m2	0.2	0.04	RB Present
Standing Crop	kg/ha	39.8	9.18	
Mean Weight	gm	18.1	21.7	
Mean Length (TL-FL)	mm	130-123	135-128	

Table 68. Measured physical parameters from three stations on Whiskey Creek, Tributary of Orofino Creek, Idaho 1983.

Physical Parameter	Station 1 Value	Station 2 Value	Station 3 Value
Late Summer Stream Flow (m3/sec)	0.46	0.13	0.13
Annual Stream Flow Variation	Moderate	Moderate	Moderate
Maximum Summer Temp. (C)	15.5	17.2	16.7
Instream Cover (%)	19	73	29
Eroding Banks (% of banks)	14	3	20
Water Velocity (cm/sec)	37	18	16
Stream Width (m)	5.08	3.8	3.8
Stream Depth (cm)	25	20	22
Cobble Embeddedness (%)	40	40	60
Major Substrate Type	Small Boulder	Small Rubble	Sand
Periphyton Coverage (%)	100	75	40
Pool Riffle Ratio	40:60	80:20	80:20

Willow Creek

Willow Creek flows intermittently for approximately 9.7 kilometers within the Nez Perce Reservation. The stream flows in a southeasterly 'direction and discharges into the upper reaches of Lawyers Creek at (SK 4.8). Two major tributaries of Willow Creek (North Fork and South Fork) converge to form the mainstem, which flows for 3.7 kilometers. The two tributaries are intermittent during late summer and their flows reflect local precipitation. Riparian vegetation is lacking throughout the system due to heavy grazing activities. Water quality analysis indicated no limitations to salmonid production (Table 69).

Two stations were established on Willow Creek: station #l, located at SK 0.8 and surveyed during summer 1982; and station #2, located at SK 2.9 and surveyed during summer 1983.

Station #l

Fish composition consisted of rainbow-steelhead trout and speckled dace. Estimated standing crop of overyearling rainbow-steelhead was 53.2 kg/ha, with a density of 0.07 fish/m2. Some of these may have been of hatchery origin due to the supplemental put and take fishery, managed by the Idaho Fish and Game Department, which occurs in this area on a yearly basis. The stream is located above a partial barrier on Lawyers Creek (Kucera et al 1983) (Table 70).

The low summer stream flow was 0.07 m3/sec, with moderate variation in annual stream flow. The maximum water temperature was 26.7 C, which can be lethal to rainbow-steelhead trout. Instream cover for overyearling fish was 1115% of the total area surveyed. Eroding banks were identified in 69% of the total stream bank length. Mean water velocity was 11 cm/sec, slightly below the optimum for rainbow-steelhead juveniles (Bovee 1978). The average stream width during low flow was 2.82 m. Mean water depth was 23 cm, slightly below the optimum described by Bovee (1978).Cobble embeddedness was 60% , which can severely limit salmonid production (Bjornn et al 1977). The major substrate was small rubble, which was identified as near optimum for rainbow-steelhead juveniles by Bovee (1978). Coverage of the substrate by periphyton was 40%, indicating fair productivity. The pool riffle ratio was 60:40, near optimum for overyearling rainbow-steelhead rearing conditions. The general stability of the banks and stream in general was fair due to the grazing activities (Table 71).

Station #2

Rainbow-steelhead trout and speckled dace were captured at station #2. The estimated standing crop of overyearling rainbow-steelhead trout was 51.9 kg/ha, with a density of 0.17 fish/m2. No subyearling rainbow-steelhead were captured. These fish were most likely fish of hatchery origin as the Idaho Fish and Game Department stocks this stream on a regular basis (Table 70).

Late summer stream flow was calculated at 0.08 m3/sec, with moderate annual variation in stream flow. The maximum water temperature was 22.2 C, approaching the maximum lethal limit for salmonids.

Eroding banks were 38% of the total stream banks surveyed. Mean water velocity was 19 cm/sec, an optimum value for rainbow-steelhead juveniles (Bovee 1978). Average stream width was 2.62 m during low flow. Mean water depth was 17 cm, slightly below optimum for this species (Bovee 1978). Cobble embeddedness was 50%, which can severely limit salmonid production (Bjornn et al 1977). The major substrate was small rubble, which is smaller than optimum for rainbow-steelhead juveniles (Bovee 1978). Periphyton coverage was 0%, indicating a lack of productivity or an extremely high sedimentation rate. The pool riffle ratio of 60:40 indicated a moderate value of the annual stream flow variation. Bank and stream stability was poor throughout this area due to overgrazing near stream banks and erosion (Table 71).

Table 69. Water sample analysis from two stations on Willow Creek, Tributary to Lawyers Creek, Idaho, 1982,83.

Constituent	Station 1 Value	Station 2 Value
Calcium, Ca, mg/l	3.93	15.27
Magnesium, Mg, mg/l	1.08	5.20
Sodium, Na, mg/l	3.26	7.06
Potassium, K, mg/l	0.94	3.24
Chloride, Cl, mg/1	0.02	0.09
Carbonate, C03, mg/1	<0.22	0.16
Bicarbonate, HC03, mg/l	0.44	1.14
Sulfate, S04, mg/l	1	3
Nitrate, N03, mg/l	<0.0l	0.04
Orthophosphate, PO4, mg/l	<0.0l	0.01
Total Residue, mg/l	65	212
Non-Filtered Residue, mg/l	<0.10	10
pH	7.3	7.7

Table 70. Fish population statistics for rainbow-steelhead trout on Willow Creek, tributary of Lawyers Creek, Idaho, 1982, 1983.

Biological Parameter	Units	Station 1 Value	Station 2 Value
Age 0+ Rainbow-Steelhead			
Density	fish/m2	0	0
Standing Crop	kg/ha	0	0
Mean Weight	gm	0	0
Mean Length (TL-FL)	mm	0	0
Age lt Rainbow-Steelhead			
Density	fish/m2	0.07	0.17
Standing Crop	kg/ha	53.2	51.9
Mean Weight	gm	66.5	33.6
Mean Length (TL-FL)	mm	--	150-142

Table 71. Measured physical parameters from two stations on Willow Creek, tributary of Lawyers Creek, Idaho, 3982, 1983.

Physical Parameter	Station 1 Value	Station 2 Value
Late Summer Stream Flow (m3/sec)	0.07	.08
Annual Stream Flow Variation	Moderate	Moderate
Maximum Summer Temp. (C)	26.7	22.2
Instream Cover (%)	11.5	.06
Eroding Banks (% of banks)	69	38
Water Velocity (cm/sec)	11	19
Stream Width (m)	2.82	2.62
Stream Depth (cm)	23	17
Cobble Embeddedness (%)	60	50
Major Substrate Type	Small Rubble	Small Rubble
Periphyton Coverage (%)	40	0
Pool Riffle Ratio	60:40	60:40

ENHANCEMENT RECOMMENDATIONS

The major problem in all the lower Clearwater River Basin watersheds is extreme annual variation in streamflow. All the watersheds investigated were characterized by excessively high flows of short duration during spring runoff and intensive precipitation periods and by very low stream flows during the dry summer and fall periods. Excessively high flows over short time periods have caused flooding and high rates of channel re-structuring to accommodate large volumes of high velocity runoff. Rates of scouring and deposition are relatively high and stream banks are relatively unstable.

The major component of stream flow which is related to stream degradation is energy. A given amount of precipitation in a watershed provides a given amount of potential stream flow energy available in that watershed. The rate at which this energy is released from the watershed is directly related to the condition of that watershed. A pristine watershed releases its stream flow energy in a more or less uniform manner over time. This enables a small stream with flow obstructions to convey this water from the watershed without excessive scouring. As a watersheds capability to reservoir precipitation is decreased; stream flow energy is released over a shorter time period. To accommodate these higher short term release, stream channels must enlarge to reach a hydraulic equilibrium. This results in the common condition where low flows only partially utilize available stream channel area and physical habitat for fish (i.e., depth, cover, etc.) is absent.

As is evident, the management of the watersheds capability to retain water is of critical importance to the condition of its associated streams. Short of managing the watershed for water retention, several "band aid" enhancement activities designed to withstand present watershed conditions can help improve stream habitat.

To address the lack of physical habitat for anadromous salmonids, instream structures designed to withstand present stream energy regimes can improve this habitat for anadromous salmonids in the lower Clearwater Basin. These structures, properly designed, could also increase the duration of streamflow releases, thereby reducing the peak stream energy potential.

Another effect of high energy release, in addition to the condition of the structural instream habitat, is the addition of sediment to the stream channel. This sediment introduction can be reduced by either stabilizing the sediment sources (i.e., streambanks, etc.) with riparian vegetation or physical means by trapping the sediment with basins upstream from the zone to be enhanced.

The following recommendations are presented as a guideline to instream enhancement of selected streams within the lower

Clearwater Basin surveyed during 1983. They should provide a general outline from which specific enhancement plans can be derived.

Bedrock Creek

Problem: Extreme annual streamflow variation; low summer flow; and lack of pool habitat.

The Bedrock Creek watershed is characterized by extremely steep slopes which have sparse vegetation on the southern exposures. The upper reaches of Bedrock Creek flow through agricultural land and lack well developed riparian vegetation. These two conditions result in extreme variation in annual stream flow: extremely high spring run off and low flow during the summer months. The extreme spring runoff has caused most debris, boulders, and other instream structures to be washed out of the system. Thus, the stream has developed flood plains in the middle and low reaches which inhibit riparian vegetation growth that would shade the stream at the reduced flow stage.

Solution: Riparian enhancement on agricultural land in the upper watershed would decrease the rate of water runoff in the spring. Additional riparian enhancement is needed in the vicinity of Louse Creek. Since the watershed has a very steep gradient, stream flow velocity in Bedrock Creek can be controlled best by placing instream deflectors such as log and boulder dams,boulder clusters, woody debris such as stumps and logs, etc., throughout the stream system. These structures would also contribute to the development of instream cover. After the conditions in the upper reaches have been addressed, the lower reaches of Bedrock Creek can be rechannelized (meandering path) and riparian vegetation can be developed along the new stream banks to shade the stream and provide overhead cover.

Predicted results:

1. Decreased annual variation in flow.
2. Increased low summer flow.
3. Increased cover for juvenile salmonids.
4. Increased pool habitat.

Specific activities:

1. Approximately 8 km of riparian enhancement.
2. Placement of approximately 176 (every 50 m) velocity check structures.
3. Rechannelize approximately 1.2 km of stream in the lower reaches.

Land ownership:

100% private

Big Creek

Problem: Moderate variation in annual stream flow; partial migration barriers.

Major enhancement to decrease variation in annual stream flow is probably not economically feasible since this stream has limited access in the canyon area. However, development of riparian vegetation can be conducted in the upper reaches of agricultural land. There are a series of small falls within k 0.4 on Big Creek, the largest of which is a natural rock formation. In addition, a small falls was created as a result of railroad trestle construction. Since these barriers are not complete migration obstructions, they should not be high priority.

Predicted results:

1. Decreased variation in annual stream flow.
2. Improve upstream passage.

Specific activities:

1. Approximately 4.8 km of riparian enhancement.
2. Remove or modify several partial passage barriers within approximately 3.2 km of stream.

Land ownership:

100% private

Butcher Creek

Problem: Extreme annual stream flow variation; low summer flow; high summer water temperatures; and lack of pool habitat.

Because of excessive grazing, the entire length of Butcher Creek has poor riparian vegetation, principally in the upper and lower reaches. This condition is a principal cause for extreme variation in annual stream flow. High spring runoff has scoured the middle and lower reaches of the stream leaving rocky floodplain areas and little pool habitat area. The lack of shading has resulted in high water temperatures, especially toward the stream mouth.

Solution: Extensive riparian enhancement is necessary in the lower 0.8 km of stream and in the headwaters, which flow through agricultural land. Instream deflector structures, such as log and rock dams, boulder groups, and woody debris, are needed in the middle and lower reaches of the stream to reduce water velocity and provide instream cover. The lower reach, including the floodplain, needs rechannelization (meanders) and bank stabilization, in addition to the aforementioned riparian enhancement.

Predicted results:

1. Decreased variation in annual stream flows.
2. Decreased summer water temperatures.

3. Increased cover and pool habitat.

Specific activities:

1. Approximately 8 km of riparian enhancement.
2. Placement of approximately 50 instream deflectors.
3. Stream channelization of 0.8 km.

Land ownership:

100% private

Water rights:

0.38 cfs

Catholic Creek

Problem: Extreme annual stream flow variation; low summer flow; lack of instream cover; eroding banks; and lack of pool habitat.

Catholic Creek is subject to excessive grazing activity in the lower reaches and intensive agricultural activity in the extreme headwaters. The middle section of the creek is within a steep canyon with well developed riparian vegetation.

Solution: Riparian enhancement is needed in the uppermost 4.8 km of stream in agricultural land and the lower 3.2 km where grazing activity is present. Instream structures and woody debris are recommended for the lower 4.8 km of stream. In addition pool construction aside from the instream structures is advised.

Predicted results:

1. Decrease in peak runoff.
2. Increased instream cover.
3. Stabilized banks.
4. Increased pool habitat.

Specific activites:

1. Approximately 6.4 km of riparian enhancement.
2. Placement of 90 instream check structures at points of high

water velocity.

3. Construction of 10 pools within the lower 4.8 km of stream.

Land ownership:

100% private

Corral Creek

Problem: Instream cover; lack of pool habitat; moderate annual stream flow variation.

Corral Creek is not as severely degraded as many streams on the Nez Perce Reservation. The lower 3.2 km show signs of grazing activity while the upper reaches have been logged.

Solution: Since the discharge from Corral Creek is small, adult fish can probably navigate only the lower 3.2 km. Therefore, it is recommended that any enhancement be limited to this area. Instream structures, and debris such as stumps and logs will provide additional cover and pool habitat. Pool construction is possible in many locations though the bedrock layer is not very deep.

Predicted results:

1. Additional instream cover.
2. Additional pool habitat.
3. Reduced stream velocity (energy),

Specific activities:

1. Approximately 35 instream structures.
2. Pool construction within 8 km stream section.
3. Debris addition for 3.2 km.

Land ownership:

5% State

15% Nez Perce Tribe

Cottonwood Creek

Problem: Extreme annual stream flow variation; lack of pool habitat; high summer water temperatures; lack of instream cover; and sedimentation.

Cottonwood Creek has poorly developed riparian vegetation throughout the entire system. This condition results in extreme variation in stream flows; high spring runoff and low summer flow. Farmland in the upper reaches of Cottonwood Creek have very high rates of soil erosion. Due to the high energy and scouring action during periods of peak runoff, little pool habitat is available in the lower 10.4 km of stream. The presence of a 9.8 m of falls at SK 10.4 completely prohibits any upstream movement by anadromous fish beyond this point.

Solution: Major rejuvination of Cottonwood Creek will be necessary to reestablish anadromous fish runs. Extensive riparian enhancement is needed along the entire length of stream, particularly in the upper reaches of agricultural land. The lower 10.4 km are eroded by floods leaving an established floodplain. Rechannelization with bank reinforcement and riparian rejuvenation of vegetation is necessary in the lower 10.4 km. Instream deflectors and dam and debris placement is recommended to increase cover for juvenile salmonids.

Predicted results:

1. Decreased water temperatures.
2. Increased pool habitat.
3. Decreased annual stream flow variation.
4. Decreased sedimentation.
5. Increased instream cover.

Specific activities:

1. Approximately 25.7 km of riparian enhancement.
2. Silt collection basins (15) on key tributaries.
3. Check dam construction and pool excavation for the lower 6.5 km.

Land ownership:

99% Private

1% Nez Perce Tribe

Water rights:

0.91 cfs

Jim Ford Creek

Problem: Moderate annual flow variation; lack of instream cover; high water temperatures; and lack of pool habitat.

The major problem confronting Jim Ford Creek is its shallow channel, which expands laterally with increased flow. Thus, during periods of low flow, the channel has very restricted riparian cover or overstory. This condition is prevalent in the middle reach of the stream. Since scouring does occasionally take place during portions of high flow, instream cover (boulders, debris, etc.) is limited.

Solution: The habitat above Jim Ford falls is heavily silted and prone to erosion. Riparian enhancement on all tributaries on the. stream is recommended. In addition, bank stabilization measures are needed to curb erosion. The stream below the falls, which is available to anadromous fish, is prone to flooding. Velocity check structures and adjacent pool habitat are recommended from this point to the mouth. The area where floodplains exist, rechannelization of the stream, bank stabilization, and enhancement of the riparian zone is recommended.

Predicted results:

1. Decreased sedimentation in the headwaters.
2. Decreased water temperatures.

3. Increased pool habitat.
4. Decreased in peak flows in velocities.

Specific activities:

1. Riparian enhancement for 11.2 km.
2. Construction of 40 pools.

Land ownership:

15% Nez Perce Tribe

22% State Land

63% Private

Water Rights:

13.77 cfs

13 cfs (Grass Hopper Creek)

Lawyers Creek (Headwaters)

Problem: Sedimentation

The major problem confronting the headwaters of Lawyers Creek is bank erosion caused by a reduction in riparian vegetation and grazing activites.

Solution: Riparian enhancement is recommended throughout this section of Lawyers Creek. Fragile top soil is subject to heavy erosion and trampling by cattle. Both small woody vegetation and overstory would protect stream banks and provide shading. As this section of stream is probably not utilized by anadromous fish, instream habitat restoration is not recommended at this time.

Predicted results:

1. Decreased sedimentation.
2. Increased channel stability.

Specific activities:

1. Riparian enhancement for 6.4 km.

Land ownership:

100% Private

Lolo Creek

Problem: High water temperatures in lower reaches; sedimentation; degraded riparian zone; and impediment to migration.

The lower reaches of Lolo Creek, off the Clearwater National Forest, has limited enhancement potential due to its size and inaccessability. The primary problems identified in this section were lack of premium spawning substrate, siltation, and high summer water temperatures, none of which can be addressed at this point. The upper 6.4 km below the Forest boundary provide spawning habitat for salmonids although excessive silt is present in places. From the forest boundary to the mouth of Musselshell Creek, the stream shows signs of heavy siltation (#3), and is the location of Lolo Falls. The remaining streams (#4-7)are impacted by road construction and mining activities. Due to its location in the upper watershed and good access on Forest Service roads, this section of stream is the logical area for major enhancement activities.

Solution: The addition of instream cover and riparian enhancment is recommended on Lolo Creek near the mouth of Yakus Creek. Instream scouring structures could be installed in the section between the mouth of Musselshell Creek and the forest boundary. However, decreased sediment load from Musselshell Creek should be the primary objective. Additional blasting of Lo10 Falls is recommended to provide better access to the upper system. Lolo

Creek, from the mouth of Musselshell Creek to the mouth of Yoosa Creek, is subject to excessive sediment deposits, and lacks instream cover and pool habitat. Scouring structures such as check dams, large boulder groups, and a greatly increased amount of secured cedar stump wads and logs would improve this section of stream. In addition, heavy vegetative cover should be planted on slopes of Forest Service road (# 100) where necessary to decrease erosion and revegetate the south bank of Lolo Creek where necessary.

Predicted results:

1. Increased clean substrate.
2. Increased cover.
3. Decreased streamside erosion.

Specific activities:

1. Riparian enhancement.
2. Woody debris
3. Instream structures

Land ownership:

30% BLM

50% Forest Service

10% State

10% Private

Water rights:

5.14 cfs

Yakus Creek

Problem: Sedimentation (upper reaches); lack of instream cover and bank erosion (lower reaches): and lack of pool habitat.

The upper reaches of Yakus Creek are subject to sedimentation from logging road construction and other logging activities. Otherwise, the stream is in good condition.

Solution: Installation of check structures and sediment collectors is recommended on small side streams which receive high sediment loads. Riparian enhancement and bank stabilization is recommended in the lower reaches of this system. In addition, check dams and the introduction of woody debris would increase instream cover and pool habitat.

Predicted results:

1. Decrease sedimenation in upper reaches.
2. Decrease bank erosion.
3. Increased instream cover and pool habitat in lower reaches.

Specific activities:

1. Installation of sediment collectors (14) in key tributaries.
2. Riparian enhancement of lower 3.2 kilometers.
3. Check dam construction (15) on lower 3.2 kilometers.

Land ownership:

50% USFS

15% State

35% Private

Musselshell Creek

Problem: Sedimentation; impediments to migration; and high water temperature.

Musselshell Creek has an exceptionally high rate of sedimentation transport which is attributed to intensive logging in the upper drainage. Road construction paralleling the upper 2.3 of this construction paralleling the upper 2/3 of this stream also provide a sediment source. Riparian vegetation while sufficient in the upper and lower reaches, is lacking in the vicinity of the Musselshell work station. Several debris dams are located in the lower 2 miles of stream which impede potential upstream migration by adult anadromous salmonids. High water temperatures found in the lower reaches of Musselshell Creek are primarily due to lack of riparian vegetation.

Solution: Riparian enhancement is recommended in the vicinity of Musselshell work station. Check dams or siltation collectors are recommended on all small tributaries to upper Musselshell Creek. The removal of debris dams in the lower reaches should facilitate upstream migration by salmon and steelhead. In addition to these recommendations, scouring structures placed in mainstem Musselshell Creek should provide clean spawning gravels. The spawning channel and pond located adjacent to Musselshell work station should be opened for rainbow-steelhead or salmon propagation.

Predicted results:

1. Decreased sediment imput.
2. Decreased water temperature.
3. Improved upstream,access for salmonids.

Specific activities:

1. Riparian enhancement - 2 miles
2. Scouring structures - 50
3. Sediment collectors - 100
4. Dam removals - 3
5. Spawning channel and pond clean up.

Land ownership:

90% USFS

10% Private

Water rights:

20 cfs (mining)

Browns Creek

Problem: Sedimentation and bank erosion.

The entire Browns Creek watershed has been either heavily grazed by cattle or logged intensively. Both of these activities have led to large amounts of sedimentation in Browns Creek. When high rates of precipitation occur renewed erosion and subsequent sedimentation take place.

Solution: Major riparian enhancement is recommended for the entire length of Browns Creek. Check structures to catch sediment runoff should be placed on all applicable tributaries to the main stream. These activities will be especially useful in the upper drainage where logging activities and subsequent skid trails and roads pose major erosional problems. The mainstem is in need of bank stabilization measures as well as riparian vegetation. Scouring structures, such as check dams and/or boulder groups, are recommended in this mainstem reach to provide clean spawning gravels for adult rainbow-steelhead.

Predicted results:

1. Decreased sediment imput.
2. Decreased bank erosion.
3. Increased channel stability.

Specific activities:

1. Riparian enhancement - 24.1 km
2. Sediment check structures - 50.
3. Scour structures - 35.

Land ownership:

10% Forest Service

10% State

80% Private

Water rights:

0.26 cfs

Eldorado Creek

Problem: Sedimentation; barriers to migration and lack of instream cover.

Eldorado Creek contains a large amount of heavy sand bedload. The majority of this sandy material is probably of natural origin (Espinosa, personal communication) and will always be present in the upper reaches. The major limitation to salmonid production in Eldorado Creek is a series of cascades, a sheer 3.6 m falls and a rock fall that inhibit upstream movement of adult salmonids. Instream cover in stream reaches where water velocity is sufficient to scour the substrate is lacking.

Solution: Extensive blasting of both the cascades and sheer falls would create stair steps for migrating adult salmonids in the lower reach of Eldorado Creek. In addition, blasting or physical removal of large boulders above Eldorado falls are necessary for upstream movement. Instream scour structures should be placed in areas where water velocity is sufficient. This would provide clean spawning gravel for adult salmonids.Check dams and boulder groups, in addition to the above mentioned scouring structures,.would provide additional cover in these areas for juvenile salmonids. Sedimentation traps are recommended on all west flowing tributaries.

Predicted results:

1. Increased clean gravel for salmonid reproduction.

2. Increased instream cover.

3. Opening of lower stream to passage by adult salmonids.

Specific activities:

1. Scouring structures - 40
2. Additional instream cover - 100
3. Blasting operations - 2
4. Boulder removal -1

Land ownership:

100% USFS

Yoosa Creek

Yoosa Creek is in relatively good condition. Little physical enhancement in recommended with the exception of increased vegetation adjacent to forest road 103 and continued maintenance of associated drain structures.

Maggie Creek

Problem: Extreme annual stream flow variation; high water temperatures; lack of instream cover; bank erosion; sedimentation; and lack of pool habitat.

High spring runoff and the related erosion and scouring activity are the primary problems on Maggie Creek. Scouring has displaced much of the woody debris and filled in natural pool habitat. Lack of overstory and riparian vegetation in the lower reaches has led to high summer water temperatures.

Solution: Check dams, instream deflectors, and related pool habitat enhancement is recommended for the lower 12.9 km of Maggie Creek. Enhancement of stream side riparian vegetation in the lower 3.2 km of stream is greatly needed. Intermittent riparian enhancement is recommended for the next 9.6 km in locations where floodplains exist. The addition of anchored woody debris (i.e., stumps, logs) is recommended throughout the system. Pool construction is especially needed in the lowest 3.2 km of stream.

Predicted results:

1. Additional instream cover.
2. Additional pool habitat.
3. Reduced stream velocity (energy).
4. Decreased water temperatures.

5. Reduced erosion and sedimentation.

Specific activites:

1. Pool habitat construction - 3.2 km (20).
2. K dams, log structures - 30.
3. Riparian vegetation - 9.6 km

Water rights:

0.25 cfs

Mission Creek (Upper)

Problem: Bank erosion; sedimentation; high water temperatures; instream cover; and lack of pool habitat.

Upper Mission Creek is subject to cattle grazing activity. Degradation of riparian vegetation has left stream banks susceptible to erosion. Lack of woody debris and large substrate restricts the formation of pool habitat.

Solution: Extensive riparian enhancement, both short woody plants and tall overstory is recommended. Small instream structures to decrease stream velocity and form pool habitat are needed. Additional woody debris throughout the system is recommended to provide cover.

Predicted results:

1. Decreased bank erosion and sedimentation.
2. Lower water temperatures.
3. Increased instream cover and pool habitat.

Specific activities:

1. Riparian enhancement - 6.4 km
2. Instream structures - 32.2 km
3. Woody debris - Depended on availability

Land ownership:

100% Private

Water rights:

Not available

Pine Creek

Problem: Pine Creek is in fairly good 'condition. Grazing by cattle is moderate and does not seem to adversely affect the stream. Only 0.8 km' section at SK 2.4 shows signs of floodplain activity. The lower 3.2 km of Pine Creek lacked sufficient instream cover for juvenile steelhead.

Solution: Rip'arian enhancement is recommended for the 0.8 km miles section at SK 2.4 and additional woody debris, pool excavation and log or rock dam structures is recommended for the lower 3.2 km of stream.

Predicted results:

1. Increased instream cover for juvenile salmonids.
2. Decreased erosion and water temperatures below SK 2.4.

Specific activities:

1. Riparian enhancement - 0.8 km
2. Woody debris - As available
3. Log or rock structures - 32 km
4. Pool excavation - 16.1 km

Land ownership:

98% Private

2% Nez Perce Tribe

Rabbit Creek

Problem: Cessation of flow to lower 4.0 km during late summer months; and lack of flow.

Solution: As the watershed of Rabbit Creek is quite small, no enhancement activities are recommended for this stream.

Water rights:

0.04 cfs

Sally Ann Creek

Problem: Sedimentation; and **extreme** annual **stream** flow variation.

The section of Sally Ann Creek below the falls (SK 0.8)is in fairly good condition. High spring runoff and excessive sedimentation in the lower end is probably a function of land use practices in headwater areas.

Solution: Riparian enhancement on Sally Ann Creek is recommended above the falls. Check dams or instream deflectors should be located in side tributaries to trap high inputs of sediment.

Predicted results:

1. Decreased peak runoff.
2. Decreased sedimentation.

Specific activities:

1. Riparian enhancement - 3.2 km
2. Side channel defelctors - 16.1 km

Land ownership:

10% State land

90% Private

Water rights:

0.58 cfs

Wall Creek

Problem: Lack of instream cover; sedimentation; moderate annual stream flow variation.

The aquatic habitat found in Wall Creek is generally of high quality. The exceptions are found where the creek flows through pasture land at approximately SK 3.2. Riparian vegetation in general is good.

Solution: Riparian enhancement is recommended in the vicinity of SK 3.2. Sediment collectors should be located in side drainages to prevent the input of sediment from nearby logging operations and grazing activities. Additional instream cover for juvenile salmonids can be provided with the addition of boulder groups, check dams and woody debris in the upper reaches of the **stream** (cutthroat trout only).

Predicted results:

1. Increased cover for juvenile salmonids.
2. Decreased sedimentation during peak runoff.
3. Decreased peak runoff.

Specific activities:

1. Sediment collectors lo&ted on key tributaries (20).
2. Additional instream cover structures in middle reach(25 structures).

Land ownership:

7% State

93% Private

Water rights:

0.46 cfs

Three Mile Creek

Problem: Extreme annual stream flow variation; high water temperature: lack of instream cover; sedimentation; and lack of pool habitat.

The Three Mile Creek drainage is generally in poor condition. Sewage effluent from the town of Grangeveille, Idaho flow into this system high in the watershed. Riparian vegetation throughout the upper watershed is degraded due to grazing and agricultural activites.

Solution: Extensive riparian enhancement is recommended in the upper Three Mile Creek watershed. Check dams constructed at strategic locations where sediment input is greatest would reduce sediment load to the lower sections of the stream, which are potentially usable by anadromous salmonids. The lower 9.5 km of Three Mile Creek requires extensive pool construction, which could be maintained with either check dams or boulder groups. In locations where floodplains now exist rechannelization (meanders) is recommended with subsequent riparian enhancement to establish new banks and riparian zones.

Predicted results:

1. Increased pool habit& and instream cover in the lower 9.5 km of stream.
2. Decreased water temperatures and sedimentation.

3. Decreased peak runoff.

Specific activities:

1. Rechannelization 2.4 km
2. Riparian vegetatian - 24.1 km
3. Check dams - (sedimentation - 25)
4. Check dams -(Pool construction - 100)

Land ownership:

100% Private

Water rights:

1.24 cfs

Whiskey Creek

Problem: Sedimentation

Except for the upper '4.8 km of Whiskey Creek, where logging and agricultural activities have degraded the riparian zone leading to increase sediment input, the drainage is generally in good condition.

Solution: Riparian enhancement is recommended for the upper 4.8 km of Whiskey Creek. In addition, a dirt road crossing the creek at approximately SK 19.3 should be stabilized to reduce erosion. (resident fish only)

Predicted results:

1. Decreased sediment load to the upper drainage.
2. Decreased water temperature.

Specific activities:

1. Riparian enhancement - 4.8 km
2. Road stabilization - 1 location

Land ownership:

25% State

75% Private

Water rights:

0.49 cfs

Willow Creek

Problem: Sedimentation;lack of instream cover; high temperatures.

Willow Creek is a severely degraded stream due to grazing and agricultural activities. Riparian vegetation is absent throughout most of the watershed. Bank erosion is prevelent along the entire length of the stream proper. Smaller tributaries are generally in better condition.

Solution: Extensive riparian rehabilitation and bank stabilization is recommended for the entire drainage. In addition to short woody vegetation, it is recommended overstory cover also be included due to the exposed nature of the streams location in an open valley.

Predicted results:

1. Decreased bank erosion.
2. Decreased sediment load.
3. Reduced water temperatures.

Specific activities:

1. Riparian enhancement - 11.2 km
2. Bank stabilization - 8 km

Land ownership:

100% Private

CONCLUSIONS

The major objective of this survey was to determine to what extent anadromous salmonids utilize streams which flow all or in part through the Nez Perce Reservation. As this report is the conclusion of two years of inventory, the first which was reported by Kucera et al (1983), this conclusion section will summarize data for both years.

Rainbow-steelhead trout were found in all streams surveyed during 1982 and 1983 with the exception of Cottonwood Creek (SF Tributary). Barriers to migration were found on Cottonwood Creek (SF Tributary), Jim Ford, Three Mile, Lawyers, Whiskey, Sweetwater, Webb and Lapwai Creeks. In the case of the other streams, water flow would be the major limitation to upstream movement of adults.

The five highest densities of overyearling rainbow-steelhead were found in Little Canyon (Middle), Cottonwood (L Middle), Big Canyon (Middle), Big Canyon (L Middle), and Jacks (Middle) Creeks. (Table 72). The five highest densities of subyearling rainbow-steelhead were found in Tom Taha (Lower), Six Mile (Middle), Bedrock (Middle), Pine (#2), and Big Canyon (L Middle) Creeks (Table 73). Chinook salmon, juveniles found occasionally at stream mouths throughout the lower Clearwater Basin, were found in great numbers only in Lolo Creek (#4).

In order to plan for the future enhancement of the lower Clearwater River Basin, criteria for prioritization of streams are necessary so that the relative enhancement potential of such streams is rated. The following criteria are very general and are meant only to identify the four streams with the most enhancement potential from all streams surveyed.

The most critical parameter affecting fish production is the amount of waterflow within a stream. The amount of flow dictates the extent of enhancement of the habitat. The second most critical parameter is the quality of the water, including temperature, nutrients, and pollutants. The third parameter, in order of importance to fish production, is the rate of sediment input into the stream. The fourth factor, and by far the easiest to enhance, is the physical habitat (depth, width, velocity, cover, etc.). These parameters are also in order of their complexity and cost in relation to attempts to alter their present conditon.

Following this line of reasoning, two streams were identified from the group surveyed during 1982 and 1983 as having the best potential for enhancement of anadromous fish production.

1. Lolo Creek System
2. Big Canyon Creek System

These streams had the largest watersheds and the highest annual flows with good quality water in the lower basin. Both streams exhibited problems with sedimentation and habitat availability to varying extents.

Two additional criteria are necessary to finalize the prioritization process. These are not physical but policy criteria. The first consideration is the importance of the species to be enhanced. The second consideration is the excediency of an enhancement project (i.e., a project would be easier if done on land controlled by the initiator of the project). Federal, State, or Tribally controlled land would be easier to access than privately owned land.

The top two streams which have most potential for enhancement within the lower basin are:

1. Lolo Creek System

This stream has the highest flow of good quality water of those streams surveyed. This stream can support both rainbow-steelhead trout, spring chinook, and possibly fall chinook salmon. Ninety percent of the critical land associated with this stream is either federal or state controlled.

2. Big Canyon Creek System

This stream has one of the two highest flows of good quality water. It can support rainbow-steelhead trout in its lower 19.3 kilometers. Only about 5% of this critical land is controlled by the federal government. The inaccessability and its location entirely within the Nez Perce Reservation make enhancement of this stream feasible,

Most of the streams inventoried during 1982 and 1983 were found to have habitats in marginal condition,though a wide range of habitat conditions were found from good to bad. The majority of these streams were at a point where further degredation could severely limit salmonid production. As the streams inventoried were generally small with privately owned watersheds, enhancement activities may be logistically complicated (easements, land use contracts, right of ways). Habitat protection to maintain the stream systems in their present state of marginal salmonid production may be the priority approach.

Orofino Creek, Potlatch River and Clear Creek also flow within the reservation, and are large systems similar to Lolo and Big Canyon Creeks. Inventory data is lacking on these streams and it is reccommeded that inventory activities continue on these streams.

The Habitat Quality Index (HQI)was originally intended to describe the relationships between salmonid biomass and habitat quality. These relationships have yet to be modelled accurately. This model would have potentially described the carrying capacity of the streams surveyed which would have identified to what extent the streams were seeded.by returning adults. In addition, the optimum production within the streams (following enhancement activities) could have been predicted. These data are critical to the enhancement planning and prioritization process.

Table 72. A ranking of overyearling rainbow-steelhead population found in the lower Clearwater River Basin, Idaho, 1982, 1983.

Stream	Station	Standing Crop kg/ha	Density fish/m2
Little Canyon	Middle	89.1	0.13
Cottonwood	L Middle	87.6	0.22
Big Canyon	Middle	78.6	0.18
Big Canyon	L Middle	42.8	0.13
Jacks	Middle	41.7	0.19
Whiskey	1	39.8	0.02
Sally Ann	1	38.6	0.39
Pine	2	37.8	0.25
Bedrock	Middle	35.6	0.16
Bedrock	2	35.6	0.60
Yakus	1	31.4	0.18
Big	1	26.7	0.08
Wall	1	24.3	0.18
Lapwai	Middle	24.2	0.04
Butcher	2	23.1	0.06
Lolo	5	22.2	0.13
Jim Ford	2	21.8	0.07
Big Canyon	Lower	20.4	0.04
Mission	U Middle	18.7	0.03
Pine	1	17.3	0.10

Table 73. A ranking of subyearling rainbow-steelhead population found in the lower Clearwater River Basin, Idaho, 1982, 1983.

Stream	Station	Standing Crop kg/ha	Density fish/m2
Tom Taha	Lower	98.2	3.6
Sixmile	Middle	55.1	2.4
Bedrock	Middle	23.1	1.6
Pine	2	18.4	1.0
Big Canyon	Middle	17.5	1.2
Whiskey	1	14.9	0.7
Sally Ann	1	14.7	1.1
Little Canyon	Middle	13.2	0.2
Jim Ford	2	9.6	0.4
Cottonwood	.L Middle	1.5	0.5
Lapwai	Middle	6.9	0.7
Yakus	1	6.7	0.6
Wall	1	5.2	0.5
Clear	Middle	4.7	0.1
Maggie	2	3.3	
Cottonwood	Middle	3.1	0.2
Lolo	5	3.0	
Sweetwater	Middle	2.2	0.1

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