RECONNAISSANCE (1:20,000) FISH AND FISH HABITAT INVENTORY OF HORSETHIEF CREEK (300-971300)

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TIMBERLAND CONSULTANTS

PROJECT REFERECE INFORMATION

MELP Project Number	KBM98203
FRBC Activity Number	18988
FDIS Project number	1964
FRBC Region	Kootenay/Boundary
MELP Region	Kootenay Region
MELP District	Invermere District
FW Management Unit	4-26
Fisheries Planning Unit	N/A
DFO Sub-District	N/A
Forest Region	Nelson Forest Region
Forest District	Invermere Forest District
Forest Licensee and Tenure #	Slocan Forest Products Ltd. Radium Division

WATERSHED INFORMATION

Watershed Group	COLR
Watershed Name	Horsethief Creek
Watershed Code	300-971300
UTM at Mouth	11.566654.5603101
Watershed Area	61.511 ha
Total Stream Length	1582.74 km
Stream Order	Sixth order
NTS Map	82K/07, 82K/08, 82K/09, 82K/10
TRIM Map	82K.047, 048, 049, 057, 058, 059, 060, 067, 068, 069
BEC Zone	ICH and ESSF
Air Photos	BCB95062 92-242, BCB95063 11-13, BCB95093 7-13

SAMPLING DESIGN SUMMARY

Total Number of Reaches	3034
Random Sampling Sites	54
Discretionary Sample Sites	40
Total Sample Sites	94
Field Sampling Dates	September 7 to 10, 1999

CONTRACTOR INFORMATION

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DISCLAIMER

"This product has been accepted as being in accordance with approved standards within the limits of Ministry quality assurance procedures. Users are cautioned that interpreted information on this product developed for the purposes of the Forest Practices Code Act and Regulations, for example stream classifications, is subject to review by a statutory decision maker for the purposes of determining whether or not to approve an operational plan."

ACKNOWLEDGMENTS

This reconnaissance (1:20,000) fish and fish habitat inventory describes watershed-wide fish distributions and habitat characteristics for all sub-watersheds within the project area. Timberland Consultants Ltd. was commissioned by Slocan Forest Products Ltd. to undertake this inventory to the standards specified by the Ministry of Environment, Lands, and Parks.

Funding for this inventory was provided by Forest Renewal BC. Slocan Forest Products Ltd. wish to recognize the efforts of the Province of British Columbia (Hon. Dan Miller, Premier), in the development of a baseline inventory of fish and fish habitat as an important step in the management of the resource.

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1.0 INTRODUCTION

1.1 Project scope/objectives

This project was a Forest Renewal British Columbia (FRBC) funded study, initiated to address one objective. This objective was to describe watershed-wide fish distributions and habitat characteristics. Until recently, such baseline fisheries information was unavailable or limited for many watersheds in British Columbia. The Reconnaissance (1:20,000) Fish and Fish Habitat Inventory (RIC 1999a) is a standard methodology to obtain baseline fishery resource information. The inventory sampling plan was developed through cooperation between the Ministry of Environment, Lands, and Parks (MELP) and Slocan Forest Products Ltd. (SFP).

1.2 Location

Horsethief Creek is a large sixth order watershed located west of Radium Hot Springs (Figure 1). The Horsethief Creek watershed contains 51 third order streams, 11 fourth order streams, and 2 fifth order streams.

Figure 1. Overview Map of Study Area

1.2.1 Access

A helicopter was used to access the majority of the sampling sites in the study area (29 sites). Road access was available to reaches near the mainstem. Many of the roads shown on the map that access the back end of some of the smaller watersheds within the Horsethief Creek drainage are old mining roads that have either been deactivated or are not accessible by vehicle (i.e. Law Creek, McDonald Creek, Farnham Creek).

Directions to Horsethief Creek from Radium are as follows:

- Turn left off Highway 95, opposite the turn off right onto Highway 93, towards the lumber mill and airfield (approximately .5km).
- Turn left onto the Horsethief Forest Service Road (FSR).
- Stay on this road to access the majority of the roads in the Horsethief drainage.
- To access Bruce Creek and Law Creek by road you have to go to Wilmer using Forsters Creek FSR (approximately 10km).
- Once in Wilmer turn right onto Bruce Creek FSR. Drive approximately 20km to reach the lower reaches of Bruce Creek.
- You can also get to Wilmer via Invermere.

2.0 RESOURCE INFORMATION

i. First Nations issues and interests:
None identified.

ii. Development and land use:
Logging: Present.
Mining: Past and present small mining claims.
Recreation: Hiking, canoeing, kayaking, and camping.

iii. Other developments and concerns: Some of the land on the valley floor is used as pasture land for cattle.

iv. Uses by wildlife:
Ungulates, carnivores, fur bearers, and avian species occur within the study area.

v. Hydrology:
Water Survey of Canada Gauging Station No. 08NA005 is located 3km upstream from the mouth of Horsethief Creek (Environment Canada 1991). Peak flows measured at this station occur during June and July (Figure 2).

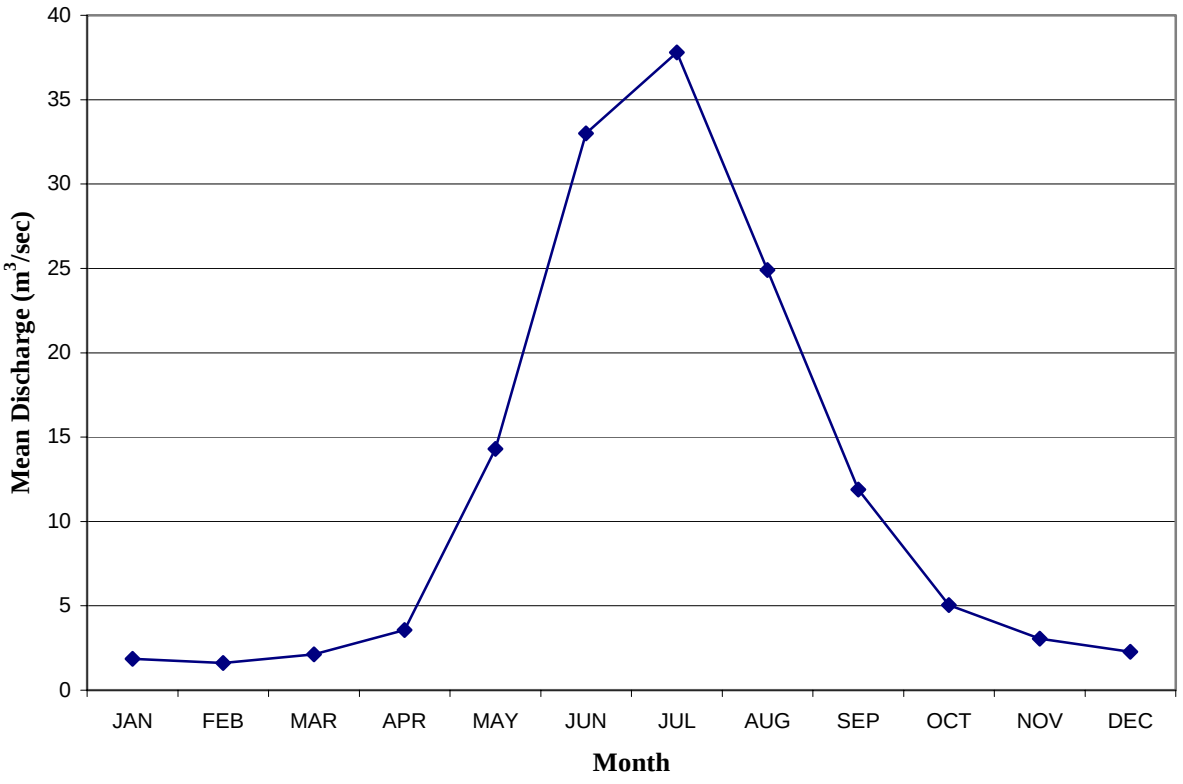

Figure 2. Mean monthly discharge for Horsethief Creek near Wilmer (Station # 08NA005) from 1912 to 1951 (Environment Canada 1991).

vi. Previous presence of fish:

Previous fisheries information was available for some streams within the study area (Table 1).

Table 1. Previously documented presence of fish in Horsethief Creek watershed.

Stream Name	Watershed Code	Species	Information Source**
Horsethief Creek	300-971300	BT, CC, KO, LNC, LSU, MW, RB, WCT	FISS database and maps (1995 & 1999)
	300-971300-42800	LSU, MW, WCT	FISS database and maps (1995 & 1999)
	300-971300-55500	NFC	Interior Reforestation 1999
	300-971300-42800	NFC	Interior Reforestation 1999

*BT=bull trout, CC=sculpin, KO=Kokanee, LNC=longnose dace, LSU=longnose sucker, MW=mountain whitefish, RB=rainbow trout, WCT=westslope cutthroat trout, and NFC=no fish caught
**FISS=Fisheries Information Summary System

3.0 METHODS

The Pre-field Project Plan for Phases 1 to 3 of Slocan Forest Products Ltd's Chart Area identified a total of 94 sites for sampling. Field surveys were conducted between September 7 to September 10, 1999. Procedures for completion of the site card and fish card were consistent with the Reconnaissance (1:20,000) Fish and Fish Habitat Inventory (RIC 1999a).

Fish sampling was completed using either a Smith Root 12A POW backpack electrofisher or a Smith Root 12B backpack electrofisher, between two sampling crews. Where no fish were captured in the first 100 lineal meters or 10 times the bankfull width (whichever was greater) of electrofishing, an additional 100 lineal meters was sampled. Minnow traps were deployed as a second fish sampling method. The traps were baited with dry dog food and set in a variety of habitat types including pools (Category 1, 2, or 3), runs, glides, and riffles. Traps were left in place to fish overnight. Angling was also conducted as a second method at some sites and a first method at sites where water levels were to high to complete electrofishing effectively. At difficult access sites (helicopter or long hikes) sampling was conducted by electrofishing only.

Temperature, pH, and conductivity were measured using an Aqua Check Multiparameter Probe, Version 7.0. Disposable 35mm cameras were used for photodocumentation.

Data collected in the field was entered into Version 7.3 Field Data Information System (FDIS).

3.1 Alterations to the Project Plan

A total of 51 sites were deleted from the original 94 sites generated from the random sampling process during Phases 1-3 of the Inventory. Fifty of the 51 sites were deleted upstream of a chute located in Reach 14 of Horsethief Creek. When no fish were captured at any of the 16 sites sampled upstream of Reach 14, the remaining sites were deleted. A site located on 300-971300-33100 Reach 4 was deleted when Reach 2 on the same stream was sampled and determined a non-visible channel.

A sample site was moved from Reach 2 in Farnham Creek to Reach 3. Reach 2 was located in a steep walled canyon and was not accessible to complete fish sampling. Site 48 was moved from 300-971300-42800-45700 Reach 1 to 300-971300-42800 Reach 6. This site was moved because the tributary (300-971300-42800-45700, Reach 1) was dry. Moving this site allowed fish sampling to be completed in this watershed.

Voucher specimens were not collected in this drainage due to the low numbers of fish captured and identification of the different fish species was easily determined.

4.0 RESULTS AND DISCUSSION

4.1 Logistics

The cool and wet weather conditions during the 1999 field-sampling period contributed to high and prolonged stream discharge in the larger systems. The high water levels made it difficult and unsafe to sample many of the larger streams. Angling and minnow traps were deployed at sites where discharge was too high to electrofish efficiently and safely.

4.2 Summary of Sub-Basin Biophysical Information

Horsethief Creek is a sixth order watershed that covers an area of 61,511ha. The Horsethief Creek mainstem extends approximately 65km. The study area can be divided into seven sub-basins within the drainage. These sub-basins are Horsethief Creek, Bruce Creek, Law Creek, Gopher Creek, McDonald Creek, Stockdale Creek, and Farnham Creek (Table 2).

Table 2. Summary of watershed information for the Horsethief Creek Watershed.

Stream Name	Watershed Code	UTM at mouth	Watershed Area (ha)	Stream Length (km)	Stream Order	NTC Maps	BEC Zone	Lake Names	Wetlands
Horsethief Creek	300-971300	11.566654.5603101	27,140	635	6	82K/7, 82K/9, 82K/10	MS, ESSF, AT	Lake of the Hanging Glacier	60 wetlands, 7,672,047m^2 total area.
Bruce Creek	300-971300-26300	11.554444.5601626	5,358	144	5	82K/8, 82K/9	MS, ESSF		1 wetland, 42,252$m^{2.}$
Law Creek	300-971300-26300-22800	11.552213.5549110	2,721	73	4	82K/9	MS, ESSF		none
Gopher Creek	300-971300-48100	11.545265.5601683	1,863	52	4	82K/9	MS, ESSF		2 wetlands, 249,023m^2.
McDonald Creek	300-971300-57600	11.540714.5602184	5,052	142	4	82K/8, 82K/9	MS, ESSF, AT		1 wetland, 1,434m^2.
Stockdale Creek	300-971300-68700	11.535524.5600657	11,621	328	5	82K/10	ESSF, AT		none
Farnham Creek	300-971300-79100	11.531625.5595960	7,756	241	5	82K/7	ESSF, AT		none

4.3 Habitat and Fish Distribution

4.3.1 General Characteristics and Observations

Stream flows this year were much higher than in the past and remained higher for a longer period of time. Flows did not appear to drop significantly in the Nelson Forest Region until mid September. These high flows may directly and indirectly relate to the very low numbers of fish captured in many watersheds this year.

High discharges (i.e. floods) and increased mean channel velocities can displace resident fishes. Previous studies indicate floods can significantly decrease total fish numbers and also show that it takes approximately 2 years for trout populations to recover to pre-flood densities (Lamberti, 1991; Niemi et al, 1990). Young of the year fishes may be particularly vulnerable to floods because of their poor swimming ability and small size (Harvey, 1987). During a flood adult fish are often displaced due to the decreased habitat, since pools fill with sand and debris (Seegrist and Gard, 1972). In addition, adfluvial species typically initiate upstream migration into tributaries during the falling crest of the freshet. It is likely that this year adfluvial species such as bull trout may have delayed this behavior due to prolonged high flow conditions.

Flooding often increases suspended sediments in streams. Suspended sediments, at high enough concentrations and for sustained periods, can interfere with normal gill functions limiting respiration and may result in death (Cordone and Kelley, 1961). In addition, suspended sediment can affect the survival rate of developing trout embryos, by clogging the pore spaces between gravels decreasing the supply of oxygen (Peters, 1962).

Flooding can drastically reduce the invertebrate fauna in streams (Siegfried and Knight, 1975). The scouring action of floodwaters will often dislodge organisms from the substrate (Siegfried and Knight, 1975), thus reducing the available forage once floods subside.

These severe conditions were present in the majority of watersheds sampled and likely had a negative impact on total numbers of fishes encountered during sampling efforts. The high flows of 1999 may have produced conditions where food and rearing habitat were limited combined with increased sediment flushing downstream. Electrofishing effort in the larger streams were impeded, due to difficult wading conditions caused by high velocities and larger volumes of water.

Fish distribution within any given watershed is the result of a wide variety of factors including the presence of migration barriers, presence of suitable overwintering habitat, maintenance of suitable year round flows, and previous stocking. Where possible, this report identifies specific factors that can explain the absence of fish from a given reach. For the purposes of describing fish habitat and distribution, the study area was divided into eight sub-basins within the drainage. These sub-basins are lower Horsethief Creek mainstem (starting at the mouth up to the confluence with Stockdale Creek), Bruce

Creek, Law Creek, Gopher Creek, McDonald Creek, Stockdale Creek, Farnham Creek and upper Horsethief Creek mainstem (starting at confluence of Stockdale upstream to the headwaters).

The lower section of Horsethief Creek up to the confluence with Stockdale Creek is a sixth order stream (Reach 1 to 17). Channel gradient through the lower reaches of Horsethief Creek does not exceed 3%, except for in Reach 14 where the gradient is 4.5%. The first 11 reaches and Reaches 15 to 17 can generally be characterized as irregular wandering in a frequently confined channel. A waterfall is located in Reach 6 that prevents upstream migration of fish from the Columbia River (Table 2 and Appendix 1, Figure 1b). Reaches 12 and 13 are comprised of riffle-pool morphology meandering next to a large swamp/marsh area. This swamp area has been named "the Grottos" (i.e. local name). Reach 14 is comprised of cascade-pool morphology and flows through a steep walled canyon. A large chute is located within this canyon preventing upstream migration of resident fish populations (Table 3 and Appendix 1, Figure 1, Interpretive Map 4 of 4). Fish do not inhabit this watershed upstream of this barrier.

Reach 1 of Horsethief Creek supports a diverse fish community, which includes bull trout (*Salvelinus confluentus*), rainbow trout (*Oncorhynchus mykiss*), westslope cutthroat trout (*O. clarki lewisi*), kokanee (*O. nerka*), mountain whitefish (*Prosopium williamsoni*), longnose dace (*Rhinichthys cataractae*), longnose sucker (*Catostomus catostomus*), and sculpins (*Cottus spp*.). The high diversity may be related to the close proximity to the Columbia River. Some species may utilize lake, large river and stream habitat during their life cycle. Adfluvial bull trout for example, may spawn and rear in Horsethief Creek and its tributaries and then migrate into Columbia River as juveniles and adults to feed and mature. These fish species may utilize Horsethief Creek up to the waterfall in Reach 6.

Resident populations of bull trout, westslope cutthroat trout, mountain whitefish, longnose sucker and longnose dace exist upstream of the waterfall in Reach 6 and downstream of the chute in Reach 14 (Interpretive Map 3 of 4 and 4 of 4). Longnose sucker was the dominant species captured within "the Grottos". Westslope cutthroat trout was the only species captured in a small tributary (ILP 12433) that flows into the Grottos. Fish presence is assumed in the lower reaches of all tributaries to Horsethief Creek (located downstream of Reach 14 on the mainstem of Horsethief Creek) with a gradient less than 20%. Reaches exceeding 20% are assumed non-fish bearing.

Bruce Creek is a fifth order stream that flows north east into Horsethief Creek. The mainstem of Bruce Creek is approximately 20km long and was separated into 19 reaches. The valley walls are very steep and water is only present in gullies during peak runoff. The majority of the streams shown on the TRIM maps are non-visible channels or slide chutes that may have water present only during snowmelt. Reaches 1 through 13 range in gradient from 4% to 9% and can be characterized as cascade-pool or step-pool morphology. A gradient barrier and dewatered section of stream was located in the middle of Reach 13 that is a fish migration barrier (Table 3). No fish were captured

upstream of this gradient barrier and dewatered section. Four bull trout were captured in Reach 6 and 10 of Bruce Creek.

Law Creek is a fourth order stream that flows north east into Bruce Creek. The mainstem of Law Creek is approximately 13km long and was separated into 12 reaches. Reaches 1 to 3 are fairly steep with an average gradient of 14% and step-pool morphology. The gradient in Reaches 4 to 6 decreases to approximately 5% creating cascade-pool morphology. Reach 7 has a gradient of 33% creating a definite fish migration barrier. Upstream of Reach 7 the channel alternates between step-pool and cascade-pool morphology. No fish were captured in Reach 2 or Reach 9 during this inventory. We suspect that a gradient barrier exists in Reach 1 preventing upstream fish migration. The valley walls of Law Creek are very steep and water is only present in gullies during peak runoff. The majority of the streams shown on the TRIM maps are non-visible channels or slide chutes that may have water present only during snowmelt.

Gopher Creek is a fourth order stream that flows north into Horsethief Creek. The confined channel flows in a sinuous pattern down a fairly steep valley wall. Reach 1 has a gradient of 5% and likely supports fish. Reach 2 has a site gradient of 14% and Reach 3 has a reach gradient of 20%. Reach 2 was sampled during this study and no fish were captured. A fish migration barrier was not located between the confluence of Horsethief Creek and the site located in Reach 2 therefor fish are suspected to inhabit this creek up to the gradient barrier of Reach 3. A debris flow ripped down the channel (in August 1999) and caused major disturbance to the stream channel (Appendix 1, Figure 42 and 43). We suspect that the recent disturbance to the channel may have flushed fish downstream to more stable habitat.

McDonald Creek is a fourth order stream that flows north from it glacier headwaters into Horsethief Creek. The mainstem of McDonald Creek was separated into 13 reaches. Stream gradients along the mainstem of this watershed range from 3% to 48%. The majority of the mainstem can be characterized as cascade-pool or step-pool morphology. No fish were captured in McDonald Creek due to its location upstream of the fish barrier in Reach 14 of Horsethief Creek.

Stockdale Creek is a fifth order stream that flows north from the glaciers at the headwaters then east at the confluence with Edourd Creek until it enters Horsethief Creek. The mainstem of Stockdale Creek was divided into 15 reaches. The first two reaches have a relatively steep gradient (averaging 15%) and a large chute is located approximately 100m upstream of the confluence with Horsethief Creek (Table 3, and Appendix 1, Figure 56). Reaches 3 to 8 (excluding Reach 6) have an average gradient of 2% creating riffle-pool morphology. Reach 6 flows through a canyon and has a gradient of 23%. Reaches 9 to 13 have an average gradient of 6% creating cascade-pool morphology. This watershed contains no fish due to the impassable chute located in Reach 14 of Horsethief Creek.

Farnham Creek is a fifth order stream that flows north west into Horsethief Creek. The Commander Glacier and other unnamed glaciers are located throughout the headwaters of this watershed. Reach 2 on the mainstem of Farnham Creek flows through a large canyon suspected to contain a chute or waterfall. Upstream of Reach 2 the gradient decreases and the channel changes to riffle-pool morphology and cascade-pool morphology up to Reach 6. The channel through these reaches is frequently confined and has an irregular wandering pattern. Reaches 7 to 11 are confined and have a sinuous pattern with gradients of 17% to 58% creating step-pool morphology. No fish were captured in this watershed due to the chute located in Reach 14 of Horsethief Creek.

The upper section of Horsethief Creek, from the glacier headwaters downstream to the confluence of Stockdale Creek, is a fifth order stream (Reaches 18 to 30). A frequently confined channel with a sinuous pattern characterizes reaches 18 to 22. Reach 23 is straight and steep containing a large waterfall (Appendix 1, Figure 13). Reaches 25 to 28 have fairly steep gradients creating step-pool morphology. Fish were absent in these reaches due to the chute in Reach 14 of Horsethief Creek.

The Lake of the Hanging Glacier is located in Reach 30 of Horsethief Creek. The head wall of a glacier is located at the inlet of the 165ha lake. No existing fisheries information was available for the Lake of the Hanging Glacier. A sample site was located in Reach 28 approximately 500m downstream of the lake with no fish captured. The water temperature at this site was 5°C on a sunny day in mid-September. In addition, during the overview flight the helicopter flew approximately 50m above the lake and no fishes were observed. We also suspect that the low water temperatures and prolonged ice-up expected due to the glacier, would cause limiting growth conditions.

The Horsethief Creek watershed upstream of the chute in Reach 14 of Horsethief Creek could easily support a resident population of fish. There are abundant lakes at the headwaters and the mainstems of the fourth and fifth order streams have good habitat that could support fish year round (i.e., spawning, rearing, adult holding, overwintering habitat etc.).

Table 3. Summary of historic and new barriers to fish migration found in Horsethief Creek Watershed, September 7 to September 10, 1999.

Stream Name	Watershed Code/ILP	TRIM map #	Reach	Site	Barrier Type [1]	Height of Barrier (m)	Verified in Field (Y or N)	Description of Barrier
Horsethief Creek	300-971300		6	N/A	F	N/D	Y	Falls are a barrier to fish migrating upstream from the Columbia River. Height was not distinguishable due to interpretation from the helicopter.
Horsethief Creek	300-971300		14	N/A	C	N/D	Y	Chute is a barrier to upstream migration of the resident fish population. Height was not distinguishable due interpretation from the helicopter.
Horsethief Creek	300-971300	82K.047	22	37	F	40	Y	Waterfall, fish migration barrier.
	300-971300-42800	82K.059	6	48	CV	0.5	Y	Double culvert.
	300-971300-43000	82K.059	4	51	CV	0.4	Y	Culvert.
Gopher Creek	300-971300-48100	82K.059	2	53	NS	6	Y	Debris flow from upstream. Is not a fish migration barrier.
Gopher Creek	300-971300-48100	82K.059	5	54	C	8	Y	Upstream fish migration barrier.
Stockdale Creek	300-971300-68700	82K.058	1	65	C	25	Y	Large chute; fish migration barrier

[1] CV = culvert, F = falls, C = chute or cascade, UNK = unknown, N/D = not determined

4.4 Fish Age, Size and Life History

During this inventory project 5 species of fish were captured; bull trout, westslope cutthroat trout, mountain whitefish, longnose dace, and longnose sucker (Table 4). Although FISS records indicate that kokanee, rainbow trout, and suckers utilize the lower reaches of Horsethief Creek, these species were not captured during this inventory since no sampling was conducted downstream of Reach 9 on Horsethief Creek.

Table 4. Summary of length-at-age data from fish sampled in the Horsethief Creek Watershed, September 7 to September 10, 1999.

Stream Name	Watershed Code	Species	Maturity	Total Fish	Mean Length (mm)	Range of Lengths	
						Min Length (mm)	Max Length (mm)
	12433	WCT	IM	1	20	20	20
	12433	WCT	M	1	142	142	142
	12433	WCT	MT	24	87	68	110
Bruce Creek	300-971300-26300	BT	IM	3	71	10	102
Bruce Creek	300-971300-26300	BT	MT	1	178	178	178
	300-971300-43000	BT	MT	1	200	200	200
	300-971300-43000	LNC	IM	6	26	23	30
	300-971300-43000	LNC	MT	2	65	50	80
	300-971300-43000	LSU	MT	19	65	40	108
	300-971300-43000	MW	MT	1	56	56	56
	300-971300-43000	WCT	MT	1	154	154	154
	300-971300-43000	WCT	M	1	309	309	309

BT=bull trout, WCT=westslope cutthroat trout, LNC=longnose dace, LSU=longnose sucker, MW=mountain whitefish
M=Mature, MT=Maturing, IM=Immature

The lower reaches of Horsethief Creek may be an important spawning area for adfluvial bull trout and kokanee from the Columbia River. A total of 1 mountain whitefish, 8 longnose dace, 19 longnose suckers, and 5 bull trout were captured during this inventory (Table 4). With the low number of these different species captured, a length-frequency histogram was not produced for all species.

Westslope cutthroat trout ranged in size from 20mm to 309mm (Figure 2). With a total of 28 westslope cutthroat trout captured, this was the most abundant species within this watershed. A small tributary to "the Grottos" had the greatest number of westslope cutthroat trout captured of any site sampled with a total of 26.

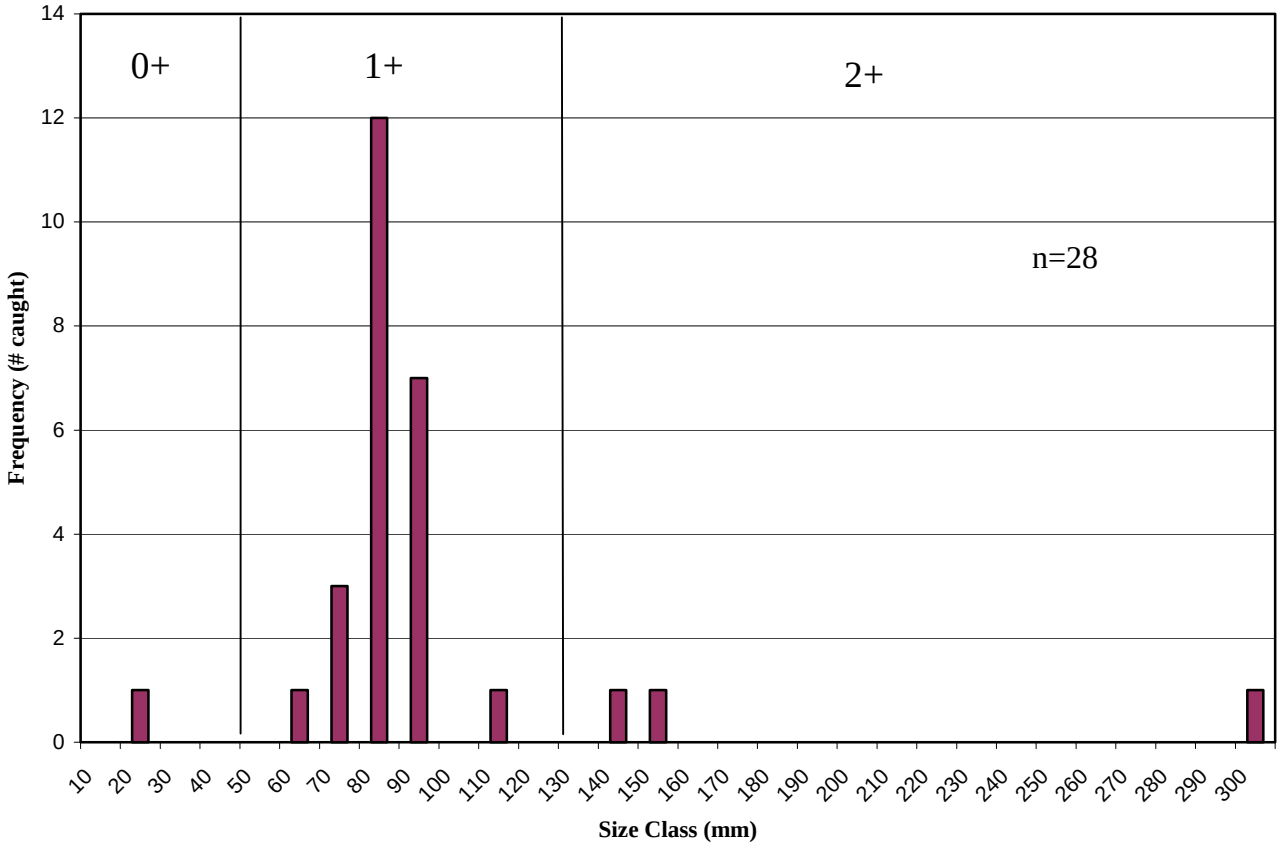

Figure 3. Length-frequency histogram and suggested age classes of sampled westslope cutthroat trout from the Horsethief Creek watershed, September 7 to September 10, 1999.

Three age classes were distinguishable from the histogram (Figure 3). Twenty-six of these westslope cutthroat trout were captured in one small tributary with excellent spawning habitat. The low number of young of the year captured in this tributary may be due to the electrofishing settings were able to capture larger fish easier than the small fish or the young of the year may have still been emerged in gravel.

4.5 Significant Features and Fisheries Observations

4.5.1 Fish and Fish Habitat

The complex of wetlands and lakes along Horsethief Creek (300-971300-43000) provide deep water, with abundant instream vegetation for a variety of fish species including bull trout, westslope cutthroat trout, mountain whitefish, longnose dace, and longnose sucker. A small unnamed tributary (ILP 12433) that was sampled during this study had excellent spawning habitat. Twenty-six young of the year westslope cutthroat trout were captured at this site indicating important spawning and rearing habitat within this reach.

Although adfluvial bull trout may utilize the lower reaches of Horsethief Creek, no additional information regarding this occurrence was documented during this study, except for the resident population upstream of the chute in Reach 6. Bull trout, considered sensitive and vulnerable, are a blue listed species in the Province of BC (CDC 1999).

Existing information indicates that kokanee spawning extends approximately 14km upstream from its confluence with the Columbia River (Oliver, 1995). Escapement estimates of between 12,000 to 15,000 spawning kokanee indicates that the lower reaches of Horsethief Creek is a high value spawning stream (Oliver, 1995). Enumerations from a helicopter flown approximately 50 m above ground level were completed on Horsethief Creek in 1996 and 1997 by W.T. Westover from the Ministry of Environment, Lands and Parks in Cranbrook. In 1996 there were an estimated 7,575 spawning kokanee and in 1997 the number declined to 194 spawning kokanee.

Horsethief Creek watershed may be considered a high value sport-fishing stream. However, due to the area that was sampled (upstream of 20 km on the mainstem from the confluence) and the low intensity of fish sampling conducted we cannot conclude that this watershed is a high value sport-fishing stream. Based on existing studies completed on the lower reaches of Horsethief Creek these 14 km of stream have the potential to be a high value spawning stream for kokanee.

4.5.2 Habitat Protection Concerns

4.5.2.1 Fisheries Sensitive Zones

We did not identify any Fishery Sensitive Zones during the inventory.

4.5.2.2 Fish above 20% Gradients

No fish were captured in any reach with a gradient greater than 20% in the Horsethief Creek watershed.

4.5.2.3 Restoration and Rehabilitation Opportunities

One habitat concern was identified during this inventory. A debris flow occurred in Reach 1 to 3 of Gopher Creek (Appendix 1, Figure 42 and 43). The debris flow was caused by a heavy rainfall in August and started in the alpine and carried to Horsethief Creek (V. Jablanczy, SFP (Radium), pers. comm. 1999). A very large amount of sediment was transported downstream impacting the stream channel. Riparian vegetation was removed from the streambank during this event. Rehabilitation and restoration work could be completed to re-establish vegetation along the streambank and add in-stream structures to provide holding cover for fish.

4.6 Fish Bearing Status

4.6.1 Fish Bearing Reaches

Of the 43 sites sampled, 6 sites were fish bearing and 2 are expected to be fish bearing (Table 5).

Table 5. Summary of data from surveyed fish bearing reaches in Horsethief Creek Watershed, September 7 to September 10, 1999.

Stream Name	Watershed Code	Reach	Site	Species	Channel		Proposed Riparian Class	Follow-up Sampling (Y or N)	Comments
					Gradient (%)	Width (m)			
	12433	1	34	WCT	1	2.0	S3	N	24 young-of-the-year WCT captured in this reach. Good spawning/rearing habitat.
Bruce Creek	300-971300-26300	2	39		9	12.0	S2	N	Fish bearing even though no fish caught because BT were captured upstream.
Bruce Creek	300-971300-26300	6	40	BT	5	10.2	S2	N	Only 1 fish captured in this reach.
Bruce Creek	300-971300-26300	10	41	BT	2	8.3	S2	N	All fish captured under nice undercut bank.
	300-971300-43000	1	49	BT, LNC, LSU, MW	1	3.6	S3	N	Deep slow moving water. Abundant vascular plants in channel.
	300-971300-43000	2	50	WCT, LSU	1	21.7	S1	N	Large WCT (309mm) captured by angling.
	300-971300-43000	4	51	WCT	13	1.1	S4	N	Small channel with abundant overhanging vegetation.
Gopher Creek	300-971300-48100	2	53		14	7.1	(S2)	Y	Did not catch fish but suspect fish could inhabit this reach since a gradient barrier was not located downstream. In addition a recent debris flow impacted this stream and may have flushed fish downstream.

BT=bull trout, WCT=westslope cutthroat trout, LNC=longnose dace, LSU=longnose sucker, MW=mountain whitefish

4.6.2 Non-Fish Bearing Reaches

Of the 43 sites sampled, 35 sites were non-fish bearing (Table 6).

Table 6. Summary of data from surveyed non-fish bearing reaches in Horsethief Creek Watershed, September 7 to September 10, 1999.

Stream Name	Watershed Code/ILP	Reach	Site	Gradient (%)	Proposed Riparian Class	Electrofishing Specifications				Other Methods		Comments
						Dist (m)	Time (sec)	Cond (uS)	Temp (C)	Type	Effort	
	5678	1	11		N/A							Non-visible channel.
	10355	1	16		N/A							Non-visible channel.
	11144	1	20		N/A							Non-visible channel.
	11209	1	21		N/A							Non-visible channel.
	11436	1	22		N/A							Non-visible channel.
	12215	1	29		N/A							Non-visible channel.
	12226	1	30		N/A							Non-visible channel.
	12363	3	31		N/A							Non-visible channel.
	12390	1	32		N/A							Non-visible channel.
	12402	1	33		N/A							Non-visible channel.
Horsethief Creek	300-971300	15	35	4	S5			169	4	AG, MT	24hour	Site located upstream of chute in Reach 14 of Horsethief Creek.
Horsethief Creek	300-971300	22	37	3	S5	200	510	177	4			Site located upstream of chute in Reach 14 of Horsethief Creek.
Horsethief Creek	300-971300	28	38	4	S5	250	675	77	5			Site located upstream of chute in Reach 14 of Horsethief Creek.
Bruce Creek	300-971300-26300	13	42	3	S5	200	294	299	6			De-watered section and gradient barrier downstream.
Law Creek	300-971300-26300-22800	2	43	15	S5	200	552	303	6	AG		Suspect gradient barrier in Reach 1 of Law Creek.
Law Creek	300-971300-26300-22800	9	44	2	S5	200	541	287	4			Non-visible channel.
	300-971300-26300-73500	1	45		N/A							Non-visible channel.
	300-971300-33100	2	46		N/A							Non-visible channel.
	300-971300-42800	6	48	13	S6	200	312	177	7			Large gradient barrier downstream.
	300-971300-44100	2	52	4	S6	200	255	213	7			Cattle have destroyed stream banks and channel near road does not follow a direct path. Fish passage upstream of the road is not possible due to the lack of a defined channel.
Gopher Creek	300-971300-48100	5	54	33	S5	200	538	310	5			Gradient barrier downstream.
	300-971300-48100-32200	2	55	19	S5	200	496	373	4			Gradient barrier downstream.
	300-971300-52500	2	56		N/A							Non-visible channel.
McDonald Creek	300-971300-57600	1	57	10	S5	200	620	249	5	MT	24hour	Site located upstream of chute in Reach 14 of Horsethief Creek.
McDonald Creek	300-971300-57600	4	58	4	S5	200	626	241	6	MT	24hour	Site located upstream of chute in Reach 14 of Horsethief Creek.
Stockdale Creek	300-971300-68700	1	65	1	S5	100	614	141	5			Site located upstream of chute in Reach 14 of Horsethief Creek.
Stockdale Creek	300-971300-68700	4	66	1	S5	300	942	149	5			Site located upstream of chute in Reach 14 of Horsethief Creek.
Stockdale Creek	300-971300-68700	7	67	2	S5	200	501	141	5			Site located upstream of chute in Reach 14 of Horsethief Creek.
Stockdale Creek	300-971300-68700	10	68	3	S5	200	525	141	5			Site located upstream of chute in Reach 14 of Horsethief Creek.
	300-971300-68700-14400	1	71	6	S6	200	396	26	6			Site located upstream of chute in Reach 14 of Horsethief Creek.
Edourd Creek	300-971300-68700-36800	3	73	4	S5	200	763	143	5			Site located upstream of chute in Reach 14 of Horsethief Creek.
	300-971300-68700-46100-4130	7	76	5	S5	200	409	301	5			Site located upstream of chute in Reach 14 of Horsethief Creek.
Farnham Creek	300-971300-79100	3	80	6	S5	245	610	272	5	MT	24hour	Site located upstream of chute in Reach 14 of Horsethief Creek.
Farnham Creek	300-971300-79100	4	81	1	S5	250	852	269	5			Site located upstream of chute in Reach 14 of Horsethief Creek.
Farnham Creek	300-971300-79100	8	82	6	S5	200	550	272	5			Site located upstream of chute in Reach 14 of Horsethief Creek.

MT=minnow traps, AG=angling,.

4.6.3 Follow-up Sampling Required

Of the 43 sites sampled, 1 site requires follow-up sampling (Table 7).

Table 7. Follow-up sampling required for classification of reaches in the Horsethief Creek Watershed, September 7 to September 10, 1999.

Stream Name	Watershed Code	Reach	Site	Timing	Methods	Comments
Gopher Creek	300-971300-84100	2	53	August	EF, MT	Did not catch fish but suspect fish could inhabit this reach since a gradient barrier was not located downstream. In addition a recent debris flow impacted this stream and may have flushed fish downstream.
Bruce Creek	300-971300-26300	11		August	EF, MT	May sample to determine if fish bearing or not fish bearing.

EF=electrofishing, MT=minnow traps

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APPENDIX 1. FDIS Summary and Photographs Horsethief Creek

APPENDIX 2. Hardcopy Maps