Bull Trout (*Salvelinus confluentus*) Presence/Not Detected Study in Six Streams between Whistler and Pemberton, British Columbia

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Executive Summary

Bull trout (*Salvelinus confluentus*) populations are at presumed conservation risk levels in the southwestern corner of British Columbia. Their habitat is threatened by urban development, poaching, and over fishing. Since the Resort Municipality of Whistler, and the surrounding area, is used extensively for recreational purposes, it is important to determine bull trout presence in order to aid in planning processes, to ensure that fish populations and habitat are not drastically compromised. The purpose of this study was to determine the presence of bull trout in selected streams between Whistler and Pemberton British Columbia.

The study area was located between the Resort Municipality of Whistler and Pemberton British Columbia. The six streams selected to be sampled over the duration of the study were: Blackcomb Creek, Fitzsimmons Creek, Nineteen Mile Creek, Rutherford Creek, Soo River, and Twentyone Mile Creek. Each stream was selected based on the presence of suitable bull trout habitat, which included attributes that bull trout have been shown in scientific literature to prefer, or at the request of the Ministry of Water Land and Air Protection. The fieldwork was conducted by British Columbia Institute of Technology Fish, Wildlife and Recreation students between October 2004 and April 2005. Sampling methods included the use of juvenile seine nets, minnow traps, and angling. The fish capture component of the study occurred between October 2004 and January 2005.

Two bull trout were captured over the duration of the study. One bull trout was captured in Fitzsimmons Creek, while the other was captured in Blackcomb Creek, which is a component of the Fitzsimmons Creek watershed. Although bull trout were not captured in the Soo River, Rutherford Creek, Twentyone Mile Creek and Nineteen Mile Creek, the scope and duration of the study were far too limited to conclude that bull trout are not present in those areas. Additionally,

rainbow trout (*Oncorhynchus mykiss*) were captured in Twentyone Mile Creek, Nineteen Mile Creek, Blackcomb Creek, and Fitzsimmons Creek, and the Soo River.

Acknowledgements

We would like to thank Mr. Iain Lunn, of the Ministry of Water Land and Air Protection for providing us with this unique learning experience, advice, and the necessary equipment to complete this study. We are very grateful for this opportunity. Thank you Dr. Eric Taylor, Associate Director of the University of British Columbia Biodiversity Research Centre, for completing the DNA analysis of the tissue samples collected during this study.

We would also like to thank Mr. Bob Gunn of the British Columbia Institute of Technology for providing us with literature and guidance, especially during the initial phases of this project. Thank you Dr. Marvin Rosenau, Fisheries Management Instructor at the British Columbia Institute of Technology, for sharing all your expertise in report writing, we appreciated it very much. Thank you Mr. Rick Chester, Integrated Resources Management instructor at the British Columbia Institute of Technology for assisting us with the mapping component of this report. Finally, thank you Mr. Tom Saare, British Columbia Institute of Technology Assistant Instructor, for all your help in obtaining the endless list of equipment.

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1.0 Introduction

Dolly Varden char (*Salvelinus malma malma*) were once believed to inhabit the coastal streams of British Columbia (Fig. 1), and it was assumed that bull trout only existed in British Columbia's interior watersheds. However, a study conducted in 1978 in Washington State disproved this theory and by 1980, it was widely accepted that these two separate species coexisted with each other in the coastal streams of Puget Sound (United States Fish and Wildlife Service, 1998).

Figure 1: Distribution of Dolly Varden char in British Columbia. Source: Ministry of Water, Land and Air Protection, 1999.

Bull trout belong to the char genus, and are currently a blue listed species[1] in British Columbia (Ministries of Sustainable Resource Management and Water, Land and Air Protection, 2002). Urban encroachment and habitat loss are two major factors that have contributed to the decline of bull trout populations throughout British Columbia. There are 198 watershed groups in British Columbia that contain confirmed bull trout populations (Fig. 2), of those, only 84 watersheds have bull trout populations that are presumed healthy[2]. Another 69 watersheds in British Columbia have bull trout populations that are at conservation risk[3] levels, or are at presumed conservation risk[4] levels (Ministry of Water, Land and Air Protection, 2002).

The Ministry of Water, Land, and Air Protection is currently determining the distribution of bull trout in the coastal region of Southwestern British Columbia, especially the Sea to Sky corridor, an area in which bull trout distribution was unknown (Fish Wizard, 2004).

[1] Blue-listed species are at risk, but are not extirpated, endangered or threatened; particularly sensitive to human or natural disturbances (Ministry of Sustainable Resource Management, 2004).
[2]Viable for at least twenty years if no new threats are added to the watershed and either real data showing populations are healthy or absence of significant threats and known occurrence in watershed (Ministry of Water, Land and Air Protection, 2002).
[3] Population is known to be in decline (data available) and threats are identified (Ministry of Water, Land and Air Protection, 2002).
[4] Current threats are believed to be significantly affecting the population and/or population is considered to be at risk (Ministry of Water, Land and Air Protection, 2002).

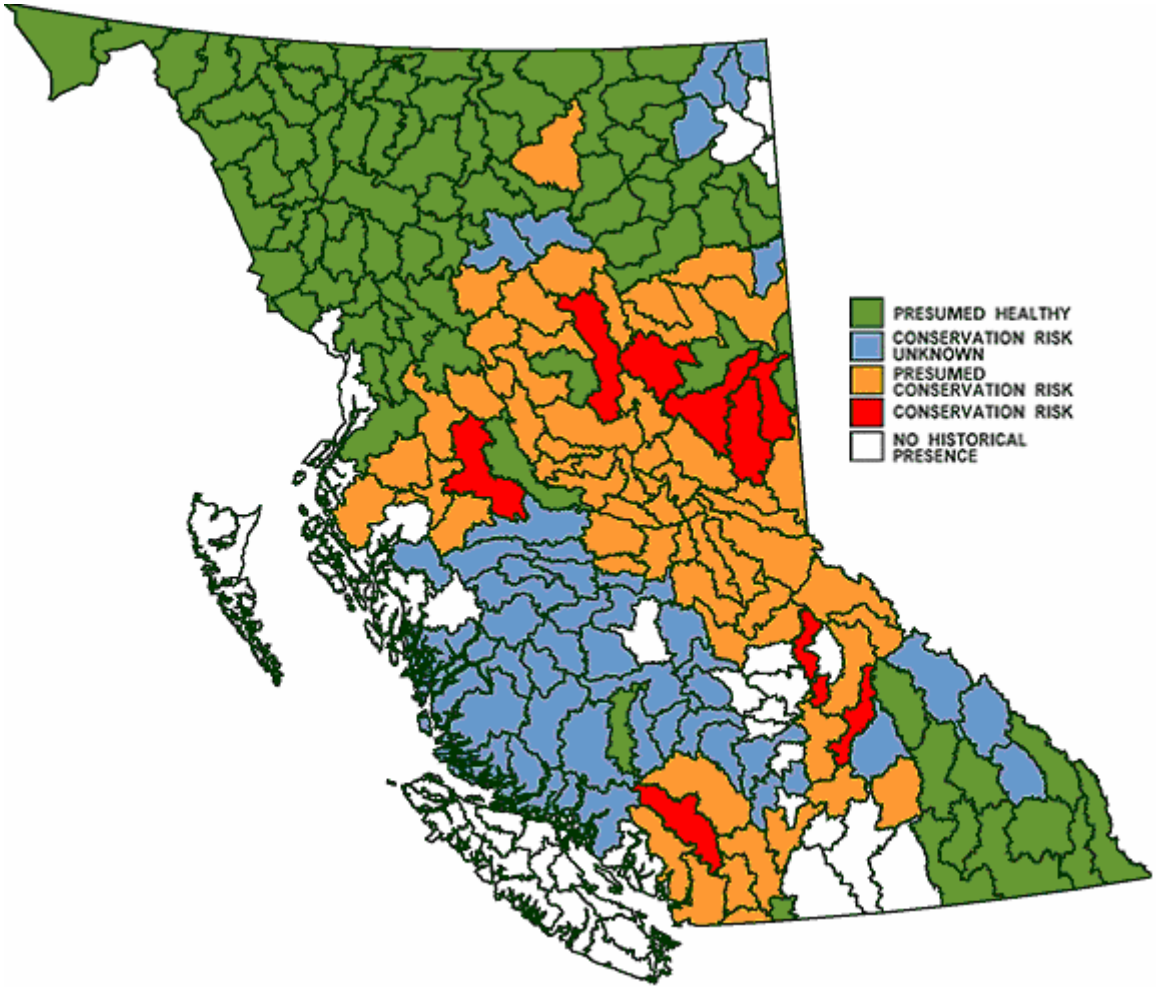

Figure 2: Distribution and status of bull trout in British Columbia streams. Source: Ministry of Water, Land and Air Protection, 2002.

1.1 Background

In 2003/2004, students from the British Columbia Institute of Technology completed a bull trout presence study in eight selected streams between Furry Creek and Whistler, British Columbia (Harper et. al., 2004). This study provided data for the Ministry of Water Land and Air Protection that aided in determining the distribution of bull trout in the Sea to Sky corridor of British Columbia. The streams which were sampled included Thistle Creek, Daisy Creek, Shannon

Creek, Stawamus River, Brohm River, Garibaldi Creek, and Unnamed Creek and Millar Creek. No bull trout were detected in any of the sampled streams upon completion of the study. At the request of the Ministry of Water, Land, and Air Protection, and in partnership with the British Columbia Institute of Technology the 2004/2005 bull trout presence/not detected study was conducted in six streams located between Whistler and Pemberton British Columbia, north of the 2003/2004 study.

1.2 Objectives

The objectives of this study were to:

1) determine the presence of bull trout in six selected streams between Whistler and Pemberton, British Columbia, and
2) collect tissue samples from all salmonid species captured, for DNA analysis at the University of British Columbia.

To ensure that juvenile bull trout were not misidentified in the field, tissue samples were collected from every captured fish belonging the salmonid family.

2.0 Life History

2.1 Embryo

Bull trout embryos are deposited in redds up to 25cm deep, where gravel substrate ranges from 6.25mm to 25.6mm in diameter. Gravel larger than 6.25mm in diameter within the spawning areas provides increased porosity around the redd. This allows a greater amount of water to pass through the gravel, into the redd and around the embryos. Bull trout embryo survival is optimal when the water temperature does not exceed 2ºC. When water temperatures rise above 8ºC, embryo survival is reduced by up to 75% (King County, 1999). Increased substrate porosity facilitates greater water flow around the embryo when dissolved oxygen levels are low due to cold water temperatures (Montana Fish, Wildlife and Parks, 2003).

2.2 Alevin

Embryos require an average of 271 accumulated thermal units (ATU's) in order for bull trout to emerge as alevin (Williamson, 2005). Bull trout alevin thrive in slightly elevated water temperatures in comparison to the cold water temperatures that they prefer in the embryonic stage; consequently, bull trout alevin absorb their yolk sacks slowly in the northern distributions in comparison to the southern distributions (Williamson, 2005).

2.3 Fry

Bull trout fry typically move from higher-gradient incubation areas to lower-gradient rearing areas once they become free-swimming (United States Fish and Wildlife Service, 1998). At this stage, bull trout are largely insectivorous (Baxter and McPhail, 1996). The most limiting factor for bull trout fry survival is the absence of complex habitat with abundant overhanging and submerged cover (Montana Fish, Wildlife and Parks, 2003).

2.4 Sub-Adult

Bull trout sub-adults are known to demonstrate four distinct life history forms:

1) Resident bull trout carry out their lifecycle in the stream in which it reared.
2) Adfluvial bull trout rear in their natal stream for up to four years, at which time they migrate to a lake. Mature adfluvial bull trout only return to their natal streams in order to spawn.
3) Fluvial bull trout rear in their natal streams, then migrate to a larger river or stream upon reaching maturity.
4) Anadromous bull trout occur in coastal streams that do not have migration barriers. They rear in their natal streams, but migrate to the ocean in order to mature (Fish Passage Center, 2004).

2.5 Adult

Adult bull trout (Fig. 3) may live for up to twelve years (Montana Fish, Wildlife and Parks, 2003). Adult fish are almost exclusively piscivorous and prey on other fish such as rainbow trout, cutthroat trout (*Oncorhynchus clarki*) and sculpins (*Cottus sp.)* (Montana Fish, Wildlife and Parks, 2003). Other species that bull trout predate on include salmon fry, whitefish (*Coregoninae sp*.) and other bull trout (Post and Johnston, 2002). Adult bull trout prefer areas with a gravel substrate size of 2-6cm, with less than 30% of the streambed being fine sediment (U.S. Army Corps Of Engineers, 2004). Limiting factors for adult bull trout populations include habitat degradation, poor water management practices, over harvesting and poaching (Montana Fish, Wildlife and Parks, 2003).

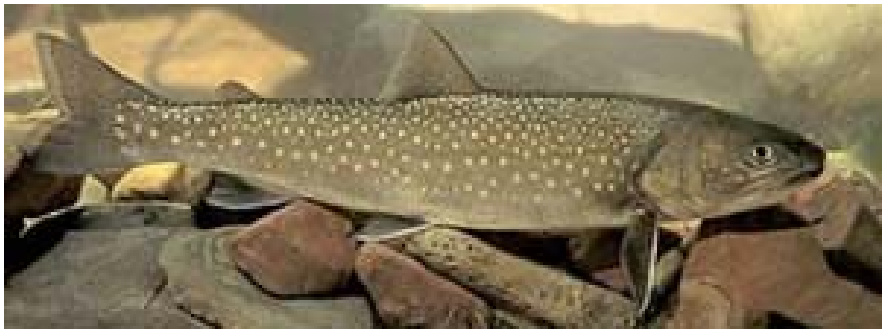

Figure 3: Adult bull trout. Source: Fish Passage Center, 2004.

2.6 Habitat Modification Sensitivity of Bull Trout

Bull trout have the most specific habitat requirements and are the most sensitive to a change of water quality out of all the salmonid species (Niemi, 2004). Due to specific habitat requirements of bull trout, rapid urbanization, road building, water extraction and logging have led to the decline of bull trout populations in the Pacific Northwest; only 44%-45% of the estimated historical bull trout population remains today (Niemi, 2004). Due to the sensitive habitat requirements of bull trout, it can be assumed that if a bull trout population thrives in a stream, then the stream can be considered to be healthy (Neimi, 2004).

2.7 Spawning

Bull trout are between four and five years old when they reach sexual maturity (Montana Fish, Wildlife and Parks, 2003). They prefer to spawn in cold and clear tributaries (Baxter and McPhail, 1996). Spawning generally takes place from late August to early November. Bull trout typically spawn in high gradient mountain streams, usually with a stream order of three or four (Montana Fish, Wildlife and Parks, 2003). Sexually mature bull trout will not spawn until the water temperature drops below 8˚C; however, an optimum water temperature for spawning occurs between 4˚C and 7˚C (Baxter and McPhail, 1996). One female will dig a redd and attract up to five males to fertilize her eggs. Bull trout do not die after spawning, they may spawn every year or every other year (Nature Serve Explorer, 2005).

2.8 Juvenile Bull Trout Rearing Habitat

Juvenile bull trout require cold, clean water. Optimum growth occurs below 13˚C, and preferably between 4˚C and 8˚C (Baxter and McPhail, 1996). Young bull trout prefer habitat with complex cover, which includes coarse woody debris, streamside vegetation, large boulders and undercut banks (Platts and Partridge, 1983).

2.9 Adult Bull Trout Habitat Requirements

The habitat requirements of adult bull trout are generally similar to that of juvenile bull trout. However, as bull trout get larger, they move to areas with increased current velocities. Adult bull trout may be found in rivers, lakes and in some cases, marine environments (King County, 1999).

3.0 Study Area Description

The six streams sampled are located between Whistler and Pemberton in southwestern British Columbia, (Fig. 4). This area is located approximately 145km north of Vancouver B.C. and is accessible via Highway 99, which is also known as the 'Sea to Sky Highway'.

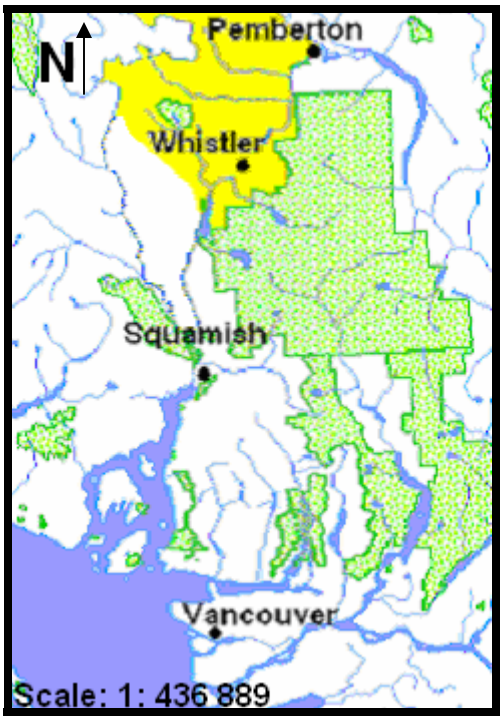

Figure 4: Study area in relation to Vancouver, British Columbia. The study area is outlined in yellow. Adapted from the Community mapping network, 2005.

The study area was stratified into two sampling areas based on their proximity to Whistler. Area 1 was located in the Resort Municipality of Whistler and consisted of Nineteen Mile Creek, Twentyone Mile Creek, Blackcomb Creek and Fitzsimmons Creek (Fig. 5). Area 2 was located south of the District of Pemberton, and contained Rutherford Creek and the Soo River (Fig. 5).

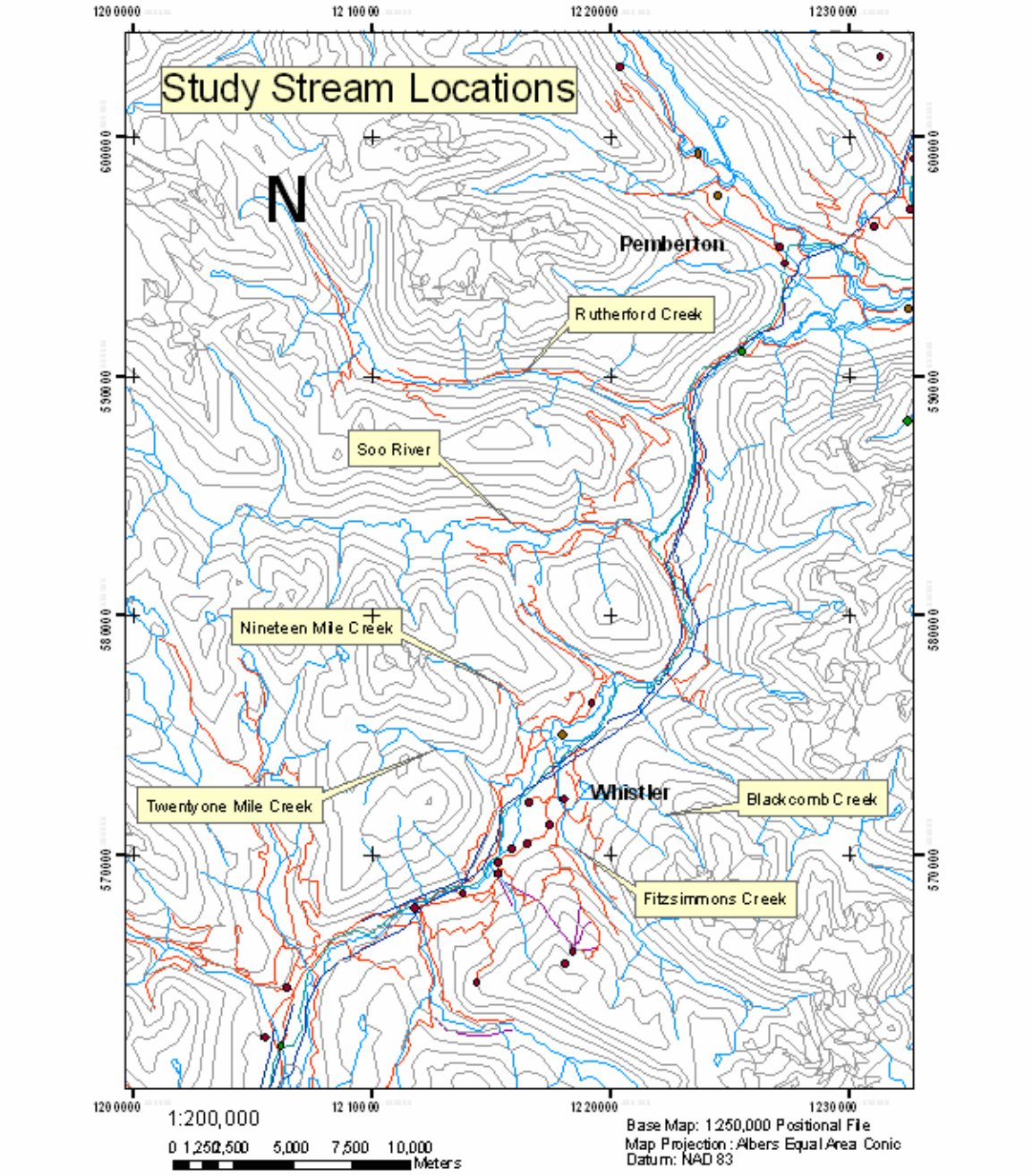

Figure 5: Map of study area, including the six streams sampled. Source: Rick Chester, British Columbia Institute of Technology, 2005.

3.1 Sampling Area 1: Resort Municipality of Whistler

The Resort Municipality of Whistler is situated in the valley between Blackcomb and Whistler Mountain, in the Coast Mountain Range, 123km north of Vancouver (eNorthern B.C., 2005). The elevation of the Resort Municipality of Whistler is 668m above sea level (Tourism Whistler Media Room, 2004). In 2001 the population of Whistler was 8896 (Statistics Canada, 2001). Whistler is a year round destination for outdoor enthusiasts. It receives 54% of its visitors in the summer months when the average temperature ranges between 9ºC and 23ºC. During the winter the average temperature falls between -8ºC and 3ºC (Tourism Whistler Media Room, 2004).

In area 1, Nineteen Mile Creek, Twentyone Mile Creek, Blackcomb Creek, and Fitzsimmons Creek were sampled. Each stream was assigned three sample sites (Appendix B). Each sample site was selected based on exhibiting bull trout habitat requirements.

3.1.1 Nineteen Mile Creek

Access to the sampling sites on Nineteen Mile Creek was via Alpine Way, east of Highway 99. Nineteen Mile Creek discharges into Green Lake. The only known obstruction to fish migration on this stream is a cascade located approximately 700m upstream of Alpine Way (Fish Wizard, 2004). Nineteen Mile Creek is a high gradient, fast flowing mountain creek in its upper reaches; however, below the Highway 99 crossing, it meanders through a mixed coniferous and deciduous forest. Nineteen Mile Creek has a stream order of 2 (Fish Wizard, 2004). The substrate in the lower reaches of the creek is dominated by cobbles (Appendix B).

3.1.2 Twentyone Mile Creek

Twentyone Mile Creek flows from Rainbow Lake downstream in a southeastern direction and discharges into Alta Creek. It is a cold, fast flowing mountain creek

with a stream order 3 (Fish Wizard, 2004). A culvert under Rainbow Road may be an impassible barrier to upstream fish migration during high or low flow conditions (Fig.6). Cobbles and boulders dominate the substrate in Twentyone Mile Creek. A series of hiking and mountain biking trails have been constructed adjacent to Twentyone Mile Creek.

Figure 6: Twentyone Mile Creek culvert beneath Rainbow Road. Photo by Zac Semeniuk. April 8, 2004.

3.1.3 Blackcomb Creek

Blackcomb Creek has a stream order of 2, and is a tributary of Fitzsimmons Creek (Fish Wizard, 2004). This creek flows through the Fairmont Hotel golf course and is accessible from Lost Lake Park. The riparian vegetation surrounding the creek is composed primarily of Pacific willow (*Salix lasiandra*), devils club (*Oplopanax horridus*) and western red cedar (*Thuja plicata*).

Blackcomb Creek has an abundance of pool/riffle habitat (Appendix B). In addition, Blackcomb Creek has an abundance of large woody debris in the stream channel (Appendix B). The substrate is dominated by cobbles, and fine particles. A fish way has been installed in Blackcomb Creek, which aids fish to bypass a cascade. Fish may swim up Blackcomb Creek, and through an off-channel that connects Blackcomb Creek with Lost Lake. Fish may then exit Lost Lake adjacent to where they entered it via the fish way, and return to Blackcomb Creek above the cascade. Due to sediment infilling, this passage appears to be impassible to adults and juveniles, because several of the fish way baffles are buried in the substrate (Fig. 7). Water does not flow over the baffles during low flow conditions, which is likely restricting fish access to the upper reaches of the stream (Fig.7). There were 400% more fish captured below the cascade than above the cascade, which may indicate that the fish ladder is a migratory barrier (Table 1).

Table 1: Number of Fish Captured Above and Below the Cascade in Blackcomb Creek.

Type of Fish Captured	Captured Above Cascade	Captured Below Cascade
Bull Trout	0	1
Rainbow Trout	1	3
Total	1	4

Figure 7:Sediment infilling of fish way baffles between Blackcomb Creek and Lost Lake. Photo by Jen Carter. April 6, 2005.

3.1.4 Fitzsimmons Creek

Fitzsimmons Creek is accessible from Mons Road, east of Highway 99. The banks of the creek have been armored with riprap to provide erosion protection. The vegetation surrounding the creek is composed largely of willow (*Salix sp.)* and red alder (*Alnus rubra*). Fitzsimmons Creek has a stream order of 3 (Fish Wizard, 2004). The headwaters of Fitzsimmons Creek are located at the Fitzsimmons Glacier on Blackcomb Mountain, 17.96km away from its outlet on the south side of Green Lake (Fish Wizard, 2004). Fitzsimmons Creek was turbid throughout the duration of the study (Fig. 8). The substrate of Fitzsimmons Creek is dominated by cobbles and fine particles. There were moderate amounts of large woody debris located in the stream channel (Appendix B).

Figure 8: Turbid water conditions in Fitzsimmons Creek. Photo by Zac Semeniuk. November 20, 2004.

3.2 Area 2: District of Pemberton

Pemberton is a small community with a population of 1637 (Industry Canada, 2004). The main industrial activities are logging, ranching and farming; however, tourism is becoming increasingly important to Pemberton's economy (Beautiful B.C. Network, 2004). Pemberton is located approximately 155km north of Vancouver (eNorthern B.C., 2005). The Soo River and Rutherford Creek are tributaries of the Green River, which flows out of the north end of Green Lake and continues northward to Pemberton.

In area 2, the Soo River and Rutherford Creek were sampled. Each stream was assigned three sample sites (Appendix B). Each sample site was selected based on exhibiting bull trout habitat requirements.

3.2.1 Soo River

The Soo River is located between Whistler and Pemberton British Columbia. It is 45.84km in length from its headwaters near the Pemberton ice fields, to the confluence with the Green River (Fish Wizard, 2004). The Soo River has a stream order of 4 (Fish Wizard, 2004).

The Soo River canyon is home to an Independent Power Project, approximately 10km upstream from the confluence with the Green River (Fish Wizard, 2004). Despite the high water event in October 2003, there was an abundance coarse woody debris observed in several of the pools in the lower reaches of the river (Appendix B). There are deep pools in the lower reaches in which the substrate is dominated by boulders, cobbles and gravel (Appendix B).

3.2.2 Rutherford Creek

The headwater to Rutherford Creek originates at the Pemberton ice fields, 26.67km from the confluence with the Green River (Fish Wizard, 2004). Rutherford Creek has a stream order of 3 (Fish Wizard, 2004).

Rutherford Creek suffered extensively from flooding that occurred in October 2003, which washed out the Whistler-Pemberton Highway bridge and the BCR railway bridge (Burke, 2003). During reconnaissance, we observed a stream channel that was extremely scoured. Boulders dominated the substrate; however, there were trace amounts of coarse woody debris and cobbles observed throughout the three sites that were sampled. Pool and riffle habitat was observed exclusively in site 1 and 2 (Appendix A).

Below the Highway bridge, boulders dominate the substrate in Rutherford Creek. In addition to this, the creek bed has been channelized to accommodate the construction of the new Highway 99 bridge and Railway bridge, in conjunction with the bank stabilization work (Fig. 10).

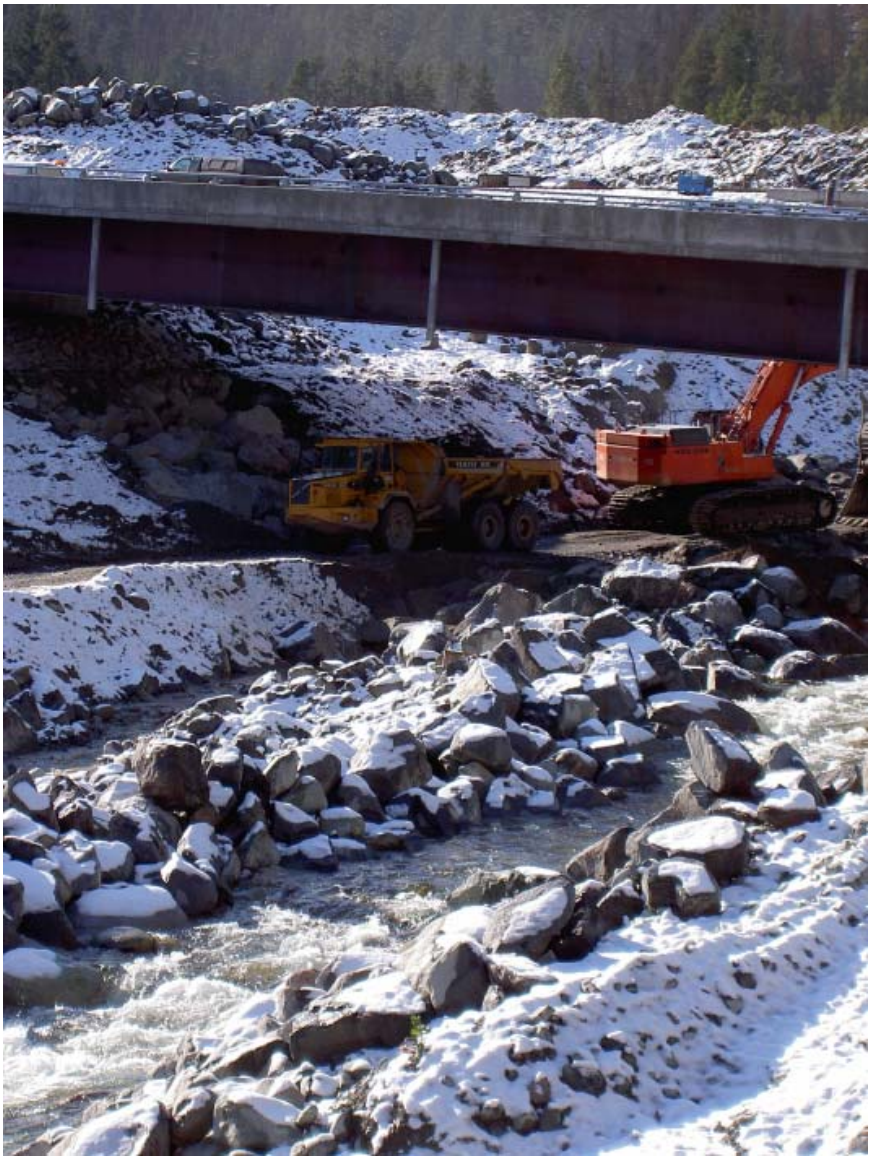

Figure 10: Construction occurring within the Rutherford Creek channel. Photo by Zac Semeniuk. November 3, 2004.

4.0 Methods

4.1 Stream Selection

During stream selection, the following criteria were considered:

- Deep pool habitat which remains connected to the main channel during low water flow conditions
- Large woody debris present in the stream channel
- Logjams present in the stream channel
- Streamside vegetation
- Stream order >2
- Cobble or gravel substrate
- Convenient road access

The Soo River and Rutherford Creek were sampled at the request of the Ministry of Water, Land and Air Protection.

Preference was given to streams that drained glaciers because it was likely that glacial melt water would remain colder than the 15°C, which is a requirement for a resident bull trout population, during the warmest months of the year (Baxter and McPhail, 1996). Once the streams were selected, sample sites were established wherever the most complex habitat existed.

4.2 Distinguishing Features of Bull trout and Dolly Varden Char

Bull trout are commonly misidentified as Dolly Varden char because they are similar in appearance (Fig. 11). The morphological distinction between bull trout

and Dolly Varden char was only confirmed in 1991 (Post and Johnston, 2002).

When identifying char species the following features were noted.

Adult bull trout identification features (Post and Johnston, 2002):

- Large head with a large pointed mouth
- Extended upper jaw bone that appears to curve downward
- Dorsal fin has no defined black spots or markings
- White colored leading edge on anal and pelvic fins
- Sides and back may have pale yellow-orange round spots on them
- Slightly forked caudal fin
- Inner margin of the mouth has short gill rakers with strong teeth

Adult Dolly Varden char features that differ from bull trout features:

- Smaller pale yellow-orange spots on sides and back which are spread further apart than those on bull trout (BC Fish Facts, 1999)
- The inner margin of the mouth has long gill rakers that lack teeth (Post and Johnston, 2002)
- Shorter upper jaw bone that appears straight (Haas, unknown)

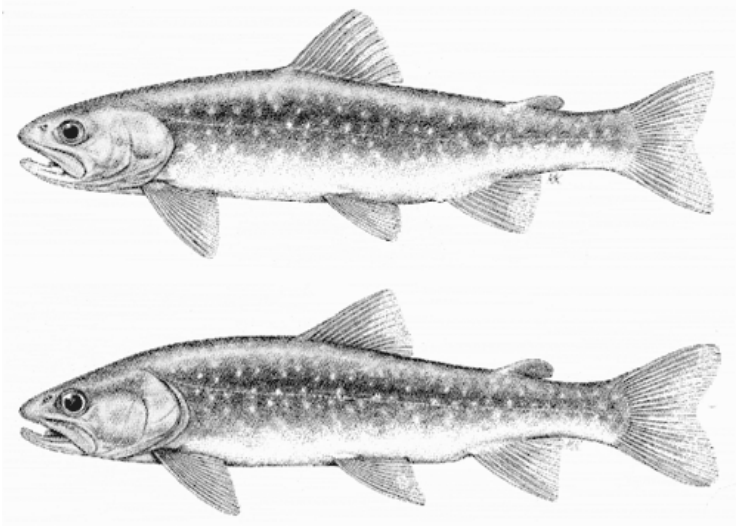

Figure 11: Dolly Varden char (top) and bull trout (bottom). Source: Post and Johnston, 2002.

4.3 Capture Techniques

4.3.1 Beach Seining

Beach seining was conducted in the Soo River and Rutherford Creek. Nineteen Mile Creek, Twentyone Mile Creek, Blackcomb Creek and Fitzsimmons Creek were not seined because the stream channels were small, shallow and contained boulders, and large woody debris, which made the stream channel irregular in depth and difficult to seine.

The following steps were carried out while attempting to capture fish using a 10m juvenile seine net:

One end of the net was firmly anchored to the shore. One crew member held the middle of the seine net while the other crew member held the free end of the net. The seine net was then stretched across the sample site, perpendicular to the current. Slowly, the free end of the seine net was brought down the stream with the current by one crew member, ensuring that the lead line remained in contact with the stream substrate at all times. The other crew member positioned the middle of the net so the entire juvenile seine net formed a semi-circle. Finally, both ends of the seine net were beached, at which time the lead line was slowly gathered and brought onto the shore. The crew members would carefully observe the area surrounded by the net for trapped fish while it was brought into the shore.

4.3.2 Minnow Trapping

At each site, three Gee-40 type minnow traps were used. During the first trapping session, the Gee-40 minnow traps were baited with dry and canned cat food and soaked for 6 hours at each site. This method was unsuccessful,

subsequently, the bait was changed to salmon roe and a 24 hour soak time was implemented.

Each minnow trap was baited with approximately 15g of roe salmon roe, which was tied into a golf ball sized bag using nylon panty hose. One bait bag was fastened to the top of each minnow trap prior to setting it. Traps were set in the early morning and retrieved the following morning in the same order they were placed. In sites with fast flowing water or if there was a possibility of rain in the forecast, cobbles were placed inside the traps to serve as anchors in order to weigh the traps down. Anchoring the traps reduced the chance of trap loss during high water conditions. In addition, the traps were secured to a stationary object on the shore using a 1/8in nylon rope.

4.3.3 Angling

Angling was used as a fish capture method in the following streams:

- Twentyone Mile Creek
- Rutherford Creek
- Soo River

A Shakespeare spincasting rod and reel loaded with 6lb test mainline, and a centerpin reel loaded with 12lb mainline, paired with a Sage 2106MB were used to angle for adult bull trout. The set up consisted of a 3in dink float, 1/3oz of lead, a size 14 black barrel swivel and a red size 6 Gamakatsu octopus hook attached to 24in of 4lb P-line CFX fluorocarbon line. Extremely light gear was required in all of the creeks angled due to clear water conditions.

Small pieces of fresh salmon roe were used as bait, as per the Letter of Authorization from Mr. Iain Lunn, of the Ministry of Water, Land and Air Protection (Appendix C). Angling sessions lasted for exactly one hour at each sample site.

4.4 Catch Per Unit Effort

Catch per unit effort was calculated for each fish capture method used. Minnow trapping units were based on a 24 hour soak day. Minnow traps were soaked for 6 hours each initially because each trap would denote ¼ of a unit.

4.5 DNA Collection

Due to the similar characteristics of Dolly Varden char and bull trout, field identification of any char captured at the sample sites could only be reliable to the genus. In order to identify the char to species, tissue samples were collected for DNA analysis. DNA was collected using two methods:

1) fish under 50mm were retained;
2) fish over 50mm had a minimum of 25mm^2 of their right pelvic fins removed and stored in a vile containing a 95% concentration of ethyl alcohol.

Captured fish were transferred into a 20L bucket in order to be identified and measured. Pelvic fins were removed using hemostats and scissors. The fish were then placed into a bucket where they were allowed to recover from the handling process prior to being released back into the stream at the same location that they were captured.

4.6 Materials

The following materials were used for beach seining:

- 10m juvenile seine net
- 2 x 20L buckets
- Minnow dip net

The following materials were used for minnow trapping:

- Gee-40 minnow traps
- 1/8in nylon rope
- Salmon roe

- Dry and canned cat food
- Flagging tape
- Laminated trap identification tags
- Nylon panty hose
- 2 x 20L buckets
- Minnow dip net

The following materials were used to collect DNA:

- 2.5ml vials
- 95% concentration ethyl alcohol
- Hemostats
- Scissors
- 2 x 20L buckets
- Fish measuring board

5.0 Results

Beach seining (Table 2) and angling efforts (Table 3) were ineffective, which may indicate that fish density is low. Moreover, there were no fish recaptured, which would have facilitated a population estimate calculation of a specific reach. The sample size was too small in order to formulate a conclusion regarding the population size or density with a reasonable degree of confidence. Nevertheless, cold water conditions may have made the fish lethargic, which may explain the low catch per unit effort of angling, seining and minnow trapping. On November 3, 2005, each of the six streams had water temperatures below 5°C (Table 4). The low velocity areas of Blackcomb Creek, Fitzsimmons Creek, Nineteen Mile Creek and Twentyone Mile Creek began to freeze on or about November 3, 2004 (Fig.9).

Table 2: Beach seining catch per unit effort summary.

Stream	Number of Seine Sets	Number of Fish Captured	Catch Per Unit Effort
Rutherford Creek	36	0	0.0
Soo River	36	0	0.0
Total	**72**	**0**	**0.0**

Table 3: Angling catch per unit effort summary.

Stream	Rod Hours	Number of Fish Captured	Catch Per Unit Effort
Rutherford Creek	30	0	0.0
Soo River	30	0	0.0
Twentyone Mine Creek	24	0	0.0
Total	**84**	**0**	**0.0**

Table 4: Stream temperatures as of November 3, 2004. All Temperatures were measured with an alcohol thermometer. Tenths of degrees were recorded by best estimation

Stream	Temperature (°C)
Soo River	3.6
Rutherford Creek	3.1
Fitzsimmons Creek	2.7
Twentyone Mile Creek	2.5
Blackcomb Creek	2.4
Nineteen Mile Creek	1.9

Figure 9: Crew member holding a piece of ice from Fitzsimmons Creek, November 3, 2004. Photo By Jen Carter

A total of sixteen salmonids were captured over the duration of the study (Table 5). All of the fish were captured in minnow traps. The catch per unit effort of the

minnow traps remained consistently low throughout the study (Table 5). One bull trout was captured in Fitzsimmons Creek, while one bull trout was captured in Blackcomb Creek (Table 6). A total of fourteen rainbow trout were captured in Blackcomb Creek, Fitzsimmons Creek, Nineteen Mile Creek the Soo River and Twentyone Mile Creek (Table 6).

Table 5: Catch per unit effort of streams sampled. Catch per unit effort is based on a 24 soak day.

Stream	Total Minnow Trap Soak Time in Hours	Number of Fish Captured	Catch Per Unit Effort
Blackcomb Creek	810	5	0.148
Fitzsimmons Creek	810	4	0.119
Nineteen Mile Creek	810	5	0.148
Twentyone Mile Creek	810	1	0.030
Rutherford Creek	437	0	0
Soo River	437	1	0.055
Total	**4114**	**16**	**0.093**

Table 6: DNA Analysis of Tissue Collected.

Sample #	Site #	Date (dd/mm/yy)	Stream	Species Field ID	Species DNA Result	Fork Length (mm)
1	3	3/11/04	Blackcomb Cr.	Rb	Rb (gh7-57)	47
2	1	10/11/04	Blackcomb Cr.	char	Bt (gh7-51,Fok223)	115
3	1	3/11/04	Blackcomb Cr.	Rb	Rb (gh7-57)	119
4	1	21/11/04	Blackcomb Cr.	Rb	Rb (gh7-57)	93
5	1	21/11/04	Blackcomb Cr.	Rb	Rb (gh7-57)	109
6	3	3/11/04	Nineteen Mile Cr.	Rb	Rb (gh7-57)	48
7	2	3/11/04	Nineteen Mile Cr.	Rb	Rb (gh7-57)	87
8	3	10/11/04	Nineteen Mile Cr.	Rb	Rb (gh7-57)	95
9	2	21/11/04	Nineteen Mile Cr.	Rb	Rb (gh7-57)	51
10	2	10/11/04	Nineteen Mile Cr.	Rb	Rb (gh7-57)	59
11	3	3/11/04	Fitzsimmons Cr.	Rb	Rb (gh7-57)	71
12	1	21/11/04	Fitzsimmons Cr.	char	Bt (gh7-51, Fok223)	117
13	1	10/11/04	Fitzsimmons Cr.	Rb	Rb (gh7-57)	76
14	1	10/11/04	Fitzsimmons Cr.	Rb	Rb (gh7-57)	108
15	1	21/11/04	Twentyone Mile Cr.	Rb	Rb (gh7-57)	101
16	1	3/11/04	Soo River	Rb	Rb (gh7-57)	112

None of the fish captured had an absence of tissue from the right pelvic fin, indicating that there were not any recaptured fish. In addition, eleven sculpins were captured in Twentyone Mile Creek. There were no fish captured in Rutherford Creek during the study; however, this does not indicate an absence of fish in Rutherford Creek.

The majority of the rainbow trout captured throughout the study were found in Blackcomb Creek, Nineteen Mile Creek and Fitzsimmons Creek (Table 7). Similarly, the two bull trout, which were captured over the duration of the study, were found in Blackcomb Creek and Fitzsimmons Creek (Table 7). Generally, the fish found in Fitzsimmons Creek and Blackcomb Creek had a fairly consistent fork length distribution; however, the fish from Blackcomb Creek had a more evenly distributed fork length frequency (Fig. 10) in comparison to the fork length frequency distribution of the fish captured in Fitzsimmons Creek (Fig. 11). The fish found in Nineteen Mile Creek appeared to be smaller than other fish

captured in nearby streams (Fig. 12). Fish from Nineteen Mile Creek had the smallest average fork length of 68mm, while the fish sampled from Fitzsimmons Creek had the second smallest average fork length of 93mm. Additionally, the fish that were captured in Blackcomb Creek had the largest average fork length of 96.6mm (Table 8). Average fork lengths were obtained by calculating the mean fork length of a minimum of four samples.

Table 7: Fish captured, fork length, location of capture and date captured.

Sample #	Stream	Sample Site #	Type of Fish Captured	Fork Length in millimeters	Date Captured (dd/mm/yy)
1	Blackcomb Cr.	3	Rb	47	3/11/04
2	Blackcomb Cr.	1	Bt	115	10/11/04
3	Blackcomb Cr.	1	Rb	119	3/11/04
4	Blackcomb Cr.	1	Rb	93	21/11/04
5	Blackcomb Cr.	1	Rb	109	21/11/04
6	Nineteen Mile Cr.	3	Rb	48	3/11/04
7	Nineteen Mile Cr.	2	Rb	87	3/11/04
8	Nineteen Mile Cr.	3	Rb	95	10/11/04
9	Nineteen Mile Cr.	2	Rb	51	21/11/04
10	Nineteen Mile Cr.	2	Rb	59	10/11/04
11	Fitzsimmons Cr.	3	Rb	71	3/11/04
12	Fitzsimmons Cr.	1	Bt	117	21/11/04
13	Fitzsimmons Cr.	1	Rb	76	10/11/04
14	Fitzsimmons Cr.	1	Rb	108	10/11/04
15	Twentyone Mile Cr.	1	Rb	101	21/11/04
16	Soo River	1	Rb	112	3/11/04
	Total		**2 x Bt 14 x Rb**		

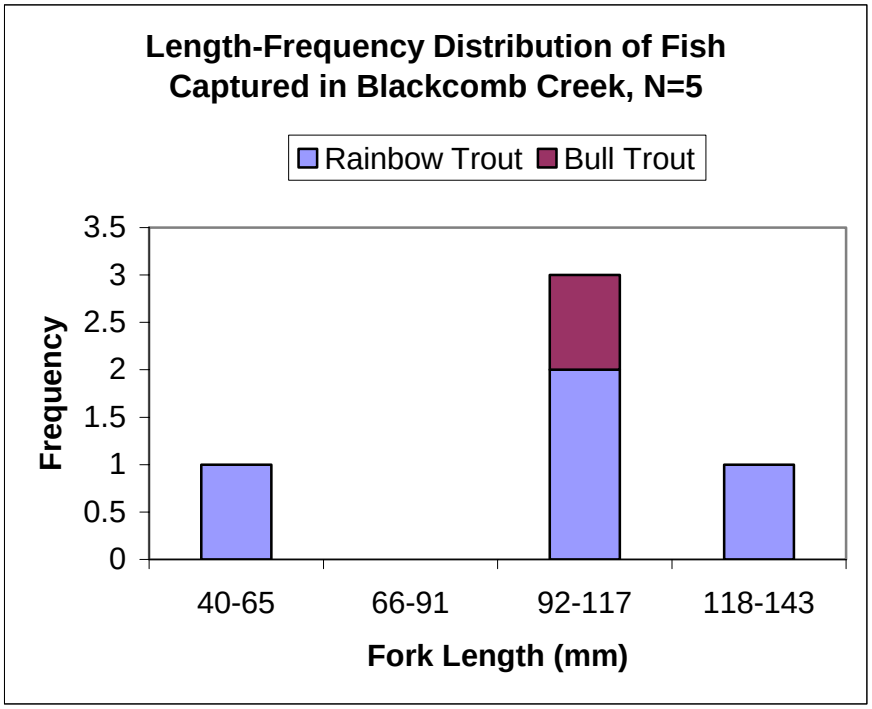

Figure 10: Length-Frequency Distribution of Bull Trout and Rainbow Trout Captured in Blackcomb Creek. N=5

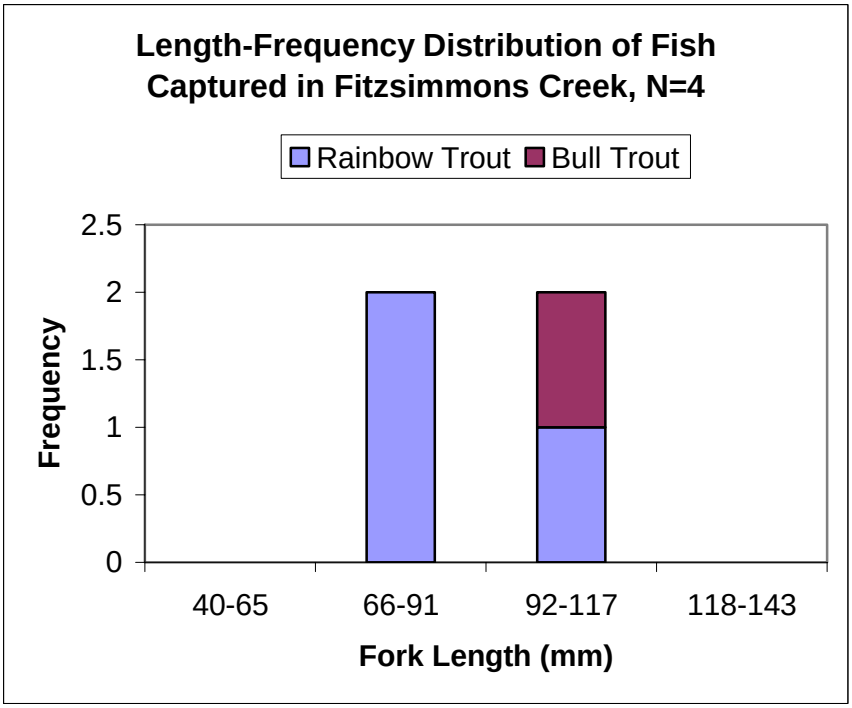

Figure 11: Length-Frequency Distribution of Bull Trout and Rainbow Trout Captured in Fitzsimmons Creek. N=4.

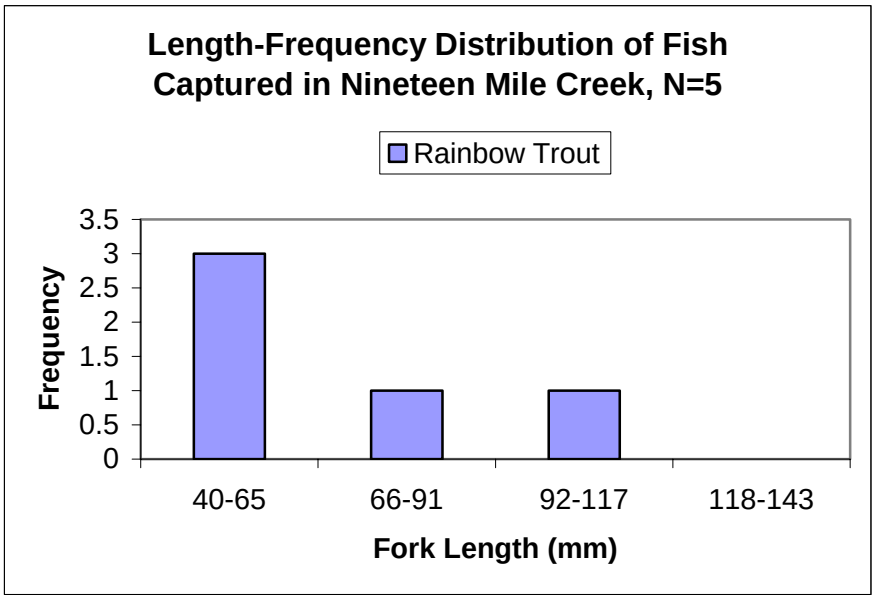

Figure 12: Length-Frequency of Rainbow Trout Captured in Nineteen Mile Creek. N=5.

Table 8: Mean fork length of fish captured during the 2004/2005 bull trout presence/not detected study. Minimum N=4.

Stream	Mean Fork Length (mm)
Nineteen Mile Creek	68
Fitzsimmons Creek	93
Blackcomb Creek	96.6

The of the two bull trout sampled were captured in the Fitzsimmons Creek watershed; sample 2 was obtained from Blackcomb Creek, while sample 12 was from Fitzsimmons Creek. Both of these streams drain glaciated areas: the Fitzsimmons Glacier and the Blackcomb Glacier. Each bull trout was captured in an area that had trace to moderate amounts of large woody debris and overhanging streamside vegetation (Appendix B). The riparian areas of Blackcomb Creek and Fitzsimmons Creek contained mixed stands of coniferous and deciduous trees and shrubs (Appendix B).

6.0 Discussion

Rutherford Creek was subject extensive flood damage in October 2003. Extremely heavy rainfall inundated the southwestern coast of British Columbia, and caused flood damage in several communities (The Updater, 2003). Many rivers in southwestern British Columbia reached water levels that may only be recorded once every century. Although there is no hydrometric data for Rutherford Creek, or the Soo River, the hydrographs for the Lillooet River, north of the study area, (Fig. 13) and the Squamish River, south of the study area, (Fig. 14) indicate that the water levels were the highest in recorded history (Fig. 15) (Fig. 16).

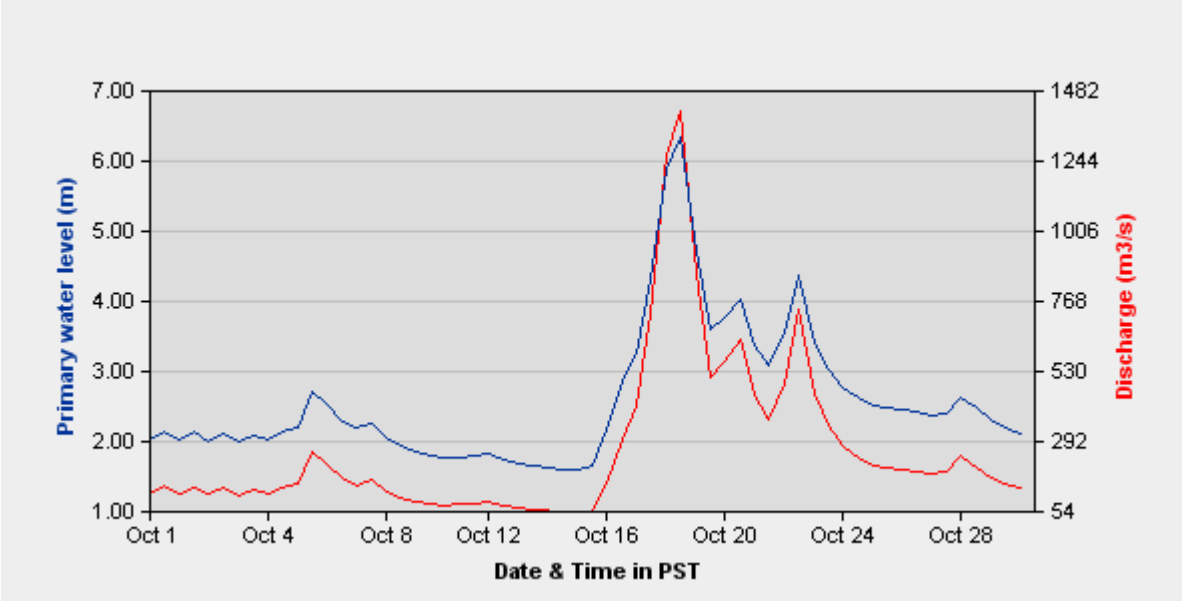

Figure 13: Hydrograph and discharge level of the Lillooet River near Pemberton. Period for October 2003. Source: Environment Canada, 2005.

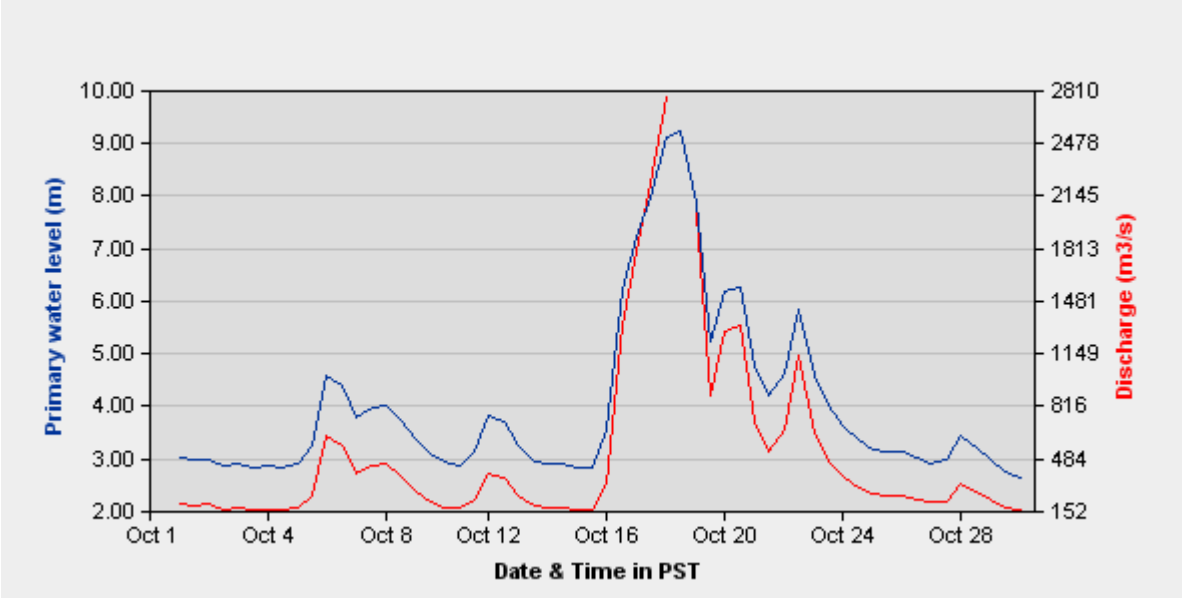

Figure 14: Hydrograph and discharge level of the Squamish River near Brackendale. Period between October 1, 2003 and October 31, 2003. Source: Environment Canada, 2005.

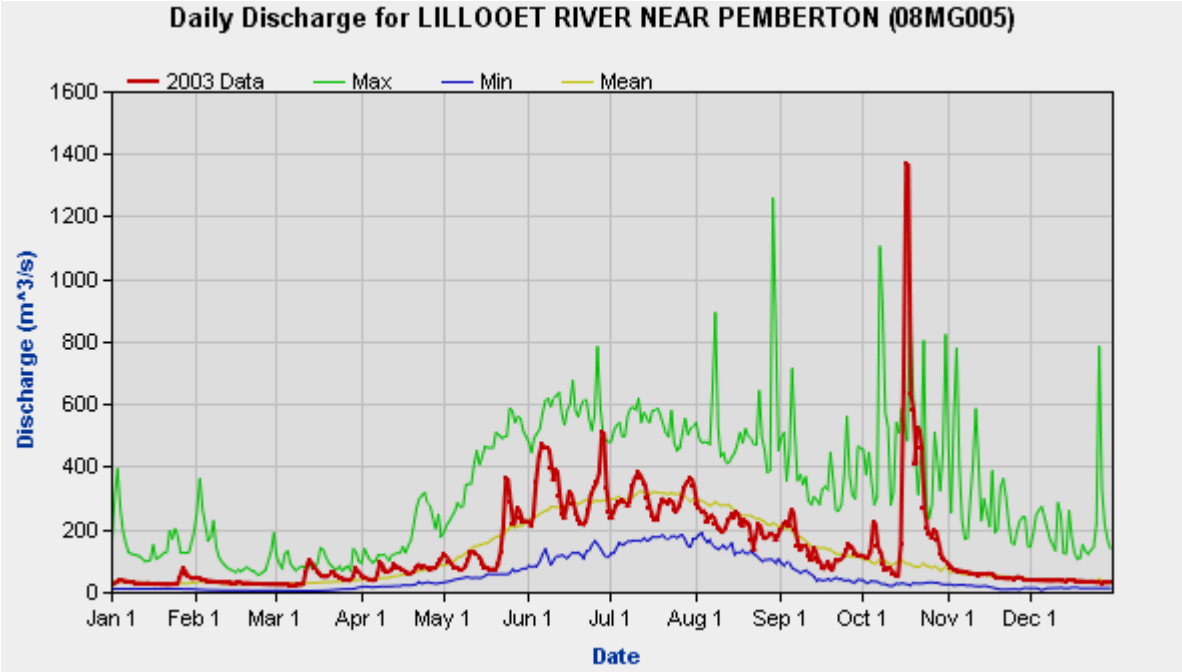

Figure 15: Daily discharge of the Lillooet River from 1914 to 2003. Maximum, minimum and mean discharge statistics correspond to data recorded between 1914 and 2001. Source: Environment Canada, 2005.

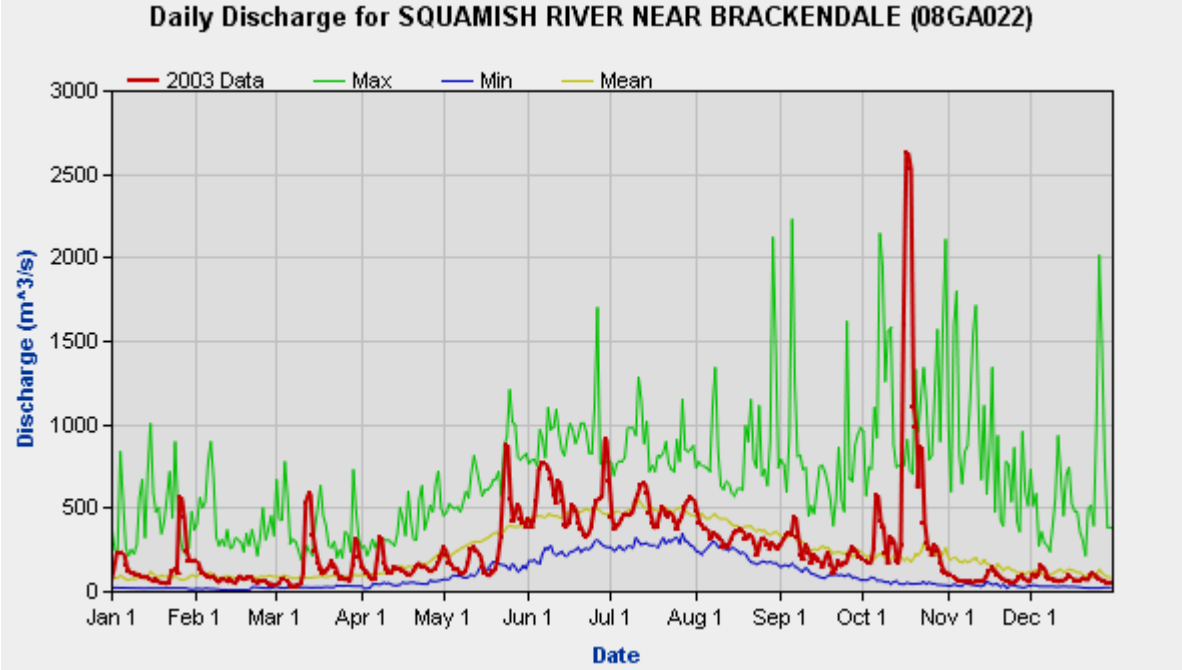

Figure 16: Maximum, minimum, and mean daily discharge of the Squamish River from 1922 to 2003. Maximum, minimum and mean discharge statistics correspond to data recorded between 1922 and 2001. Source: Environment Canada, 2005.

Rutherford Creek exhibits hard-bed channel characteristics; therefore there is little lateral movement of the stream channel (Appendix B). The hard-bed channel is highly resistant to degradation and weathering, which results in minimal creation off channel habitat for fish. Furthermore, during high water events, adult and juvenile fish are likely confined to the main channel of hard-bed streams, where the current velocity is the greatest in comparison to off channel habitat. Although the channel in lower reaches of the Soo River is far less restricted in terms of lateral channel movement when compared to Rutherford Creek, the channel still exhibits hard-bed characteristics (Appendix B). Due to the minimal off channel habitat that exists, which may provide refuge for fish during the flood event of October 2003 (Appendix B), it is possible that fish residing or rearing in Rutherford Creek or the Soo River were flushed out of these streams and pushed directly into the Green River, then possibly pushed over Narin falls and eventually into the Lillooet River or Lillooet Lake. This may

explain the low catch per unit effort in both of these systems. In addition, this flood event likely changed the stream substrate composition, morphology, streamside vegetation and large woody debris accumulation. If this is the case, it may take several years for fish residing in Green Lake to exit the lake, and spawn or carry out part or all of their life history in the Green River tributaries located above Narin Falls.

The sampling sites on the Soo River were host to some of the most complex habitat in area 2, yet only one fish was captured between all three of the sample sites. Overhanging streamside vegetation, large woody debris, large boulders and deep pools were all features that could be readily observed in the lower reaches of the Soo River (Appendix B). The low catch per unit effort in the Soo River is perplexing due to the level of complex habitat that is present (Appendix B).

Approximately 450m downstream of the Highway 99 bridge, Nineteen Mile Creek had cut a channel over an embankment, which resulted in the creation of a cascade that measures 0.7m in height during low flow conditions. This may serve as a barrier to juvenile and some adult salmonids. This cascade may limit the available habitat for that exists in Nineteen Mile Creek, thus reducing the carrying capacity of the creek. However, there was detritus and large woody debris present in the new channel, which may provide nutrients for aquatic vertebrates and invertebrates further downstream.

This study took place at a time when fish activity is low due to their decreased metabolic rate, which is induced by cold-water conditions (Table 4). Electrofishing was not a feasible method of fish capture over the duration of the study. The increased amount of voltage required to effectively capture fish throughout the cold water conditions encountered would have been fatal to embryos and alevin which may be present within the substrate of the stream

(Fisheries and Aquaculture Extension Program, 2001). To compound this limitation, the fish capture sessions did not overlap with the out migration of juvenile salmonids from their natal streams. Additionally, the fish capture component of the study only marginally overlapped with adult bull trout spawning times, which provided a very limited time frame in which capturing adult bull trout would have been possible. The fall and spring school semesters in which this study was conducted during inadvertently bound the sampling sessions to late fall and early winter.

During a fish presence survey in the Rocky Reach Reservoir in Washington State, the catch per unit effort of salmonids captured in fyke nets increased by approximately 300% in May when compared to the catch per unit effort in October (Duke Engineering, 2001). It would be reasonable to assume that the catch per unit effort in this study would increase if sampling efforts took place during spring, summer or early fall. Although the fieldwork component of this study was conducted at a time of year that was not conducive to capturing maximum amounts of salmonids, two bull trout were still captured. If the study was carried out throughout the late spring until the early fall, the catch per unit effort may rise along with the total number of bull trout captured. In addition, adult bull trout, returning to their natal streams in order to spawn from August to November may be intercepted by angling, seining, and electrofishing or by a fish fence.

In subsequent years of the bull trout presence/not detected study, future students of the British Columbia Institute of Technology Fish, Wildlife and Recreation Program could begin sampling at the beginning of September and conclude the fieldwork by the beginning of December. Alternatively, students could commence fieldwork at the beginning of February and conclude the study at the beginning of April. Both of these options may result in a higher catch per unit effort, but limitations such as volatile weather, unsafe highway conditions, school

sponsored fieldwork, ongoing assignments and tests could hinder the completion of the study. Moreover, both of the previously outlined sampling schedules do not fall directly into a time frame, which would allow for maximum fish trapping efficiency.

7.0 Recommendations

In order to clearly understand the distribution of bull trout between Whistler and Pemberton, British Columbia, we recommend that further stream inventories, including habitat assessment and mapping be completed. Furthermore, an assessment of bull trout limiting factors such as rapid urban encroachment into fish habitat, road building, poor water use practices and logging within the Green Lake watershed should be completed.

We recommend that current fish stocking programs be evaluated and proceed with caution in order to avoid possible increased interspecific competition. In Alberta, bull trout populations have been shown to exhibit reduced growth and survival rates, and in some cases, bull trout populations have been extirpated as a direct result of increased interspecific competition due to the introduction of non-native fish species (Post and Johnston, 2002).

Since bull trout are sensitive to over fishing, compromised water quality, habitat fragmentation and degradation, their presence must be confirmed in the watersheds between Whistler and Pemberton, British Columbia, especially within the Green Lake watershed. Greater road accessibility, increased angling pressure, Highway 99 construction and upgrades in preparation for the 2010 Winter Olympic Games, and rapid urban development all pose risks to anadromous and non-anadromous bull trout, which may carry out part or, all of their life history in the streams between Whistler and Pemberton, British Columbia.

It would be advantageous to determine bull trout presence within the Green Lake watershed prior major development in preparation for the 2010 Winter Olympic Games. If bull trout presence is confirmed within the streams that may be affected by the modification of Highway 99 or other construction, more stringent

guidelines could be adhered to in order to mitigate the risk of bull trout habitat fragmentation, alteration, disruption or destruction.

To understand the population size, composition, and distribution of bull trout in the Green Lake watershed, stream and lake sampling must be conducted on a yearly basis from late winter until late fall. Specifically in the Fitzsimmons Creek watershed, important bull trout habitat must be identified, which should include, but not be limited to:

- key spawning areas, and
- juvenile rearing areas.

Additionally, a population estimate of resident bull trout populations that utilize the Fitzsimmons Creek watershed should be completed. Annual adfluvial and fluvial adult bull trout spawner escapement should be completed within the Fitzsimmons Creek watershed. Furthermore, the annual recruitment of bull trout juveniles from the Fitzsimmons Creek watershed to Green Lake should be completed. Installing a fish fence in the main channel Fitzsimmons Creek would facilitate the previously outlined numeration.

In addition, if bull trout presence is confirmed, habitat restoration or enhancement work could be accomplished by providing overhanging vegetation, optimal spawning substrate, functional large woody debris, artificially created pools and riffle habitat, and by modifying fish migration barriers to mitigate habitat fragmentation or loss.

We recommend that more sampling be completed within the study area in the future in order to further determine bull trout distribution. A combination of limited time to conduct the study coupled with low stream temperatures may have resulted in a lower than normal catch per unit effort of bull trout.

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8.1 Personal Communication

Cory J. Williamson (personal communication, May 11, 2005) verified this.

Appendix A: Stream Site Descriptions

Nineteen Mile Creek: Site 1

- UTM Coordinates: E 503165 N 5555224
- Substrate: Gravel and fine
- Cover: Large woody debris, small woody debris, overhanging banks

Figure 18: Nineteen Mile Creek site 1. April 8, 2004. Photo by Jen Carter.

Nineteen Mile Creek: Site 2

- UTM Coordinates: E 503134 N 5555200
- Substrate: Fine and cobbles
- Cover: Large woody debris, small woody debris

Figure 19: Nineteen Mile Creek site 2. April 8, 2004. Photo by Zac Semeniuk.

Nineteen Mile Creek Site: 3

- UTM Coordinates: E 503015 N 5555215
- Substrate: Fine and gravel
- Cover: Large woody debris, small woody debris, overhanging banks

Figure 20: Nineteen Mile Creek Site 3. April 8, 2004. Photo by Zac Semeniuk.

Twentyone-Mile Creek: Site 1

- UTM Coordinates: E 501206 N 5552972
- Substrate: Boulders and cobbles
- Cover: Large woody debris, small woody debris, overhanging banks, boulders

Figure 21: Twentyone Mile Creek site 1. April 8, 2004. Photo by Zac Semeniuk.

Twentyone-Mile Creek: Site 2

- UTM Coordinates: E 501192 N 5552966
- Substrate: Boulders and cobbles
- Cover: Large woody debris, boulders

Figure 22: Twentyone Mile Creek site 2. April 8, 2004. Photo by Zac Semeniuk.

Twentyone Mile Site 3

- UTM Coordinates: E 501063 N 555.087
- Substrate: Cobbles and boulders
- Cover: Large woody debris, small woody debris, boulders, overhanging vegetation

Figure 23: Twentyone Mile Creek site 3. April 8, 2004. Photo by Jen Carter.

Blackcomb Creek: Site 1

- UTM Coordinates: E 504401 N 5552526
- Substrate: Cobbles and gravel
- Cover: Large woody debris, boulders, small woody debris, overhanging banks, deep pools

Figure 24: Blackcomb Creek Site 1. Photo by Zac Semeniuk.

Blackcomb Creek: Site 2

- UTM Coordinates: E 504522 N 5552642
- Substrate: Boulders and cobbles
- Cover: Large woody debris, boulders, small woody debris

Figure 25: Blackcomb Creek site 2. November 10, 2004. Photo by Zac Semeniuk.

Blackcomb Creek: Site 3

- UTM Coordinates: E 504590 N 5552614
- Substrate: Boulders and cobbles
- Cover: Large woody debris, boulders

Figure 26: Blackcomb Creek site 3. November 10, 2004. Photo by Jen Carter.

Fitzsimmons Creek: Site 1

- UTM Coordinates: E 503471 N 5553680
- Substrate: Boulders and cobbles
- Cover: Small woody debris, overhanging streamside vegetation

Figure 27: Fitzsimmons Creek site 1. November 10, 2004. Photo by Jen Carter.

Fitzsimmons Creek: Site 2

- UTM Coordinates: E 503382 N 5553556
- Substrate: Boulders and cobbles
- Cover: Large woody debris, boulders, small woody debris, overhanging banks, overhanging streamside vegetation

Figure 28: Fitzsimmons Creek site 2. November 10, 2004. Photo by Zac Semeniuk.

Fitzsimmons Creek: Site 3

- UTM Coordinates: E 503398 N 5553462
- Substrate: Boulders and cobbles
- Cover: Boulders

Figure 29: Fitzsimmons Creek site 3. November 10, 2004. Photo by Zac Semeniuk.

Soo River: Site 1

- UTM Coordinates: E 509713 N 5567390
- Substrate: Cobbles and fine
- Cover: Large woody debris, small woody debris, overhanging banks, deep pools

Figure 30: Soo River site 1. October 13, 2004. Photo by Jen Carter.

Soo River: Site 2

- UTM Coordinates: E 509750 N 5567367
- Substrate: Cobbles and boulders
- Cover: Large woody debris, small woody debris, boulders, deep pools

Figure 31: Soo River site 2. October 13, 2004. Photo by Jen Carter.

Soo River: Site 3

- UTM Coordinates: E 5019872 N 5567040
- Substrate: Cobbles and fine
- Cover: Large woody debris, small woody debris, overhanging banks

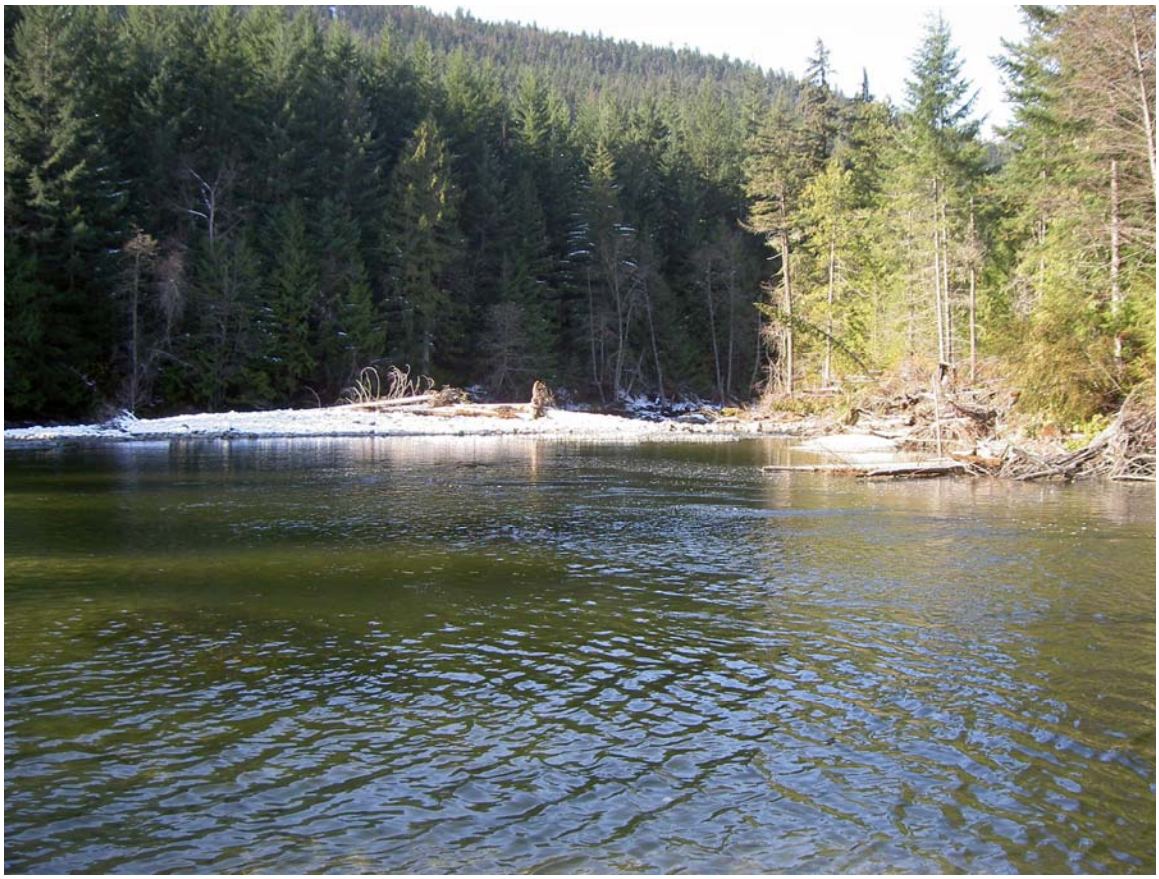

Figure 32: Soo River site 3. October 13, 2004. Photo by Zac Semeniuk.

Rutherford Creek: Site 1

- UTM Coordinates: E 509753 N 5569244
- Substrate: Cobbles and boulders
- Cover: Boulders

Figure 33: Rutherford Creek site 1. November 3, 2004. Photo by Jen Carter.

Rutherford Creek: Site 2

- UTM Coordinates: Unknown; access from secondary road that runs adjacent to Rutherford Creek on the east side of the valley
- Substrate: Boulders and cobbles
- Cover: Boulders, deep pools

Figure 34: Rutherford Creek site 2. November 3, 2004. Photo by Zac Semeniuk.

Rutherford Creek: Site 3

- UTM Coordinates: Unknown; access from secondary road that runs adjacent to Rutherford Creek on the east side of the valley
- Substrate: Cobbles and boulders
- Cover: Boulders and deep pools

Figure 35: Rutherford Creek site 3. April 8, 2005. Photo by Zac Semeniuk.

Appendix B: Stream Site Cards

SITE CARD

Field	Value
STREAM NAME (gaz.)	Blackcomb Creek
(local)	Blackcomb Creek
WATERSHED CODE	119-467100-97600-17100
ILP MAP #	92J.016
ILP #	
NID MAP #	
NID #	
REACH #	–
SITE #	1
FIELD UTM	10 504401 5552526
SITE LG	
ACCESS	Y2
DATE	20050407
TIME	1320
AGENCY	
CREW	JLC, ZES
FISH FORM	Y / (N)

CHANNEL						
mthd	T					
CHANNEL WIDTH (m)	4.6	4.2	4.4	4.5	4.4	4.4
WETTED WIDTH (m)	4.5	4.2	4.2	4.1	4.2	4.1
RES. POOL DEPTH (m)	0.6	0.7	0.7	0.6	0.6	0.4

GRADIENT %: 2% GE

Wb Dp (m) | STAGE L (M) H | No Vis. Ch. | Dry/Int. | DW | Tribs.

WATER: EMS | REQ. # | TEMP °C | COND. µS/cm | pH | TURB. T M L (C)

MORPHOLOGY: FLD SNS | BED MATERIAL Dominant / Subdom. | D95 (cm) | D (cm) | Morph. RP-W

COVER	SWD	LWD	B	U	DP	OV	IV
AMT	T	S	T	T	N	T	N
LOC	P	P	P	P		P	

Total

CROWN CLOSURE: 0 (1) 2 3 4 5

LWD FNC N (F) A | DIST C (E) | INSTREAM VEG N A M V

LB SHP U V (S) O | RB SHP U V (S) O

TEXTURE F G (C) B R A | TEXTURE F G C (B) R A

RIP. VEG. N G S C D (M) W | RIP. VEG. N G S C D (M) W

STAGE INIT SHR PS YF (MF) NA | STAGE INIT SHR PS YF (MF) NA

DISTURBANCE INDICATORS: D1 B1 B2 B3 D1 D2 D3 C1 C2 C3 C4 C5 S1 S2 S3 S4 S5

PATTERN TM ME IM IR (SI) ST

ISLANDS (N) O I F S AN

BARS (N) SIDE DIAG MID SPAN BR

COUPLING (DC) PC CO

CONFINEMENT EN CO FC (OC) UN N/A

C	NID MAP #	NID #	TYPE	HT / LG (m)	mthd	PHOTO	COMMENTS	UTM
						R__ F__		
						R__ F__		
						R__ F__		
						R__ F__		

FEATURES

SITE CARD

Field	Value
STREAM NAME (gaz.)	Blackcomb Creek
(local)	Blackcomb Creek
WATERSHED CODE	119-467100-97600-17100
ILP MAP #	92J.016
ILP #	
NID MAP #	
NID #	
REACH #	–
SITE #	2
FIELD UTM	10 504522 5552642
SITE LG	
ACCESS	Y2
DATE	20050407
TIME	1215
AGENCY	
CREW	JLC, ZES
FISH FORM	Y / (N)

CHANNEL						
mthd	T					
CHANNEL WIDTH (m)	3.6	4.2	4.2	4.6	4.5	4.6
WETTED WIDTH (m)	3.1	3.3	3.7	3.6	3.7	3.7
RES. POOL DEPTH (m)	0.2	0.3	0.3	0.3	0.2	0.2

GRADIENT %: 2% GE

Wb Dp (m) | STAGE L (M) H | No Vis. Ch. | Dry/Int. | DW | Tribs.

WATER: EMS | REQ. # | TEMP °C | COND. µS/cm | pH | TURB. T M L (C)

MORPHOLOGY: FLD SNS | BED MATERIAL Dominant / Subdom. | D95 (cm) | D (cm) | Morph. RPC-W

COVER	SWD	LWD	B	U	DP	OV	IV
AMT	T	T	S	N	N	N	N
LOC	P	P	P				

Total

CROWN CLOSURE: 0 (1) 2 3 4 5

LWD FNC (N) F A | DIST C (E) | INSTREAM VEG N (A) M V

LB SHP U V (S) O | RB SHP U V (S) O

TEXTURE F G (C) B R A | TEXTURE F G C (B) R A

RIP. VEG. N G S C D (M) W | RIP. VEG. N G S C D (M) W

STAGE INIT SHR PS YF (MF) NA | STAGE INIT SHR PS YF (MF) NA

DISTURBANCE INDICATORS: D1 B1 B2 B3 D1 D2 D3 C1 (C2) C3 C4 C5 S1 S2 S3 S4 S5

PATTERN TM ME IM IR (SI) ST

ISLANDS (N) O I F S AN

BARS (N) SIDE DIAG MID SPAN BR

COUPLING (DC) PC CO

CONFINEMENT EN CO FC (OC) UN N/A

C	NID MAP #	NID #	TYPE	HT / LG (m)	mthd	PHOTO	COMMENTS	UTM
						R__ F__		
						R__ F__		
						R__ F__		
						R__ F__		

FEATURES

SITE CARD

STREAM NAME (gaz) Blackcomb Creek (local) Blackcomb Creek

WATERSHED CODE 100 | 914 | 671 | 010 | 918 | 010 | 171 | 010

ILP MAP # 92J.016 | ILP # | NID MAP # | NID #

REACH # - | SITE # 3 | FIELD UTM 10 504590 5552614 | SITE LG | ACCESS YZ

DATE 20 | 05 | 04 | 07 | TIME 1313 | AGENCY | CREW JLC ZES | FISH FORM Y (N)

CHANNEL	mtd	T						GRADIENT %		EMS		REG. #	
CHANNEL WIDTH (m)	2.3	2.4	2.5	2.4	2.4	2.5		2%	BE	TEMP °C		COND.	µS/cm
WETTED WIDTH (m)	1.1	1.2	1.4	1.5	1.6	1.4				pH		TURB. T M L (C)	
RES. POOL DEPTH (m)	0.2	0.4	0.9	0.4	0.4	0.2				FLD SNS			

W_b Dp (m) | STAGE L (M) H | No Vis. Ch. DW | Dry/Int. Trib.s | BED MATERIAL Dominant | Subdom. | Morph. RPe-W

COVER

	Type	SWD	LWD	B	U	DP	OV	IV
	AMT	T	T	T			S	
	LOC	P	P	P		P		

CROWN CLOSURE: 0 (1) 2 3 4 5

LWD FNC N (F) A DIST C (E)

LB SHP (U) V S O

TEXTURE F G (C) B R A

RIP. VEG. N G S C D (M) W

STAGE INIT SHR PS YF (MF) NA

INSTREAM VEG N A M V

RB SHP U V (S) O

TEXTURE F G (C) B R A

RIP. VEG. N G S C D (M) W

STAGE INIT SHR PS YF (MF) NA

MORPHOLOGY

DISTURBANCE INDICATORS: O1 B1 B2 B3 D1 D2 D3 | C1 (C2) C3 C4 C5 S1 S2 S3 S4 S5

PATTERN TM ME IM IR (SI) ST

ISLANDS (N) O I F S AN

BARS (N) SIDE DIAG MID SPAN BR

COUPLING (DC) PC CO

CONFINEMENT EN CO FC (OC) UN N/A

WATER

FEATURES

C	NID MAP #	NID #	TYPE	HT / LG (m)	mtd	PHOTO	COMMENTS	UTM
						R___ F___		
						R___ F___		
						R___ F___		
						R___ F___		

SITE CARD

STREAM NAME (gaz) Nineteen Mile Creek (local) Nineteen Mile Creek

WATERSHED CODE 100 | 914 | 671 | 010 | 918 | 810 | 10

ILP MAP # 92J.016 | ILP # | NID MAP # | NID #

REACH # - | SITE # 1 | FIELD UTM 10 503165 5555214 | SITE LG | ACCESS YZ

DATE 20 | 05 | 04 | 06 | TIME 1128 | 25 | AGENCY | CREW JLC ZES | FISH FORM Y (N)

CHANNEL	mtd	T						GRADIENT %		EMS		REG. #	
CHANNEL WIDTH (m)	3.1	3.3	3.2	3.6	3.6	3.4		1%	BE	TEMP °C		COND.	µS/cm
WETTED WIDTH (m)	3.1	3.3	3.2	3.3	3.3	3.3				pH		TURB. T M L (C)	
RES. POOL DEPTH (m)	0.5	0.7	0.7	0.8	0.6	0.6				FLD SNS			

W_b Dp (m) | STAGE L M H | No Vis. Ch. DW | Dry/Int. Trib.s | BED MATERIAL Dominant cobble Subdom. fine | D95 (cm) | D (cm) | Morph. RPe

COVER

	Type	SWD	LWD	B	U	DP	OV	IV
	AMT	T	S	N	T	S	T	N
	LOC	P	P		P	P	P	P

CROWN CLOSURE: 0 (1) 2 3 4 5

LWD FNC N (F) A DIST (C) E

LB SHP U V (S) O

TEXTURE F G (C) B R A

RIP. VEG. N G S C D (M) W

STAGE INIT SHR PS YF MF NA

INSTREAM VEG N (A) M V

RB SHP U V (S) O

TEXTURE F G (C) B R A

RIP. VEG. N G S C D (M) W

STAGE INIT SHR PS YF MF NA

MORPHOLOGY

DISTURBANCE INDICATORS: O1 B1 B2 B3 D1 D2 (D3) | C1 C2 C3 C4 C5 S1 S2 S3 S4 S5

PATTERN TM ME IM IR (SI) ST

ISLANDS (N) O I F S AN

BARS (N) SIDE DIAG MID SPAN BR

COUPLING (DC) PC CO

CONFINEMENT EN CO (FC) DC UN N/A

WATER

FEATURES

C	NID MAP #	NID #	TYPE	HT / LG (m)	mtd	PHOTO	COMMENTS	UTM
						R___ F___		
						R___ F___		
						R___ F___		
						R___ F___		

SITE CARD

STREAM NAME (geo.) Nineteen Mile Creek (local) Nineteen Mile Creek

WATERSHED CODE 1 1 9 4 6 7 1 0 1 0 9 8 8 1 0 1 0

ILP MAP # 92J.016 | ILP # | NID MAP # | NID #

REACH # – | SITE # 2 | FIELD UTM 10 1503154 5555100 GPS | SITE LG | ACCESS V2

DATE 2 0 0 5 0 9 0 4 0 6 | TIME 1 7 3 0 | AGENCY | CREW JLC ZES | FISH FORM Y (N)

CHANNEL	mtd	T							GRADIENT %		EMS		REQ.#	
CHANNEL WIDTH (m)	4.2	4.6	4.6	4.2	4.1	4.2			2%	GE	TEMP °C		COND. µS/cm	
WETTED WIDTH (m)	4.0	4.2	4.2	4.0	3.8	3.8					pH		TURB. T M L (C)	
RES. POOL DEPTH (m)	0.2	0.3	0.4	0.4	0.3	0.1					FLD SNS			
W_b Dp (m)			STAGE L (M) H		No Vis. Ch. DW		Dry/Int. Tribs.				BED MATERIAL Dominant: cobble Subdom.: fine			
											D95 (cm) D (cm)		Morph. RPc	

COVER

	Type	SNAG	LWD	B	U	DP	OV	IV
	AMT	T	S	N	N	N	N	N
	LOC	P	P					

CROWN CLOSURE: 0 (1) 2 3 4 5

LWD FNC N F (A) DIST (L) E

LB SHP U V (S) O

TEXTURE F G (C) B R A

RIP. VEG. N G S C D (M) W

STAGE INIT SHR PS YF MF NA

INSTREAM VEG N A M (V)

RB SHP U V (S) O

TEXTURE F G (C) B R A

RIP. VEG. (N) G S C D M W

STAGE INIT SHR PS YF MF NA

MORPHOLOGY

DISTURBANCE INDICATORS: D1 B1 B2 B3 D1 D2 (D3); C1 C2 C3 C4 C5 S1 S2 S3 S4 S5

PATTERN TM ME IM IR (SI) ST

ISLANDS (N) O I F S AN

BARS (N) SIDE DIAG MID SPAN BR

COUPLING (DC) PC CO

CONFINEMENT EN CO (FC) OC UN N/A

FEATURES

C	NID MAP #	NID #	TYPE	HT / LG (m)	mtd	PHOTO	COMMENTS	UTM
						R___ F___		
						R___ F___		
						R___ F___		
						R___ F___		

SITE CARD

STREAM NAME (geo.) Nineteen Mile Creek (local) Nineteen Mile Creek

WATERSHED CODE 1 1 9 4 6 7 1 0 1 0 9 8 8 1 0 1 0

ILP MAP # 92J.016 | ILP # | NID MAP # | NID #

REACH # – | SITE # 3 | FIELD UTM 10 1503015 5556215 GPS | SITE LG | ACCESS V2

DATE 2 0 0 5 0 9 0 4 0 6 | TIME 1 6 4 0 | AGENCY | CREW JLC ZES | FISH FORM Y (N)

CHANNEL	mtd	T							GRADIENT %		EMS		REQ.#	
CHANNEL WIDTH (m)	4.1	4.0	3.5	3.2	2.5	1.6			2%	GE	TEMP °C		COND. µS/cm	
WETTED WIDTH (m)	3.9	3.6	3.4	3.0	2.4	1.6					pH		TURB. T M L (C)	
RES. POOL DEPTH (m)	0.2	0.2	0.3	0.4	0.3	0.2					FLD SNS			
W_b Dp (m)			STAGE L (M) H		No Vis. Ch. DW		Dry/Int. Tribs.				BED MATERIAL Dominant: cobble Subdom.: fine			
											D95 (cm) D (cm)		Morph. RPc	

COVER

	Type	SNAG	LWD	B	U	DP	OV	IV
	AMT	T	N	N	N	N	T	N
	LOC	P				P		

CROWN CLOSURE: 0 (1) 2 3 4 5

LWD FNC (N) F A DIST C (E)

LB SHP U V (S) O

TEXTURE F G (C) B R A

RIP. VEG. N G S C D (M) W

STAGE INIT SHR PS YF MF NA

INSTREAM VEG (N) A M V

RB SHP U V (S) O

TEXTURE F G (C) B R A

RIP. VEG. (N) G S C D M W

STAGE INIT SHR PS YF MF NA

MORPHOLOGY

DISTURBANCE INDICATORS: D1 B1 B2 B3 D1 D2 D3; C1 C2 C3 C4 C5 S1 S2 S3 S4 S5

PATTERN TM ME IM IR (SI) ST

ISLANDS (N) O I F S AN

BARS (N) SIDE DIAG MID SPAN BR

COUPLING (DC) PC CO

CONFINEMENT EN CO (FC) OC UN N/A

FEATURES

C	NID MAP #	NID #	TYPE	HT / LG (m)	mtd	PHOTO	COMMENTS	UTM
						R___ F___		
						R___ F___		
						R___ F___		
						R___ F___		

SITE CARD

STREAM NAME (gaz.) Twentyone Mile Creek (local) Twentyone Mile Creek
WATERSHED CODE 100-190-467-101-009-181-101-053-160-100
ILP MAP # 92J.016 ILP # NID MAP # NID #
REACH # – SITE # 1 FIELD UTM 10 501206 6552971 GPS SITE LG ACCESS Y/Z
DATE 20050408 17 TIME 1430 AGENCY DREW JLC ZES FISH FORM Y (N)

CHANNEL	mthd	T						GRADIENT %		
CHANNEL WIDTH (m)		2.6	3.1	3.4	3.4	3.6	3.4	1%	5%	
WETTED WIDTH (m)		2.6	2.8	2.9	2.8	2.8	2.8			
RES. POOL DEPTH (m)		0.3	0.3	0.4	0.4	0.3	0.4			
W_b Dp (m)					STAGE L (M) H			No Vis. Ch. DW	Dry/Int. Tribs.	

COVER	Total						
Type	SWD	LWD	B	U	DP	OV	IV
AMT	T	S	T			T	
LOC	P	P	P			P	

CROWN CLOSURE: 0 | 1 (>0-25%) | 2 (>25-50%) | 3 (>50-75%) | 4 (>75-90%) | 5 (>90%)

LWD FNC N (F) A DIST (C) E
LB SHP U V (S) O
TEXTURE F G (C) B R A
RIP. VEG. N G S C D (M) W
STAGE INIT SHR PS YF (MF) NA

INSTREAM VEG (N) A M V
RB SHP (U) V S O
TEXTURE F G (C) B R A
RIP. VEG. N G S C D (M) W
STAGE INIT SHR PS YF (MF) NA

EMS REG. #
TEMP °C COND. µS/cm
pH TURB. T M L (C)
FLD SNS
BED MATERIAL Dominant Subdom.
D95 (cm) D (cm) Morph. RPC-W

DISTURBANCE INDICATORS: 01 B1 B2 B3 D1 D2 D3 | C1 C2 C3 C4 C5 S1 S2 S3 S4 S5

PATTERN TM ME IM IR (SI) ST
ISLANDS (N) 0 1 F S AN
BARS (N) SIDE DIAG MID SPAN BR
COUPLING (DC) PC CO
CONFINEMENT EN CO FC (OC) UN N/A

C	MID MAP #	NID #	TYPE	HT / LG (m)	mthd	PHOTO	COMMENTS	UTM
						R___ F___	near log bike bridge	
						R___ F___		
						R___ F___		
						R___ F___		

SITE CARD

STREAM NAME (gaz.) Twentyone Mile Creek (local) Twentyone Mile Creek
WATERSHED CODE 100-190-467-101-009-181-101-053-160-100
ILP MAP # 92J.016 ILP # NID MAP # NID #
REACH # – SITE # 2 FIELD UTM 10 501192 6552966 GPS SITE LG ACCESS Y/Z
DATE 20050408 17 TIME 1515 AGENCY DREW JLC ZES FISH FORM Y (N)

CHANNEL	mthd	T						GRADIENT %		
CHANNEL WIDTH (m)		3.6	3.6	3.5	3.6	3.7	3.7	2%	5%	
WETTED WIDTH (m)		3.2	3.1	3.2	3.2	2.1	3.1			
RES. POOL DEPTH (m)		0.2	0.9	0.5	0.5	0.3	0.2			
W_b Dp (m)					STAGE L (M) H			No Vis. Ch. DW	Dry/Int. Tribs.	

COVER	Total						
Type	SWD	LWD	B	U	DP	OV	IV
AMT	N	T	S	N	N	N	N
LOC		P	P				

CROWN CLOSURE: 0 | 1 (>0-25%) | 2 (>25-50%) | 3 (>50-75%) | 4 (>75-90%) | 5 (>90%)

LWD FNC (N) F A DIST (C) E
LB SHP U V (S) O
TEXTURE F G (C) B R A
RIP. VEG. N G S (C) D M W
STAGE INIT SHR PS YF (MF) NA

INSTREAM VEG (N) A M V
RB SHP U V (S) O
TEXTURE F G (C) B R A
RIP. VEG. N G S (C) D M W
STAGE INIT SHR PS YF (MF) NA

EMS REG. #
TEMP °C COND. µS/cm
pH TURB. T M L (C)
FLD SNS
BED MATERIAL Dominant Subdom.
D95 (cm) D (cm) Morph. RPC-W

DISTURBANCE INDICATORS: 01 B1 B2 B3 D1 D2 D3 | (C1) (C2) C3 C4 C5 S1 S2 S3 S4 S5

PATTERN TM ME IM IR (SI) ST
ISLANDS (N) 0 1 F S AN
BARS (N) SIDE DIAG MID SPAN BR
COUPLING (DC) PC CO
CONFINEMENT EN CO FC (OC) UN N/A

C	MID MAP #	NID #	TYPE	HT / LG (m)	mthd	PHOTO	COMMENTS	UTM
						R___ F___		
						R___ F___		
						R___ F___		
						R___ F___		

SITE CARD

STREAM NAME (gaz.) Twentyone Mile Creek (local) Twentyone Mile Creek
WATERSHED CODE 100-914067-100097-181000-105316000
ILP MAP # 92J.016 ILP # NID MAP # NID #
REACH # – SITE # 3 FIELD UTM 10 504063 5553087 GPS SITE LG ACCESS Y2
DATE 2006/04/07 TIME 1635 AGENCY CREW JLC, ZES FISH FORM Y (N)

CHANNEL mthd T

							GRADIENT %
CHANNEL WIDTH (m)	5.7	6.5	8.2	9.1	11.7	11.2	2% GC
WETTED WIDTH (m)	5.0	6.0	7.8	8.7	8.9	8.7	
RES. POOL DEPTH (m)	0.1	0.6	1.3	2.2	1.8	0.7	
W_b Dp (m)			STAGE L (N) H				

No Vis. Ch. DW Dry/Int. Tribs.

COVER Total

Type	SWD	LWD	B	U	DP	OV	IV
AMT	S	T	T	N	N	T	N
LOC	P	P	P			P	

CROWN CLOSURE: 0 (1) 2 3 4 5

LWD FNC N (F) A DIST (C) E
LB SHP U V (S) D
TEXTURE F G (C) B R A
RIP. VEG. N G S (C) D M W
STAGE INIT SHR PS YF (MF) NA

INSTREAM VEG (N) A M V
RB SHP U (V) S D
TEXTURE F G C B (R) A
RIP. VEG. N G S (C) D M W
STAGE INIT SHR PS YF MF (NA)

EMS REC. #
TEMP °C COND. µS/cm
pH TURB. T M L (C)
FLD SNS
BED MATERIAL Dominant Subdom.
D95 (cm) D (cm) Morph. RPcW

DISTURBANCE INDICATORS: 01 B1 B2 B3 D1 D2 D3 / C1 C2 C3 C4 C5 S1 S2 S3 S4 S5

PATTERN TM ME IM IR (SI) ST
ISLANDS (N) 0 I F S AN
BARS (N) SIDE DIAG MID SPAN BR
COUPLING (DC) PC CO
CONFINEMENT EN CO FC (OC) UN N/A

C	NID MAP #	NID #	TYPE	HT / LG (m)	mthd	PHOTO	COMMENTS	UTM
						R___ F___	Culvert	
						R___ F___		
						R___ F___		
						R___ F___		

SITE CARD

STREAM NAME (gaz.) Fitzsimmons Creek (local) Fitzsimmons Creek
WATERSHED CODE 100-914067-100091-761000
ILP MAP # 92J.016 ILP # NID MAP # NID #
REACH # – SITE # FIELD UTM 10 503411 5553680 GPS SITE LG ACCESS Y2
DATE 2005/04/07 TIME 1010 AGENCY CREW JLC, ZES FISH FORM Y (N)

CHANNEL mthd T

							GRADIENT %
CHANNEL WIDTH (m)	9.6	9.8	9.9	10.4	10.1	10.4	2% GC
WETTED WIDTH (m)	9.4	9.5	9.5	9.7	9.7	9.8	
RES. POOL DEPTH (m)	0.4	0.4	0.7	0.7	0.7	0.4	
W_b Dp (m)			STAGE L (M) H				

No Vis. Ch. DW Dry/Int. Tribs.

COVER Total

Type	SWD	LWD	B	U	DP	OV	IV
AMT	T	T	N	N	N	S	N
LOC	P	S P				P	

CROWN CLOSURE: 0 (1) 2 3 4 5

LWD FNC (N) F A DIST C (E)
LB SHP U V (S) D
TEXTURE F G (C) B R A
RIP. VEG. N S S C (D) M W
STAGE INIT SHR PS YF (MF) NA

INSTREAM VEG (N) A M V
RB SHP (U) V S D
TEXTURE F G (C) B R A
RIP. VEG. N G (S) C D M W
STAGE INIT SHR PS YF (MF) NA

EMS REC. #
TEMP °C COND. µS/cm
pH TURB. (T) M L C
FLD SNS Abandon Channels
BED MATERIAL Dominant Subdom.
D95 (cm) D (cm) Morph. RPc

DISTURBANCE INDICATORS: 01 (B1) B2 B3 D1 D2 D3 / C1 C2 C3 C4 C5 S1 S2 S3 S4 S5

PATTERN TM ME IM IR (SI) ST
ISLANDS (N) 0 I F S AN
BARS N (SIDE) DIAG MID SPAN BR
COUPLING (DC) PC CO
CONFINEMENT EN CO FC (OC) UN N/A

C	NID MAP #	NID #	TYPE	HT / LG (m)	mthd	PHOTO	COMMENTS	UTM
						R___ F___		
						R___ F___		
						R___ F___		
						R___ F___		

SITE CARD

STREAM NAME (gaz.) Fitzsimmons Creek (local) Fitzsimmons Creek
WATERSHED CODE 1 1 9 4 6 7 1 0 1 0 9 7 6 0 1 0
ILP MAP # 92J.016 ILP # NID MAP # NID #
REACH # - SITE # 2 FIELD UTM 10 503582 5565566 GPS SITE LG ACCESS Y2
DATE 2 0 1 0 5 0 4 0 7 TIME 0 9 1 5 AGENCY CREW JLC ZES FISH FORM Y (N)

CHANNEL mthd T

CHANNEL WIDTH (m)	7.6	7.8	8.1	8.1	8.3	8.6
WETTED WIDTH (m)	7.1	7.2	7.2	7.2	7.4	7.5
RES. POOL DEPTH (m)	0.2	0.4	0.4	0.7	0.7	0.4
W_b Dp (m)						

GRADIENT % 2% 66
STAGE L (M) H No Vis. Ch. Dry/Int. DW Tribs.

WATER: EMS | REG. # | TEMP °C | COND. µS/cm | pH | TURB. (T) M L C

COVER
COVER Total

Type	(SWD)	(LWD)	B	U	DP	(OV)	IV
AMT	T	T	N	N	N	S	N
LOC	SP	P				SP	

CROWN CLOSURE: 0 (1) 2 3 4 5

LWD FNC N (F) A DIST C (E)
LB SHP (U) V S O
TEXTURE F G (C) B R A
RIP. VEG. N G S C (D) M W
STAGE INIT SHR PS YF (MF) NA

INSTREAM VEG (N) A M V
RB SHP U V (S) O
TEXTURE F G (C) B R A
RIP. VEG. N G S C (D) M W
STAGE INIT SHR PS YF (MF) NA

MORPHOLOGY
FLD SNS Abandon Channels
BED MATERIAL Dominant cobble Subdom. Fines
D95 (cm) D (cm) Morph. R Pc
DISTURBANCE INDICATORS: 01 (B1) B2 B3 D1 D2 D3
C1 C2 C3 C4 C5 S1 S2 S3 S4 S5
PATTERN TM ME IM IR (SI) ST
ISLANDS (N) O I F S AN
BARS N (SIDE) DIAG MID SPAN BR
COUPLING (DC) PC CO
CONFINEMENT EN CO FC (OC) UN N/A

FEATURES

C	NID MAP #	NID #	TYPE	HT / LG (m)	mthd	PHOTO	COMMENTS	UTM
						R__ F__		
						R__ F__		
						R__ F__		
						R__ F__		

SITE CARD

STREAM NAME (gaz.) Fitzsimmons Creek (local) Fitzsimmons Creek
WATERSHED CODE 1 1 9 4 6 7 1 0 1 0 9 7 6 0 1 0
ILP MAP # 92J.016 ILP # NID MAP # NID #
REACH # - SITE # 3 FIELD UTM 10 503398 5553962 GPS SITE LG ACCESS Y2
DATE 2 0 1 0 5 0 4 0 7 TIME 0 8 0 0 AGENCY CREW JLC ZES FISH FORM Y (N)

CHANNEL mthd T

CHANNEL WIDTH (m)	10.1	10.6	10.7	11.2	11.2	10.8
WETTED WIDTH (m)	9.7	10.1	10.2	10.6	10.6	10.2
RES. POOL DEPTH (m)	0.3	0.6	0.6	0.7	0.5	0.4
W_b Dp (m)						

GRADIENT % 2% 66
STAGE L (M) H No Vis. Ch. Dry/Int. DW Tribs.

WATER: EMS | REG. # | TEMP °C | COND. µS/cm | pH | TURB. (T) M L C

COVER
COVER Total

Type	(SWD)	(LWD)	B	U	DP	(OV)	IV
AMT	T	T	N	N	N	S	N
LOC	SP	P				SP	

CROWN CLOSURE: 0 (1) 2 3 4 5

LWD FNC N (F) A DIST C (E)
LB SHP U V (S) O
TEXTURE F G C B R (A)
RIP. VEG. N G S C (D) M W
STAGE INIT SHR PS YF (MF) NA

INSTREAM VEG (N) A M V
RB SHP U V (S) O
TEXTURE F G (C) B R A
RIP. VEG. N G (S) C D M W
STAGE INIT SHR PS YF (MF) NA

MORPHOLOGY
FLD SNS Abandon Channels
BED MATERIAL Dominant cobbles Subdom. fine
D95 (cm) D (cm) Morph. R Pc
DISTURBANCE INDICATORS: 01 B1 B2 B3 D1 D2 D3
C1 (C2) C3 C4 C5 S1 S2 S3 S4 S5
PATTERN TM ME IM IR (SI) ST
ISLANDS (N) O I F S AN
BARS N SIDE DIAG (MID) SPAN BR
COUPLING (DC) PC CO
CONFINEMENT EN CO FC (OC) UN N/A

FEATURES

C	NID MAP #	NID #	TYPE	HT / LG (m)	mthd	PHOTO	COMMENTS	UTM
						R__ F__	under Lost Lake foot bridge	
						R__ F__		
						R__ F__		
						R__ F__		

SITE CARD

STREAM NAME (gaz.) Rutherford Creek (local) Rutherford Creek

WATERSHED CODE 100-914-671-010-318-810-000

ILP MAP # 92J.026 ILP # NID MAP # NID #

REACH # – SITE # FIELD UTM 10 509753 5569249 GPZ SITE LG ACCESS V2

DATE 2010/10/16 TIME 1315 AGENCY CREW JLC ZES FISH FORM Y (N)

CHANNEL	mthd	T						GRADIENT %		EMS	REG. #
CHANNEL WIDTH (m)	6.9	7.8	W1	7.8	W2	14.2		1%	GE	TEMP °C	COND. µS/cm
WETTED WIDTH (m)	10.2	11.5	10.8	10.2	9.7	9.9				pH	TURB. T M L (C)
RES. POOL DEPTH (m)	0.1	0.1	0.3	0.4	0.2	0.2				FLD SNS LWD on bank/abandon channel	
W_b Dp (m)			STAGE L (M) H		No Vis. Ch. DW		Dry/Int. Trib.			BED MATERIAL Dominant cobble Subdom. boulder	
										D95 (cm) D (cm)	Morph. RPc

WATER

COVER

	COVER							Total
Type	SWD	LWD	B	U	DP	OV	IV	
AVIT	N	N	N	N	N	N	N	
LOC								

CROWN CLOSURE: (0) 1 2 3 4 5

DISTURBANCE INDICATORS: D1 (B1) B2 B3 D1 D2 D3 | C1 C2 C3 C4 C5 S1 S2 S3 S4 S5

LWD FNC	(N) F A	DIST C (E)	INSTREAM VEG	N A M V	PATTERN	TM ME IM IR (SI) ST
LB SHP	U Y (S) O		RB SHP	U V (S) O	ISLANDS	N (O) I F S AN
TEXTURE	F S (C) (B) R A		TEXTURE	F S (C) (B) R A	BARS	(N) SIDE DIAG MID SPAN BR
RIP. VEG.	(N) G S C D M W		RIP. VEG.	(N) G S C D M W	COUPLING	(DC) PC CO
STAGE	INIT SHR PS YF (MF) NA		STAGE	INIT SHR PS YF (MF) NA	CONFINEMENT	EN (CO) FC OC UN N/A

MORPHOLOGY

COVER

FEATURES

C	NID MAP #	NID #	TYPE	HT/LG (m)	mthd	PHOTO	COMMENTS	UTM
						R___ F___	hydro electric channel	
						R___ F___		
						R___ F___		
						R___ F___		

SITE CARD

STREAM NAME (gaz.) Rutherford Creek (local) Rutherford Creek

WATERSHED CODE 100-914-671-010-318-810-000

ILP MAP # 92J.026 ILP # NID MAP # NID #

REACH # – SITE # 2 FIELD UTM SITE LG ACCESS V4

DATE 2010/10/15 TIME 1012 AGENCY CREW JLC ZES FISH FORM Y (N)

CHANNEL	mthd	T						GRADIENT %		EMS	REG. #
CHANNEL WIDTH (m)	6.4	8.0	8.7	9.8	11.2	11.3		2%	GE	TEMP °C	COND. µS/cm
WETTED WIDTH (m)	6.0	7.8	8.4	9.4	10.8	10.8				pH	TURB. T M L (C)
RES. POOL DEPTH (m)	0.2	0.4	0.7	0.8	0.6	0.3				FLD SNS newly deposited fluvial sediment	
Dp (m)			STAGE L (M) H		No Vis. Ch. DW		Dry/Int. Trib.			BED MATERIAL Dominant boulder Subdom. cobble	
										D95 (cm) D (cm)	Morph. CP_B

WATER

COVER

	COVER							Total
Type	SWD	LWD	B	U	DP	OV	IV	
AVIT	N	N	T	N	M	N	N	
LOC			P		P			

CROWN CLOSURE: (0) 1 2 3 4 5

DISTURBANCE INDICATORS: D1 B1 (B2) B3 D1 D2 D3 | C1 C2 C3 C4 C5 S1 S2 S3 S4 S5

LWD FNC	(N) F A	DIST C (E)	INSTREAM VEG	N A M V	PATTERN	TM ME IM IR (SI) ST
LB SHP	U V (S) O		RB SHP	U (V) S O	ISLANDS	N (O) I F S AN
TEXTURE	F O (C) (B) R A		TEXTURE	F G (C) (B) R A	BARS	(N) SIDE DIAG MID SPAN BR
RIP. VEG.	(N) G S C D M W		RIP. VEG.	(N) G S C D M W	COUPLING	DC PC (CO)
STAGE	INIT SHR PS YF (MF) NA		STAGE	INIT SHR PS YF (MF) NA	CONFINEMENT	EN (CO) FC DC UN N/A

MORPHOLOGY

COVER

FEATURES

C	NID MAP #	NID #	TYPE	HT/LG (m)	mthd	PHOTO	COMMENTS	UTM
						R___ F___	no UTM in field	
						R___ F___		
						R___ F___		
						R___ F___		

SITE CARD

STREAM NAME (geo.) Rutherford Creek (local) Rutherford Creek

WATERSHED CODE 1 1 9 1 4 0 7 1 0 1 0 3 8 8 1 0 1 0

ILP MAP # 92J.026 | ILP # | NID MAP # | NID #

REACH # – | SITE # 3 | FIELD UTM 10 | SITE LG | ACCESS V4

DATE 2 0 0 5 0 4 0 6 | TIME 0 9 1 0 | AGENCY | CREW JLC ZES | FISH FORM Y (N)

CHANNEL	mthd	T						GRADIENT %		EMS		REQ. #	
CHANNEL WIDTH (m)	5.1	5.3	6.7	8.2	7.5	6.6		1%	66	TEMP °C		COND. µS/cm	
WETTED WIDTH (m)	4.8	4.9	6.2	7.8	7.0	6.4				pH		TURB. T M L (C)	
RES. POOL DEPTH (m)	0.1	0.3	0.6	0.4	0.2	0.1							

W$_b$ Dp (m) | STAGE L (M) H | No Vis. Ch. DW | Dry/Int. Tribs.

FLD SNS newly deposited fluvial sediment

BED MATERIAL Dominant cobble Subdom. boulder

D95 (cm) | D (cm) | Morph. SP$_{lg}$

COVER — Total

Type	SWD	LWD	B	U	DP	OV	IV
AMT	N	N	T	N	T	N	N
LOC			P		P		

CROWN CLOSURE: 0 | 1 (1-10%) | 2 (11-25%) | 3 (26-50%) | 4 (51-75%) | 5 (>75%)

DISTURBANCE INDICATORS: O1 | B1 | (B2) | B3 | D1 | D2 | D3 | C1 | C2 | C3 | C4 | C5 | S1 | S2 | S3 | S4 | S5

LWD FNC (N) F A | DIST C (E)

INSTREAM VEG (N) A M Y

LB SHP U (V) S O | RB SHP U V (S) O

TEXTURE F G (C) (B) R A | TEXTURE F G (C) (B) R A

RIP. VEG. (N) G S C D M W | RIP. VEG. (N) G S C D M W

STAGE INIT SHR PS YF (MF) NA | STAGE INIT SHR PS YF (MF) NA

PATTERN TM ME IM IR (SI) ST

ISLANDS (N) O I F S AN

BARS (N) SIDE DIAG MID SPAN BR

COUPLING DC PC (CO)

CONFINEMENT EN (CO) FC OC UN N/A

C	MID MAP #	NID #	TYPE	HT / LG (m)	mthd	PHOTO	COMMENTS	UTM
						R___ F___	no UTM in field	
						R___ F___		
						R___ F___		
						R___ F___		

SITE CARD

STREAM NAME (geo.) Soo River (local) Soo River

WATERSHED CODE 1 1 9 1 4 0 7 1 0 1 0 4 5 8 1 0 1 0

ILP MAP # 92J.026 | ILP # | NID MAP # | NID #

REACH # – | SITE # 1 | FIELD UTM 10 509713 5567890 GPS | SITE LG | ACCESS YZ

DATE 2 0 0 5 0 4 0 6 | TIME 1 5 1 5 | AGENCY | CREW JLC ZES | FISH FORM Y N

CHANNEL	mthd	T						GRADIENT %		EMS		REQ. #	
CHANNEL WIDTH (m)	14.9	15.1	14.6	14.2	13.8	13.9		1%	66	TEMP °C		COND. µS/cm	
WETTED WIDTH (m)	13.6	14.7	14.6	13.8	13.4	13.3				pH		TURB. T M L (C)	
RES. POOL DEPTH (m)	0.2	0.3	0.4	0.3	0.3	0.3							

FLD SNS LWD jam on banks

W$_b$ Dp (m) | STAGE L (M) H | No Vis. Ch. DW | Dry/Int. Tribs.

BED MATERIAL Dominant cobble Subdom. fine

D95 (cm) | D (cm) | Morph. RPc-w

COVER — Total

Type	SWD	LWD	B	U	DP	OV	IV
AMT	T	T	N	N	N	S	N
LOC	S	S				P	

CROWN CLOSURE: 0 | 1 (1-10%) | 2 (11-25%) | 3 (26-50%) | 4 (51-75%) | 5 (>75%)

DISTURBANCE INDICATORS: O1 | B1 | B2 | B3 | D1 | D2 | (D3) | C1 | C2 | C3 | C4 | C5 | S1 | S2 | S3 | S4 | S5

LWD FNC N (F) A | DIST C (E)

INSTREAM VEG (N) A M V

LB SHP U V (S) O | RB SHP U V (S) O

TEXTURE F G (C) B R A | TEXTURE F (G) C B R A

RIP. VEG. (N) G S C D M W | RIP. VEG. N G S C (D) M W

STAGE INIT SHR (PS) YF MF NA | STAGE INIT SHR (PS) YF MF NA

PATTERN TM ME IM (IR) SI ST

ISLANDS N (O) I F S AN

BARS N (SIDE) DIAG MID SPAN BR

COUPLING (DC) PC CO

CONFINEMENT EN CO (FC) OC UN N/A

C	MID MAP #	NID #	TYPE	HT / LG (m)	mthd	PHOTO	COMMENTS	UTM
						R___ F___		
						R___ F___		
						R___ F___		
						R___ F___		

SITE CARD

STREAM NAME (geo.) Soo River (local) Soo River

WATERSHED CODE 1 1 1 9 1 9 0 7 1 0 1 0 4 1 5 1 8 1 0 1 0 0 0 0

ILP MAP # 92J.026 ILP # NID MAP # NID #

REACH # – SITE # 2 FIELD UTM 10 509750 5567367 GPZ SITE LG ACCESS Y2

DATE 2 0 0 5 0 4 0 6 TIME 1 4 0 0 AGENCY CREW JLC ZES FISH FORM Y (N)

CHANNEL	mthd							GRADIENT %		EMS		REQ. #	
CHANNEL WIDTH (m)	19.2	18.6	18.7	18.8	19.1	19.1		1%	SE	TEMP °C		COND. µS/cm	
WETTED WIDTH (m)	8.7	18.2	18.2	18.1	18.0	18.3				pH		TURB. T M L (C)	
RES. POOL DEPTH (m)	unknown									FLD SNS			
W_b Dp (m)			STAGE L (M) H			Mo Vis. Ch. DW		Dry/Int. Tribs.		BED MATERIAL	Dominant cobble	Subdom. Fine	
										D95 (cm)	D (cm)	Morph. SPb-w	

COVER — Total

	Type	SWD	LWD	B	U	DP	OV	IV
	AMT	N	T	S	N	N	N	N
	LOC		P	P				

CROWN CLOSURE: 0 (1) 2 3 4 5

LWD FNC	(N) F	A	DIST	C (E)	INSTREAM VEG	(N) A M V
LB SHP	U V S (O)				RB SHP	U V (S) O
TEXTURE	F G C (B) R A				TEXTURE	F G C (B) R A
RIP. VEG.	(N) G S C D M W				RIP. VEG.	(N) G S C D M W
STAGE	INT SHR PS (YF) MF NA				STAGE	INT SHR PS (YF) MF NA

DISTURBANCE INDICATORS: 01 B1 (B2) B3 D1 D2 D3 — C1 C2 C3 C4 C5 S1 S2 S3 S4 S5

PATTERN	TM	ME	IM	(IR)	SI	ST
ISLANDS	(N)	O	I	F	S	AN
BARS	(N)	SIDE	DIAG	MID	SPAN	BR
COUPLING	(DC)	PC	CO			
CONFINEMENT	EN	CO	(FC)	OC	UN	N/A

C	NID MAP #	NID #	TYPE	HT / LG (m)	mthd	PHOTO	COMMENTS	UTM
						R___ F___	near hwy overpass	
						R___ F___		
						R___ F___		
						R___ F___		

SITE CARD

STREAM NAME (geo.) Soo River (local) Soo River

WATERSHED CODE 1 1 1 9 1 9 0 7 1 0 1 0 4 1 5 1 8 1 0 1 0 0 0 0

ILP MAP # 92J.026 ILP # NID MAP # NID #

REACH # – SITE # 3 FIELD UTM 10 509872 5567040 GPZ SITE LG ACCESS Y2

DATE 2 0 0 5 0 4 0 6 TIME 1 2 5 5 AGENCY CREW JLC ZES FISH FORM Y (N)

CHANNEL	mthd	T						GRADIENT %		EMS		REQ. #	
CHANNEL WIDTH (m)	17.0	19.8	20.1	21.9	26.1	28.4		1%	SE	TEMP °C		COND. µS/cm	
WETTED WIDTH (m)	10.6	19.1	19.5	19.9	22.1	23.6				pH		TURB. T M L (C)	
RES. POOL DEPTH (m)	unknown									FLD SNS			
W_b Dp (m)			STAGE L M H			Mo Vis. Ch. DW		Dry/Int. Tribs.		BED MATERIAL	Dominant cobble	Subdom. fine	
										D95 (cm)	D (cm)	Morph. RPc	

COVER — Total

	Type	SWD	LWD	B	U	DP	OV	IV
	AMT	T	T	N	N	D	N	N
	LOC	P	P			P		

CROWN CLOSURE: 0 (1) 2 3 4 5

LWD FNC	N (F) A	DIST	(C) E	INSTREAM VEG	(N) A M V	
LB SHP	U V (S) O			RB SHP	U (V) S O	
TEXTURE	(F) G (C) B R A			TEXTURE	F G C (B) R A	
RIP. VEG.	N G S C (D) M W			RIP. VEG.	N G S C D (M) W	
STAGE	INT SHR PS VF (MF) NA			STAGE	INT SHR PS VF (MF) NA	

DISTURBANCE INDICATORS: 01 B1 B2 B3 D1 D2 (D3) — C1 C2 C3 C4 C5 S1 S2 S3 S4 S5

PATTERN	TM	ME	IM	(IR)	SI	ST
ISLANDS	(N)	O	I	F	S	AN
BARS	N	(SIDE)	DIAG	MID	SPAN	BR
COUPLING	(DC)	PC	CO			
CONFINEMENT	EN	CO	(FC)	OC	UN	N/A

C	NID MAP #	NID #	TYPE	HT / LG (m)	mthd	PHOTO	COMMENTS	UTM
						R___ F___		
						R___ F___		
						R___ F___		
						R___ F___		

Appendix C: Letter of Authorization

10/15/2004 11:09 FAX 604 582 5305 MELP - SURREY 001

BRITISH COLUMBIA

Ministry of Water, Land and Air Protection
Regional Operations
Lower Mainland Region

FAX SHEET

Date: Friday, October 15, 2004 # of pages (including this sheet) 2

To: **Zac Semeniuk & Jen Carter** Fax # **(604) 432-9046**

Office: BCIT – Fish and Wildlife Phone # (604)

From: **Iain Lunn** Phone # (604) 582-5234

Regional Operations
10470 152 Street, Surrey BC V3R 0Y3 Fax # (604) 930-7119

SPECIAL INSTRUCTIONS:

Zac / Jen:
Please ensure that you have the accompanying letter on your person any time you are sampling with bait. The local conservation officer Chris Doyle, has been informed of your activities. However, the Federal fisheries officers have not.
Good luck,

Iain

URGENT: Yes CONFIDENTIAL: No ORIG. IN MAIL: No

Material contained in this fax transmission may be confidential, and should only be delivered to the addressee. If you do not receive all pages, please call 604 582-5200.

Figure 13: Authorization by the Ministry of Water, Land and Air Protection to angle with bait. Page 1 of 2.

10/15/2004 11:10 FAX 604 582 5305 MELP - SURREY 002

BRITISH COLUMBIA

October 15, 2004

To whom it may concern:

Re: Bull Trout Inventory Project

By way of this letter, British Columbia Institution of Technology students **Zac Semeniuk** and **Jen Carter** have the permission of the Ministry of Water, Land and Air Protection to use bait while sampling for bull trout on the following water courses between the dates of October 15, 2004 and March 31, 2005.

1. Rutherford Creek
2. Fitzsimmons Creek
3. Soo River
4. Nineteen Mile Creek
5. Twentyone Mile Creek
6. Black Comb Creek

Sincerely,

Iain Lunn
Conservation Biologist
Ministry of Water, Land and Air Protection
Lower Mainland Region

Ministry of Water, Land and Air Protection | Regional Operations Lower Mainland Region | Mailing/Location Address: 10470 152 Street SURREY BC V3R 0Y3 | Telephone: (604) 582-5200 Facsimile: (604) 930-7119 http://www.gov.bc.ca/ http://www.gov.bc.ca/wlap/

Figure 14: Authorization by the Ministry of Water, Land and Air Protection to angle with bait. Page 2 of 2.