Appendix 15-A

Brucejack Project: 2012 Fish and Fish Habitat Baseline Report

ERM

Pretium Resources Inc.

BRUCEJACK GOLD MINE PROJECT
2012 Fish and Fish Habitat Baseline Report

PRETIVM

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BRUCEJACK GOLD MINE PROJECT

2012 FISH AND FISH HABITAT BASELINE REPORT

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Prepared for:

PRETIVM

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Prepared by:

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Executive Summary

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Engineers and Scientists

Executive Summary

The Brucejack Property is situated within the Sulphurets District in the Iskut River region, approximately 20 kilometres northwest of Bowser Lake and 65 kilometres north-northwest of the town of Stewart, British Columbia. This report presents the fish and fish habitat baseline studies completed for the project during 2010, 2011, and 2012.

The scopes of the baseline studies were to characterize fish habitat and biology of fish communities in streams, wetlands, and lakes within the fish and fish habitat study area.

The fish and fish habitat study area encompasses a total of 50 stream sites located in seven watersheds (Bell-Irving River, Bowser River, Scott Creek, Todd Creek, Todedada Creek, Unuk River, and Wildfire Creek).

Dolly Varden, bull trout, coho salmon, chinook salmon, sockeye salmon, rainbow trout, and mountain whitefish were captured at stream sites. In total, fish were captured at 20 stream reaches. Char species (Dolly Varden and bull trout) were captured in each study area watershed and were the most widely distributed fish species. Genetic analysis of a subset of char indicated that both Dolly Varden and bull trout were present in the study area, but due to morphological similarities they could not be reliably differentiated in the field. Rainbow trout and coho salmon were present in all large watersheds of the Bell-Irving drainage, but not in the Unuk River, Todd Creek, or Scott Creek watersheds. Chinook salmon were only captured in the Bell-Irving River and Unuk River watersheds near or in the large mainstem rivers.

Five fish barriers were located on Sulphurets, Wildfire, and McInnes Creek. The cascade barrier on Sulphurets Creek has been confirmed to be a barrier to fish passage; and historical sampling indicates that no fish are present upstream of the cascade barrier. A barrier created by a series of cascades and falls was located on Wildfire Creek. Sampling of several lakes and streams upstream of the Wildfire Creek barrier did not result in the capture of any fish, and sampling conducted during the baseline studies indicate that there are no fish present upstream of the Wildfire Creek barrier. The third fish passage barrier located during the survey was a waterfall on McInnes Creek, a small stream at the southeast section of the study area.

Fish and fish habitat surveys along a proposed transmission line route were conducted. Only one proposed stream crossing, the Bowser River, was identified as fish habitat. A combination of high gradient (> 30%), frequent fish barriers, and lack of suitable habitat for fish populations above fish passage barriers resulted in a default non-fish bearing designation for all other stream crossings.

Spawning sockeye and coho salmon were found in Todedada Creek and Bowser River. Sockeye salmon were found within Todedada Creek and the Bowser River watershed. Spawning coho salmon were found in the greatest numbers within Todedada Creek.

Seven lakes were surveyed in the study area. Brucejack Lake is a deep, glacier fed, high elevation lake located upstream of the fish barrier on Sulphurets Creek. No fish were captured in Brucejack Lake. Bowser Lake is deep and highly turbid. Due to the size of the lake (3,455 ha), only a section of the northwest corner of Bowser Lake was studied. In this section, a narrow littoral zone was present that provided limited fish habitat, but there was abundant juvenile fish rearing habitat located in small groundwater-fed streams entering the lake. Dolly Varden/bull trout, longnose sucker, mountain whitefish, and kokanee salmon were captured in Bowser Lake. Inlets to Todedada Lake do not provide high quality fish habitat and large portions of the lake have a narrow littoral zone, but there is abundant large woody debris and fish cover within the littoral zone and the lake outlet. Juvenile and adult Dolly Varden/bull trout and rainbow trout were observed in the lake. Four unnamed lakes were surveyed in the fish and fish habitat study area. Unnamed Lake 1, Unnamed Lake 2 and Unnamed Lake 4 were similar in habitat type. All three were small and shallow with fine organic substrate and abundant aquatic vegetation. Fish were not captured in any of the three lakes. Dolly Varden/bull trout were captured in Unnamed Lake 3. Within Unnamed Lake 3, shallow littoral areas for rearing were found along the west and east shores of Unnamed Lake 3 and spawning habitat was observed in inlets along the northwestern shore where an avalanche chute extends to the lakeshore. The rest of the shoreline was composed of bedrock with no littoral zone.

One wetland was assessed in the headwaters of Todedada Creek. This wetland contains high quality fish habitat for fish rearing and a relatively high abundance of juvenile Dolly Varden/bull trout. The majority of coho and sockeye salmon spawners observed within the study area were observed spawning in flowing channels in this wetland.

Following Metal Mining Effluent Guidelines, Dolly Varden/bull trout were selected as a sentinel species for baseline monitoring. Three sites were chosen for baseline monitoring, one each for the Wildfire Creek, McInnes Creek, and Unuk River watersheds. Baseline data was gathered to allow for monitoring of effects endpoints through indicators of energy use, energy storage, and survival. Baseline tissue metal concentrations were measured at the three monitoring sites. Diet composition was characterized through the analysis of stomach weight and stomach content composition. Diet differed primarily in regards to the relative abundance of Trichoptera and Ephemeroptera. The composition of the diet in all sites indicates the fish were primarily feeding on benthic invertebrates.

Acknowledgements

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BRUCEJACK GOLD MINE PROJECT
2012 FISH AND FISH HABITAT BASELINE REPORT

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Acronyms and Abbreviations

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Acronyms and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

0+	Young-of-year fish; fish less than one year of age
ANOVA	Analysis of Variance
CPUE	Catch-per-unit-effort, a standardized measure of fishing effort.
D	Diameter of the largest particle in a streambed that will be moved by flows
D_{95}	Diameter of particle that is greater than 95% of the other particles in a streambed
DFO	Fisheries and Oceans Canada
EF	Electrofishing
GIS	Geographic Information System
GLM	General Linear Model
GSI	Gonadosomatic Index
HSI	Hepatosomatic Index
ILP	Interim Locational Point
LWD	Large woody debris
masl	Meters above sea level
MMER	Mining Metal Effluent Regulations
MOE	Ministry of Environment (British Columbia)
NA	Not available/applicable
NCD	Non-classified drainage
NVC	No visible channel
Project	Brucejack Gold Mine Project
RIC	Resources Inventory Committee
SD	Standard deviation of the mean
SE	Standard error of the mean
SISS	Stream Information Summary System
TRIM	Terrain Resource Information Management
tpd	Tonne per day
UTM	Universal Transverse Mercator
wwt	Wet weight

1. Introduction

1. Introduction

Components of the Brucejack Gold Mine Project (the Project) will be located in the Unuk River and Bell-Irving River watersheds in proximity to a number of streams, lakes, and wetlands. Anadromous and resident fish species have been reported in the general area. Baseline studies, conducted in 2010, 2011, and 2012, were initiated to characterize the fish habitat and fish communities within areas that may be affected by the development of the Project. Key areas with high-value fish populations and fish habitat were identified and assessed using standardized sampling methodology.

This report provides an overview of the currently proposed project description, a description of methods applied in the field and during data analysis, and a presentation of results from work conducted to date.

2. Project Description

2. Project Description

Pretium Resources Inc. (Pretivm) proposes to develop the Brucejack Gold Mine Project (the Project) as a 2,700 tonne per day (tpd) underground gold and silver mine. The Brucejack property is located at 56°28′20″ N latitude by 130°11′31″ W longitude, which is approximately 950 km northwest of Vancouver, 65 km north-northwest of Stewart, and 21 km south-southeast of the closed Eskay Creek Mine (Figure 2-1). The Project is located within the Kitimat-Stikine Regional District. Several First Nation and Treaty Nations have traditional territory within the general region of the Project including the Skii km Lax Ha, the Nisga'a Nation, the Tahltan Nation, the Gitxan First Nation, and the Gitanyow First Nation.

The mine site area will be located near Brucejack Lake. Vehicle access to the mine site will be via an existing exploration access road from Highway 37 that may require upgrades to facilitate traffic during mine operations. A transmission line will connect the mine site to the provincial power grid near Stewart or along Highway 37; two options are currently under consideration.

The Project is located within the boundary range of the Coast Mountain Physiographic Belt, along the western margin of the Intermontane Tectonic Belt. The local terrain ranges from generally steep in the western portion of the Project area in the high alpine with substantial glacier cover to relatively subdued topography in the eastern portion of the Project area towards the Bell-Irving River. The Brucejack mine site will be located above the tree line in a mountainous area at an elevation of approximately 1,400 masl; surrounding peaks measure 2,200 m in elevation. The access and transmission corridors will span a range of elevations and ecosystems reaching a minimum elevation near the Bell Irving River of 500 masl. Sparse fir, spruce, and alder grow along the valley bottoms, with only scrub alpine spruce, juniper, alpine grass, moss, and heather covering the steep valley walls.

The general area of the Brucejack Property has been the target of mineral exploration since the 1960s. In the 1980s Newhawk Gold Mines Ltd. conducted advanced exploration activities at the current site of the proposed Brucejack mine site that included 5 km of underground development, construction of an access road along the Bowser River and Knipple Glacier, and resulted in the deposition of 60,000 m^3 of waste rock within Brucejack Lake.

Environmental baseline data was collected from Brucejack Lake and the surround vicinity in the 1980s to support a Stage I Impact Assessment for the Sulphurets Project proposed by Newhawk Gold Mines Ltd. Silver Standard Resources Inc. commenced recent environmental baseline studies specific to the currently proposed Project in 2009 which have been continued by Pretivm, following its acquisition of the Project in 2010. The scope and scale of the recent environmental baseline programs have varied over the period from 2009 to the present as the development plan for the Project has evolved.

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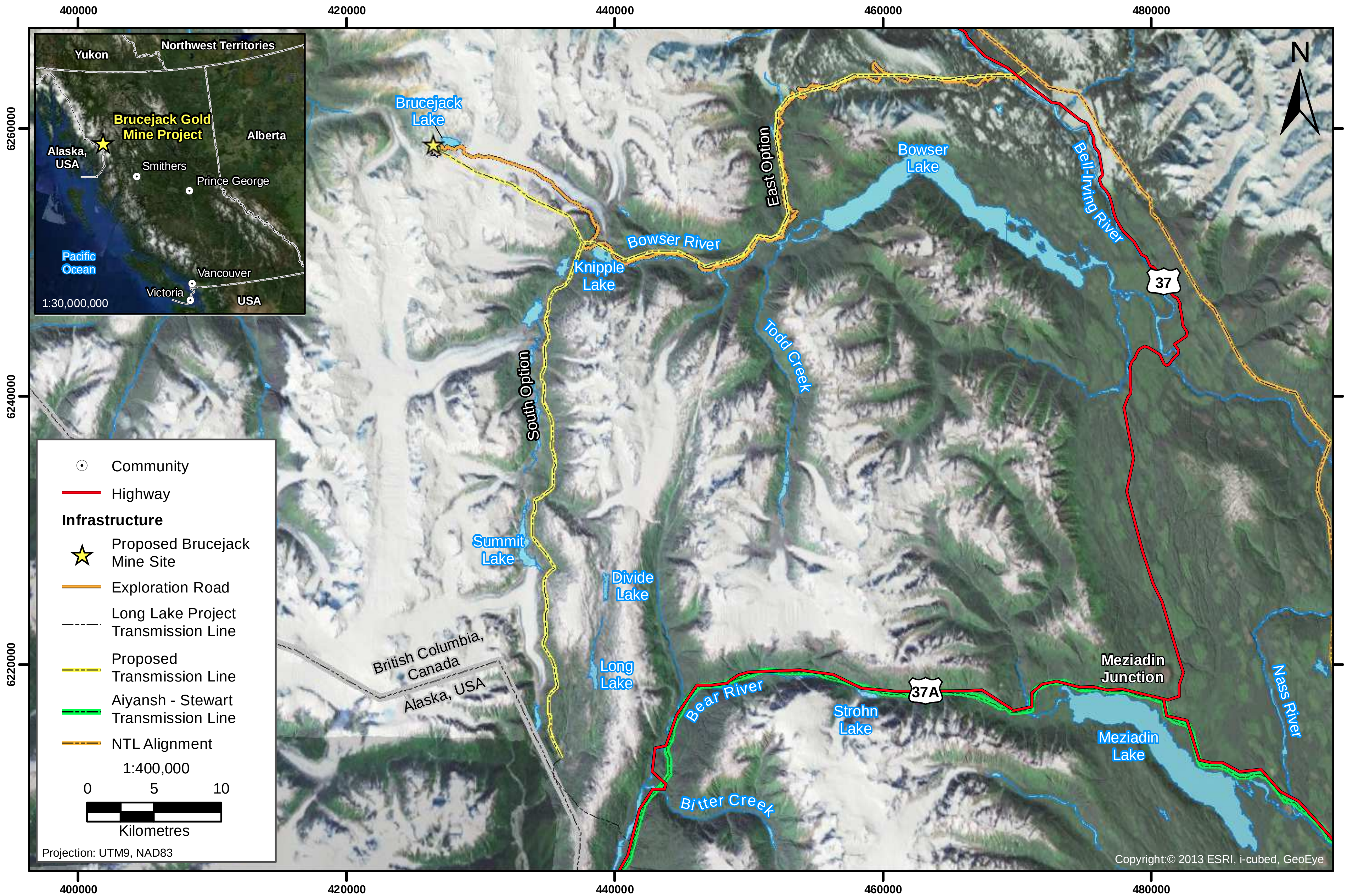

Figure 2-1

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Brucejack Gold Mine Project Overview

Figure 2-1

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3. Objectives

3. Objectives

The purpose of this study was to describe fish habitat and the biological characteristics of the fish communities in the streams, rivers, lakes, and wetlands in the fish and fish habitat study area. The specific objectives of this study were as follows:

- determine fish presence, community, and distribution for streams, rivers, lakes, and wetlands within the study area;
- assess the quality of fish habitat in streams, rivers, and lakes within the study area;
- characterize aspects of the physiology and biology of sentinel fish species in the study area, including tissue metal content, and indicators of survival, energy use and energy storage in accordance with *Metal Mining Effluent Regulation* (MMER; SOR/2002-222) guidelines (Environment Canada, 2012); and
- locate barriers to fish movement within the study area.

This baseline information will provide a reference against which the potential impacts of mine development will be measured.

4. Study Area

4. Study Area

The fish and fish habitat study area was defined to allow characterization of fish and fish habitat of all areas that could potentially be effected from any future Project activities. The study area includes major watersheds and waterbodies inside and adjacent to the Brucejack and Bowser properties, potential infrastructure, as well as sites downstream of or adjacent to development associated with the Project. In particular, sampling focused on the Bell-Irving River, Bowser River, Wildfire Creek, Todedada Creek, Scott Creek, Todd Creek, and Unuk River watersheds with additional observations from the Salmon River Watershed (Figure 4-1). Prominent waterbodies within the study area are discussed in Section 3. Individual sampling sites are shown in Section 6.

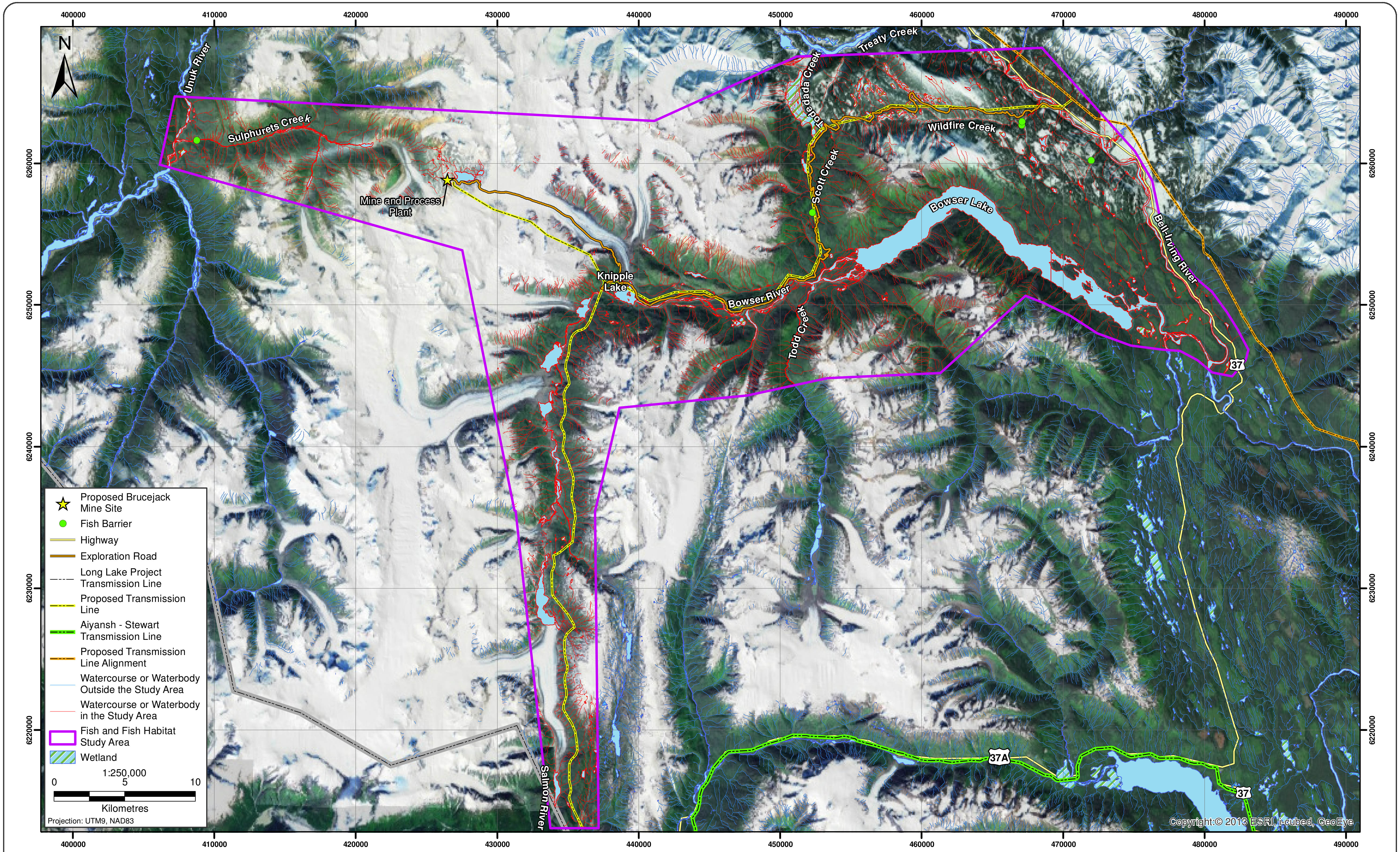

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Figure 4-1

Fish and Fish Habitat Study Area

5. Background Information

5. Background Information

5.1 APPLICABLE LEGISLATION (FEDERAL AND PROVINCIAL)

This study was designed to address Fisheries and Oceans Canada's (DFO) *No Net Loss Guiding Principle* for fish habitat (DFO 1986). Under the *No Net Loss Guiding Principle*, development should not result in a net decrease of the productive capacity of fish habitat. Section 34 of the federal *Fisheries Act* (1985) defines fish habitat as "spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes." In 2012, modifications were made to the *Fisheries Act* that are expected to result in changes to DFO principles and practices. This study was designed in consideration of legislation and regulatory guiding principles under effect in 2010 and is expected to meet contemporary regulatory requirements as well. Therefore, this baseline study provides an assessment of fish habitat quality and quantity as well as fish community composition in order to characterize the productive capacity of fish habitat within the study area.

The study was also designed to meet requirements of the *Metal Mining Effluent Regulations* following guidelines recommended by Environment Canada (2012). The MMER stipulate environmental effects testing and monitoring activities that must be undertaken by metal mines as a condition of depositing effluent. This baseline study identifies and gathers data regarding pertinent aspects of fish and fish habitat biology and health for use in future environmental monitoring activities to meet MMER requirements for the Project.

5.2 LITERATURE REVIEW

5.2.1 Sources of Historical Data

A number of studies provide information on the major waterbodies in the area, although most are limited in scope or geographic range. Data relevant to this study were gathered through online tools and catalogues such as Habitat Wizard (MOE 2011), and Mapster (DFO 2010), federal and provincial reports, and reports prepared for use by industry or other organizations.

The report most pertinent to the Project was prepared for the BC Ministry of Environment (MOE) by Saimoto and Saimoto (1998). It describes a reconnaissance level fisheries inventory of the Bell-Irving and Bowser River watersheds. Specifically, it contains fish community data for major waterbodies in the Bowser River watershed, one of the two main watersheds where Project development is expected. However, it does not provide descriptions of fish habitat in the watershed. Other relevant information was accessed from baseline reports prepared for the Seabridge Gold KSM Project, including fish habitat descriptions and fish community and biological data for select streams in the study area (Rescan 2010). Documents prepared for the Newhawk Gold Mines Ltd. Sulphurets Project provided additional data relevant to the proposed Project development, particularly in the Unuk River watershed (Tripp 1987, 1988; Newhawk 1989)

Several lakes in the study area have been surveyed (Withler 1956; Hancock and Marshall 1984; Tripp 1987, 1988; Coombs 1988; Rescan 2010). These surveys focused primarily on Bowser Lake, although a few included other waterbodies in the Bowser River watershed, including Brucejack Lake (Newhawk 1989). While some historical information is available for streams and rivers in the Project and study area, most is limited to escapement numbers (Alexander and Koski 1995; Pahlke et al. 1996; Weller et al. 2005). Almost all historical data available pertains entirely to fish presence and distribution, and there is very little available information regarding fish habitat or community structure.

5.2.2 Bell-Irving River

The Bell-Irving River runs alongside the eastern extent of the study area. Several watersheds within the study area, including the Bowser River and Wildfire Creek watersheds, discharge into the Bell-Irving River (Figure 4-1).

The Bell-Irving River is a large river within the Nass River watershed. It is approximately 165 km in length. Many tributaries of the Bell-Irving River are glacial or mountainous in origin. During periods of high glacial run off, including spring and summer, the water in the Bell-Irving may be highly turbid. The Bell-Irving River and its tributaries support chinook salmon (*Oncorhynchus tshawytscha)*, coho salmon (*O. kisutch*), sockeye salmon (*O. nerka*), rainbow trout/steelhead (*O. mykiss*), Dolly Varden (*Salvelinus malma malma*), bull trout (*S. confluentus*), and mountain whitefish (*Prosopium williamsoni*). The mainstem of the Bell-Irving River provides spawning habitat for large populations of chinook and coho salmon, but the high flows and turbid water can cause poor rearing conditions, so juvenile fish may move into the lower portions of Bell-Irving tributaries (Saimoto and Saimoto 1998).

5.2.3 Bowser River and Lake

The area of the Bowser River of interest to this study is the reaches from the headwaters of the Bowser River to Bowser Lake. These reaches of the Bowser River mainstem are large, swift, and turbulent with low potential for rearing habitat (Saimoto and Saimoto 1998). However, the floodplain has abundant side channels which provides rearing habitat for juvenile salmonids (Coombs 1988). Within the study area, the Bowser River is divided by Knipple Lake.

Bowser Lake is the second largest lake in the Nass River watershed, with a length of 23 km and a surface area of 3,610 ha (Coombs 1988). The maximum depth reported in Bowser Lake is 152 m (MOE 2011). It is the receiving waterbody for most of the Bowser River and for Scott Creek.

Adult Dolly Varden have historically been caught immediately upstream of Bowser Lake (Saimoto and Saimoto 1998), and were reported by Tripp (1987) to be found throughout the Bowser River. Mountain whitefish and bull trout have been found in Bowser River near the outlet of Knipple Lake (Tripp 1987; Saimoto and Saimoto 1998). Triple-pass electrofishing by Saimoto and Saimoto (1998) in the Bowser River upstream of Bowser Lake found fish densities to be low, which may indicate poor quality fish habitat. However, groups of spawning sockeye salmon were observed in the delta area, approximately 1 km upstream of Bowser Lake and a single adult female salmon (species unspecified) was caught 3.2 km upstream of the lake in 1979 (Hancock and Marshall 1984; Tripp 1988). Dolly Varden have been captured in the Bowser River upstream of Knipple Lake but are expected to be present at very low densities relative to other reaches in the region (Rescan 2010). Although chinook salmon, coho salmon, rainbow trout/steelhead, and longnose suckers (*Catostomus catostomus*) have been observed below Bowser Lake, none of these have previously been found above Bowser Lake (Saimoto and Saimoto 1988; Alexander and Koski 1995).

Dolly Varden have historically been fished among the islands in Bowser Lake and may also spawn and rear in the western end of the lake (Withler 1956; Coombs 1988). Juvenile salmonids have been observed rearing near the inlet, and portions of the lake are believed to provide spawning habitat for a substantial sockeye salmon population (Coombs 1988; Tripp 1988). The last three years of available sockeye salmon escapement data for this area (1997 to 1999) indicate returns of 3,000 to 66,625 sockeye salmon (FISS 2010). The lake inlet may be used as rearing and spawning habitat for coho salmon (Tripp 1988). Mountain whitefish and longnose sucker have also been observed in the lake (Withler 1956; Coombs 1988).

Mountain whitefish and Dolly Varden in Bowser Lake are found in lower densities and show a reduced growth rate when compared to other lakes in the Nass River watershed (Withler 1956). In general, the lake is thought to have relatively low fishing potential (Coombs 1988). Withler (1956) speculated that the low fish density and growth rates are due to the highly turbid water of Bowser Lake and the lack of good spawning habitat in much of the lake.

5.2.4 Salmon River

Summit Lake is an ice-dammed lake on the southern end by the Salmon Glacier. Prior to 1961, the lake drained northward over a bedrock sill into the Bowser River (Jones et al. 1985). In December 1961, probably after a long period of thinning and retreat of Salmon Glacier, a subglacial tunnel developed in the ice dam and the lake drained into the Salmon River quickly (Mathews and Clague 1993). The sudden drainage of the ice-dammed lake, referred to as jokulhlaup, occurred frequently after this event. In the early years (1960s), the lake emptied roughly every other year during the fall or early winter (October through December). But recently, the releases have been occurring almost annually and considerably earlier in the year (late July through August). The water draining from Summit Lake during a jokulhlaup flows 3 km from the terminus of Salmon Galcier in a confined valley and 5 km in a canyon before emerging into the lower Salmon River. Here it flows over a braided stream that passes through Hyder, Alaska, and drains into Portland Canal. It has been noticed that the flood magnitude and damages have generally decreased since 1960s (Devaris 2013). The annual jokulhlaup cycle is likely to continue until the glacier retreats to the point that it no longer forms an effective seal (Mathews and Clague 1993).

No comprehensive species lists are available for the Salmon River, but coho salmon and chum salmon are reported in the mainstem and tributaries (Novak 1983). In particular, a tributary known as Fish Creek, located 17 km downstream of the Salmon Glacier, has been identified as important spawning and rearing habitat for chum salmon, and is reputed to produce some of the largest chum salmon in North America. The fish-bearing status of the reaches of the Salmon River upstream of the Canada-U.S. border is not known at this time.

5.2.5 Scott Creek

Scott Creek is a large creek entering the Bowser River upstream of Bowser Lake. Dolly Varden juveniles and adults have historically been found in the lower reaches of Scott Creek (Tripp 1987, 1988; Saimoto and Saimoto 1998; Rescan 2010), 2.8 km upstream of its confluence with Bowser River (Tripp 1988), and 4 km upstream of the confluence (Saimoto and Saimoto 1998). Bull trout have only been previously found in the reach immediately upstream of the confluence with the Bowser River. Based on branchiostegal rays counts, a physiological trait used to distinguish between Dolly Varden and bull trout, possible evidence was found of hybridization between bull trout and Dolly Varden within Scott Creek (Saimoto and Saimoto 1998). Mountain whitefish use the creek for both spawning and rearing, but have only been recorded at low population densities (Tripp 1988).

No fish have historically been caught more than 5.2 km upstream of the creek mouth and may be prevented from reaching the upper portion of the creek by impassable falls, cascades, and rapids (Coombs 1988; Saimoto and Saimoto 1998). However, excellent potential spawning and rearing habitat was noted upstream of this point by Saimoto and Saimoto (1998), and may allow for the persistence of upstream resident populations. The lack of significant sampling in the upstream portion was identified as a knowledge gap by Saimoto and Saimoto (1998).

5.2.6 Todd Creek

Todd Creek is a relatively steep stream that runs north from Mount Johnson to the Bowser River, entering a short distance upstream of Bowser Lake. No historical fish community data are available for Todd Creek. A 1976 physical survey of the creek identified several rock features in the creek, but none were reported with enough detail to determine their status as possible fish barriers (MOE 2011).

5.2.7 Todedada Creek

Todedada Creek is a tributary to Treaty Creek and is outside the Bowser River system. Todedada Creek has its headwaters close to Scott Creek, separated by a narrow watershed divide. Todedada Creek provides important spawning habitat for coho salmon, with the confluence of the two main branches being used extensively during the spawning period in October (Tripp 1988). Adult coho were observed in a number of other areas of the creek, and much of the system appears suitable for coho spawning. Rainbow trout and mountain whitefish have also been found in Todedada Creek and may use it for spawning (Tripp 1987; Saimoto and Saimoto 1998).

5.2.8 Wildfire Creek

Wildfire Creek is a tributary to the Bell-Irving River, entering upstream of the confluence of the Bell-Irving River and the Bowser River. The most abundant historically reported fish species in Wildfire Creek is rainbow trout, with lower densities of mountain whitefish and Dolly Varden observed as well (Tripp 1987; Saimoto and Saimoto 1998). Whereas rainbow trout juveniles and adults have been found throughout the lower 2.5 km of the creek, mountain whitefish and Dolly Varden have only been observed in the 100 m directly upstream of the creek mouth (Saimoto and Saimoto 1998).

Wildfire Creek contains a number of 1 m-high waterfalls in the lower 2.5 km of the creek (Saimoto and Saimoto 1998). A 2 m-high fall and series of cascades located 2.5 km upstream of the confluence with the Bell-Irving River may block fish passage to the upper reaches of the stream (Saimoto and Saimoto 1998). No fish have been historically observed upstream of this point.

5.2.9 Unuk River including Sulphurets Creek and Brucejack Lake

The Unuk River system is a large, productive system with its headwaters in British Columbia. It flows through the state of Alaska into the Pacific Ocean Burrows Bay. The Unuk River system supports large populations of chinook salmon, sockeye salmon, cutthroat trout, and coho salmon, a proportion of which have been traced to the upper portions of the Unuk River watershed with exact spawning grounds unknown (Newhawk 1989; Pahlke et al. 1996; Weller et al. 2005). Recent surveys suggest the majority of salmon spawning takes place in the lower reaches of the river in Alaska (Mecum and Kissner 1989) and in Border Lake, located off the mainstem approximately 2 km upstream of the BC-Alaska border. Pink and chum salmon have been observed in these lower reaches. Although the Unuk River watershed within the United States has been well studied, there are little fisheries data available for the Canadian reaches, apart from studies conducted for the Newhawk Gold Mines Sulphurets Project (Tripp 1987, 1988; Newhawk 1989) and the Seabridge Gold KSM Project (Rescan 2010). Chinook, coho, and sockeye salmon, as well as Dolly Varden, have been captured in the reaches of the Unuk River included in the study area (Trip 1987; Newhawk 1989; Rescan 2010).

Despite the presence of Dolly Varden in the lower reach of Sulphurets Creek, no fish have been historically captured in the upstream reaches or in Sulphurets Lake (SISS 1982; Trip 1987, 1988; Newhawk 1989; Rescan 2010). Fish migration in this system is believed to be constrained by a 200 m long section of cascades, with limited spawning or rearing habitat available upstream of the cascades (Newhawk 1989; SISS 1989). Based on historical information, the portion of the Sulphurets Creek system upstream may not be fish-bearing.

Brucejack Lake is located upstream of Sulphurets Lake and Sulphurets Lake. Brucejack Lake and its outflow, Brucejack Creek, are separated from Sulphurets Lake by Sulphurets Glacier. Brucejack Lake is a high altitude, deep glacial lake with a short ice-free season, and is described as having low potential fisheries value (Newhawk 1989). No fish have been captured in Brucejack Lake and is confirmed non-fish bearing (Newhawk 1989; Price 2005).

6. Methods

6. Methods

6.1 FISH HABITAT COMPONENT DEFINITIONS

Streams, lakes, and wetlands are all watershed components that may provide habitat for fish. Fish species may use only one habitat component type or move between components. All three habitat types were sampled during the baseline studies. Streams are areas of flowing water characterized by a continuous channel with evidence of scouring to the channel bed or deposits of mineral alluvium (RIC 2001). Lakes are non-flowing, open bodies of water with maximum depths greater than 2 m. Shallow open waterbodies, or open waterbodies in which more than 25% of the surface is covered in vegetation, are considered wetlands.

Fish and fish habitat survey sites were categorized as Watershed Characterization sites, Receiving Environment sites, Reference Environment sites, or Linear Survey sites. Watershed Characterization sites were located throughout the study area and were used to collect information regarding the overall characteristics of waterbodies and fish communities in the study area. Watershed Characterization sites were not necessarily near proposed infrastructure and were selected due to their ecological importance in the watershed or as representatives of a habitat type common within the study area. Receiving Environment sites were associated with proposed infrastructure, while Reference Environment sites were selected for their similarity to Receiving Environment sites to provide potential control sites for use in future Project monitoring activities. Linear Survey sites were located along a linear transect survey line. Site types are distinguished based on the rationale for inclusion in the study, the fish habitat assessment procedures were the same for all site types (as described in Section 6.2).

6.2 FIELD SURVEY

6.2.1 Study Design

Watershed Characterization sites were studied with the objective of identifying general fish habitat and fish community characteristics of major watersheds (Figure 6.2-1; Table 6.2-1). Key watersheds were identified through examining historical information, aerial surveys, and general watershed characteristics. The Bell-Irving River, Bowser River, Wildfire Creek, Todedada Creek, Scott Creek, Todd Creek, and Unuk River watersheds were selected for study as they represent the range of stream types and characteristics present in the study area. Some sites were located in areas associated with proposed infrastructure that is no longer a part of planned Project development. The data collected from those sites are included in this report as they are still relevant to the general watershed descriptions. Sampling for general study area description was conducted in summer and fall of 2010, 2011, and 2012.

In addition to the watershed characterization survey, a linear survey was conducted along the east bank of the upper Bowser River to qualify and quantify potential fish habitat along a transect associated with the proposed transmission line – south option route (Figure 6.2-1). The transect stretches from the proposed mine site, south-east along the Knipple Glacier, south from Knipple Lake to the headwaters of the Bowser River and along Summit Lake and parts of the Salmon River watershed. The survey transect was initially aerially surveyed on August 29, 2012. The area is dry, rocky, and sparsely vegetated, allowing the crew to gain an accurate impression of the overall habitat along the transect during the aerial survey. At this stage, some sections of the transect were determined to be non-fish bearing due to excessive gradient (> 50%; Plate 6.2-1). Other parts of the transect ran through the Knipple Glacier or Salmon Glacier and had no potential as fish habitat.

Plate 6.2-1. Example of high gradient areas that were determined to be non-fish bearing along the linear survey transect in the upper Bowser River Valley.

Areas of the route that had potential to have fish habitat were surveyed on foot from August 29 to Sept 2, 2012. Crews walked the route and located streams and drainages along it. Stream sites were classified as “true streams” if they met the definition of a stream — a continuous, defined channel for at least 100 m (MOF 1998). Sites with partial or discontinuous channelization were categorized as non-classified drainages (NCDs). Sites where water seeped or flowed overland, or where water formed pools or ponds that might provide fish habitat but where no channelization was apparent, were classified as no visible channel (NVC). In some areas, steep ground or rock cliffs prevented crews from reaching the transmission line route. When unable to access the route, crews surveyed a line down slope from the route so that they could locate streams as they flowed downhill from the crossing.

6.2.2 Habitat

6.2.2.1 Streams

All major watercourses in the study area were divided into reaches based on RIC guidelines (RIC 2001). Reaches contain relatively homogenous habitat and reach breaks are located where there are large changes in habitat characteristics such as stream width, gradient, or morphology. Habitat characteristics were summarized by stream reach.

For all site classifications, a unique identifying site number, or interim locational point (ILP), was assigned.

At each stream crossing location, streams were assessed using methods based on the *Reconnaissance 1:20,000 Fish and Fish Habitat Inventory Protocol* (RIC 2001) and the *Reconnaissance 1:20,000 Fish and Fish Habitat Inventory: Site Card Field Guide* (RIC 1999). This protocol involved characterizing fish habitat over a 100 m-long section of stream by measuring physical attributes. Physical features identified included width, depth, availability of instream cover, canopy closure, substrate size, and gradient. Temperature, pH, and conductivity of the stream water were measured. Stream turbidity was estimated visually. Visual observations were made of the riparian vegetation, bank characteristics, stream morphology, and hillslope coupling. Stream features such as islands, bars, fish barriers, beaver dams, and debris jams were noted. The overall quality of the sites for fish spawning, rearing, overwintering, and migrating was estimated. Measurements were taken using a measuring tape, a meter stick, a rangefinder, a clinometer, and handheld water chemistry probes.

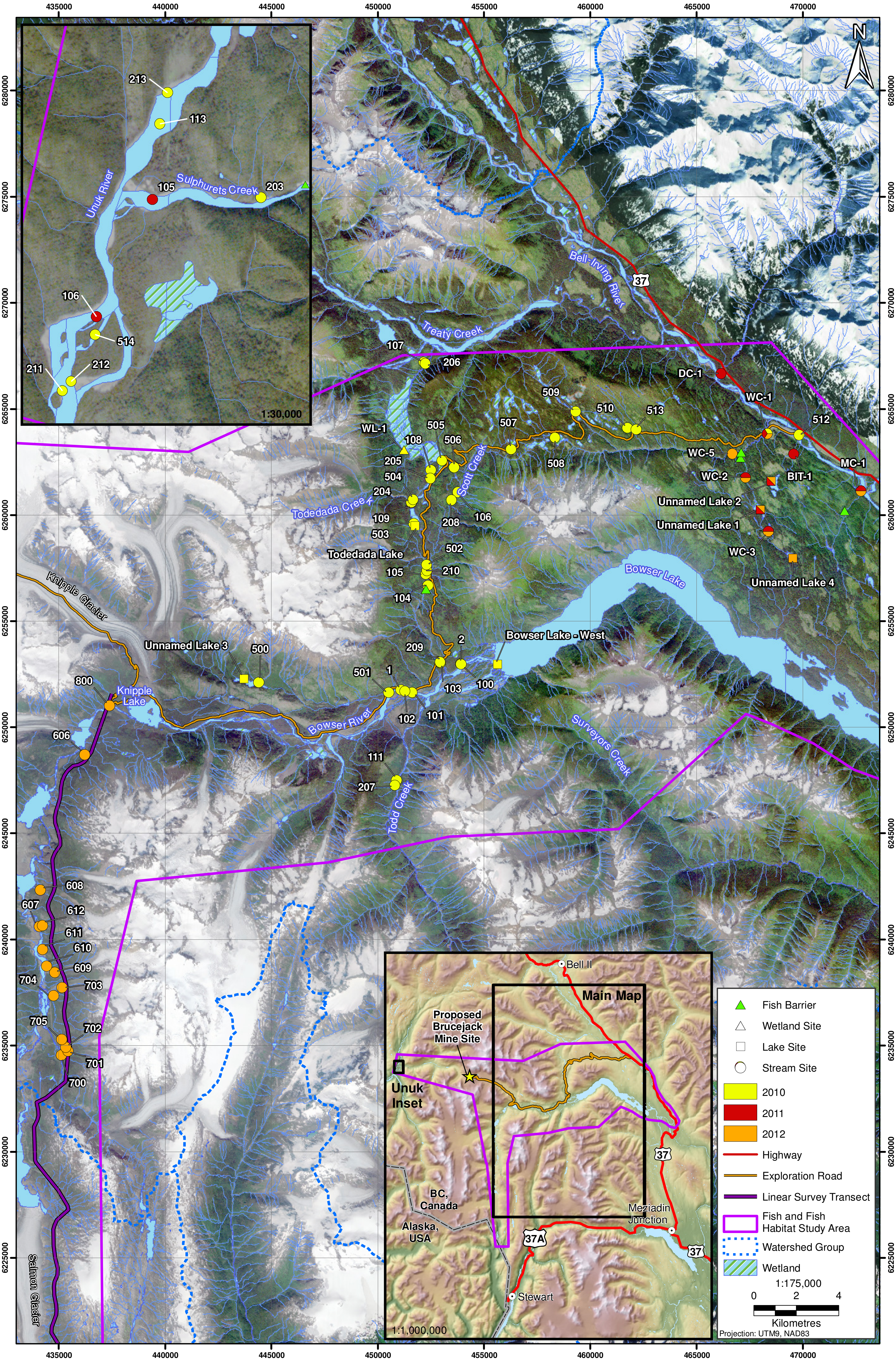

Figure 6.2-1

PRETIVM

Fish and Fish Habitat Sampling Sites

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Figure 6.2-1

Table 6.2-1. Sampling Site Rationale

Watershed	Site Name	Location		Site Description	Site Type	Receiving Environment Site Class (Near/ Mid/ Far-Field)	Rationale
		Easting	Northing				
Bell-Irving	512	469811	6263784	Bell-Irving, upstream of Wildfire Creek	Watershed Characterization	-	Major waterbody
	MC1	472737	6261147	McInnes Creek, at stream mouth	Reference Environment	-	Habitat representative of many streams in study area
	BIT1	469564	6262888	Tributary to Bell-Irving	Watershed Characterization	-	Habitat representative of many streams in the watershed
	DC1	466159	6266674	Deltaic Creek, near stream mouth	Reference Environment	-	Habitat representative of many streams in the watershed
Bowser	1	451088	6251772	Between Scott Creek and Bowser Lake	Watershed Characterization	-	Major waterbody
	2	453896	6252998	Bowser River, upstream of Scott Creek	Watershed Characterization	-	Major waterbody
	100	453917	6252990	Bowser River side channel	Watershed Characterization	-	Major waterbody
	101	451616	6251657	Bowser River, upstream of Scott Creek	Watershed Characterization	-	Major waterbody
	102	451275	6251714	Bowser River, upstream of Scott Creek	Watershed Characterization	-	Major waterbody
	500	444405	6252126	Outlet of Unnamed Lake 3	Watershed Characterization	-	Habitat representative of many streams in the watershed
	501	450512	6251650	Bowser River tributary	Watershed Characterization	-	Habitat representative of many streams in the watershed
	606	436210	6248729	Upper Bowser tributary	Linear Survey	-	Located along linear survey transect
	607	434073	6240630	Upper Bowser tributary	Linear Survey	-	Located along linear survey transect
	608	434113	6242357	Upper Bowser tributary	Linear Survey	-	Located along linear survey transect
	609	434803	6238469	Upper Bowser tributary	Linear Survey	-	Located along linear survey transect
	610	434418	6238763	Upper Bowser tributary	Linear Survey	-	Located along linear survey transect
	611	434221	6239553	Upper Bowser tributary	Linear Survey	-	Located along linear survey transect
	612	434214	6240676	Upper Bowser tributary	Linear Survey	-	Located along linear survey transect
	700	435113	6234566	Upper Bowser tributary	Linear Survey	-	Located along linear survey transect
	701	435425	6234765	Upper Bowser tributary	Linear Survey	-	Located along linear survey transect
	702	435317	6234935	Upper Bowser tributary	Linear Survey	-	Located along linear survey transect
	703	435142	6237759	Upper Bowser tributary	Linear Survey	-	Located along linear survey transect
	704	434738	6237370	Upper Bowser tributary	Linear Survey	-	Located along linear survey transect
	705	435118	6235309	Upper Bowser tributary	Linear Survey	-	Located along linear survey transect
	800	437339	6250967	Upper Bowser tributary	Linear Survey	-	Located along linear survey transect
	Unnamed Lake 3	443743	6252143	Lake in headwaters of Bowser River tributary	Watershed Characterization	-	Major waterbody
	Bowser Lake	455662	6253745	Large lake between upper and lower Bowser River	Watershed Characterization	-	Major waterbody
Scott	103	452949	6253051	Scott Creek, downstream of fish barrier	Watershed Characterization	-	Major waterbody
	104	452364	6256689	Scott Creek, upstream of fish barrier	Watershed Characterization	-	Habitat representative of many streams in the watershed
	105	452252	6257225	Scott Creek tributary	Watershed Characterization	-	Habitat representative of many streams in the watershed
	208	453468	6260718	Scott Creek tributary	Watershed Characterization	-	Major waterbody
	209	452937	6253083	Scott Creek, downstream of fish barrier	Watershed Characterization	-	Determining end of fish use
	210	452306	6257398	Scott Creek, upstream of fish barrier	Watershed Characterization	-	Habitat representative of many streams in the watershed
	502	452291	6257669	Scott Creek tributary	Watershed Characterization	-	Determining end of fish use
	507	456275	6263109	Scott Creek tributary, headwaters	Watershed Characterization	-	Major waterbody
Todd Creek	111	450882	6247507	Todd Creek mainstem	Watershed Characterization	-	Major waterbody
	207	450797	6247264	Todd Creek mainstem	Watershed Characterization	-	Habitat representative of many streams in the watershed

(continued)

Table 6.2-1. Sampling Site Rationale (completed)

Watershed	Site Name	Location		Site Description	Site Type	Receiving Environment Site Class (Near/ Mid/ Far-Field)	Rationale
		Easting	Northing				
Todedada Creek	106	453763	6261089	Todedada tributary, headwaters	Watershed Characterization	-	Major waterbody
	107	452159	6267218	Todedada mainstem in wetland area	Watershed Characterization	-	Major waterbody
	108	452498	6262132	Todedada mainstem, upstream of wetland	Watershed Characterization	-	Major waterbody
	109	451577	6260592	Todedada mainstem, headwaters	Watershed Characterization	-	Major waterbody
	204	451575	6260610	Todedada mainstem, headwaters	Watershed Characterization	-	Major waterbody
	205	452477	6261738	Todedada mainstem, headwaters	Watershed Characterization	-	Major waterbody
	206	452234	6267150	Todedada mainstem in wetland area	Watershed Characterization	-	Habitat representative of many streams in the watershed
	503	451695	6259604	Inlet to Todedada Lake	Watershed Characterization	-	Habitat representative of many streams in the watershed
	504	451657	6260735	Todeadada tributary	Watershed Characterization	-	Habitat representative of many streams in the watershed
	505	453024	6262582	Todedada wetland tributary	Watershed Characterization	-	Habitat representative of many streams in the watershed
	506	453594	6262260	Todedada wetland tributary	Watershed Characterization	-	Habitat representative of many streams in the watershed
	Todedada Lake	451734	6259451	Lake in headwaters of Todedada Creek	Watershed Characterization	-	Major waterbody
	WL-1	453594	6262260	Large wetland on Todedada Creek	Watershed Characterization	-	Major waterbody
Unuk River	112	408363	6261530	Sulphurets Creek, upstream of barrier	Receiving Environment	Far-field	Downstream of mine site and infrastructure
	113	407571	6262191	Unuk River side channel	Watershed Characterization	-	Major waterbody
	203	408387	6261597	Sulphurets Creek, downstream of barrier	Receiving Environment	Far-field	Downstream of mine site and infrastructure
	211	406786	6260036	Unuk River, downstream of Sulphurets Creek	Receiving Environment	Far-field	Downstream of mine site and infrastructure
	212	406857	6260112	Unuk River side channel	Receiving Environment	Far-field	Downstream of mine site and infrastructure
	213	407633	6262443	Unuk River, upstream of Sulphurets Creek	Watershed Characterization	-	Major waterbody
	514	407051	6260489	Unuk River, downstream of Sulphurets Creek	Receiving Environment	Far-field	Downstream of mine site and infrastructure
	UR1	407511	6261580	Unuk River side channel	Receiving Environment	Far-field	Downstream of mine site and infrastructure
	SC1	407061	6260634	Sulphurets Creek, downstream of barrier	Receiving Environment	Far-field	Downstream of mine site and infrastructure
Wildfire Creek	508	458326	6263660	Wildfire Creek tributary, upstream of fish barrier	Watershed Characterization	-	Determining end of fish use
	509	459307	6264890	Wildfire Creek tributary, upstream of fish barrier	Watershed Characterization	-	Determining end of fish use
	510	461746	6264122	Wildfire Creek tributary, upstream of fish barrier	Watershed Characterization	-	Determining end of fish use
	511	468322	6263846	Wildfire Creek mainstem, below barrier	Watershed Characterization	-	Determining end of fish use
	513	462158	6264044	Wildfire Creek tributary, upstream of fish barrier	Watershed Characterization	-	Determining end of fish use
	WC1	468336	6264206	Wildfire Creek mainstem, below barrier	Reference Environment	-	Habitat representative of many streams in the watershed
	WC2	467306	6261771	Wildfire Creek mainstem, upstream of fish barrier	Watershed Characterization	-	Determining end of fish use
	WC3	468036	6259424	Wildfire Creek mainstem, upstream of fish barrier	Watershed Characterization	-	Determining end of fish use
	WC5	466688	6262896	Wildfire Creek mainstem, upstream of fish barrier	Watershed Characterization	-	Determining end of fish use
	Unnamed Lake 1	467825	6260560	Headwaters of Wildfire Creek tributary	Watershed Characterization	-	Major habitat type
	Unnamed Lake 2	468726	6261285	Headwaters of Wildfire Creek tributary	Watershed Characterization	-	Major habitat type
	Unnamed Lake 4	469533	6257982	Headwaters of Wildfire Creek tributary	Watershed Characterization	-	Major habitat type

Dashes indicate site is not expected to be within Receiving Environment

Barriers to fish movement at or below the site were noted. Photographs, height and width measurements, and descriptions of each barrier were taken.

A subset of sites on major streams was selected for more detailed fish habitat surveys. In addition to the reconnaissance level inventory following the RIC protocols (RIC 2001), the sites were surveyed based on the methodology outlined in the *Fish Habitat Assessment Procedures* (FHAP; Johnston and Slaney 1996), a system developed for the BC Watershed Restoration Program. These sites are identified in Tables 6.2-1 and 6.2-2. The detailed habitat assessments collected additional information on flow levels, substrate composition, bank condition and habitat type. Whereas the RIC survey characterizes habitat on a reach-level basis, the FHAP survey characterizes the availability and quality of habitat in individual habitat units, which are classified by type. A single reach may contain several habitat units. The habitat types for classification were:

- **pool -** a low velocity area with low gradient (approximately 0%), a non-turbulent surface and a concave bottom;
- **glide -** a habitat with a gradient of less than 4%, a non-turbulent surface, and moderate velocity;
- **riffle -** a turbulent habitat with a gradient of less than 4% and a moderate to fast flow;
- **cascade -** a swift flowing, high gradient habitat unit; and
- **other -** comprised of all other habitat types.

Table 6.2-2. Stream Sampling Sites for the Brucejack Fish and Fish Habitat Baseline Study

Site Name	Watershed	Reach ID	Year Surveyed	Fish Habitat	Detailed Habitat	Fish Community	MMER
1	Bowser	2	2010	X	X	X	
2	Bowser	1	2010	X	X	X	
100	Bowser	NA	2010	X	X	X	
101	Bowser	2	2010	X	X	X	
102	Bowser	2	2010	X	X	X	
103	Scott	1	2010	X	X	X	
104	Scott	2	2010	X	X	X	
105	Scott	NA	2010	X	X	X	
106	Todedada	NA	2010	X	X	X	
107	Todedada	2	2010	X	X	X	
108	Todedada	3	2010	X	X	X	
109	Todedada	4	2010	X	X	X	
111	Todd	1	2010	X	X	X	
112	Unuk	1	2010	X	X	X	
113	Unuk	NA	2010	X	X	X	
203	Unuk	NA	2010	X	X		
204	Todedada	4	2010	X	X	X	
205	Todedada	4	2010	X	X	X	
206	Todedada	2	2010	X	X	X	
207	Todd	1	2010	X	X	X	
208	Scott	NA	2010	X	X	X	
209	Scott	1	2010	X	X	X	
210	Scott	2	2010	X	X	X	

(continued)

Table 6.2-2. Stream Sampling Sites for the Brucejack Fish and Fish Habitat Baseline Study (completed)

Site Name	Watershed	Reach ID	Year Surveyed	Fish Habitat	Detailed Habitat	Fish Community	MMER
211	Unuk	1	2010	X	X	X	
212	Unuk	1	2010	X	X	X	
213	Unuk	1	2010	X	X	X	
500	Bowser	NA	2010	X		X	
501	Bowser	NA	2010	X		X	
502	Scott	NA	2010	X		X	
503	Todedada	NA	2010	X		X	
504	Todedada	NA	2010	X		X	
505	Todedada	3	2010	X		X	
506	Todedada	5	2010	X		X	
507	Scott	NA	2010	X		X	
508	Wildfire	NA	2010	X		X	
509	Wildfire	NA	2010	X		X	
510	Wildfire	NA	2010	X		X	
511	Wildfire	1	2010	X		X	
512	Bell-Irving	1	2010	X		X	
513	Wildfire	NA	2010	X		X	
514	Unuk	1	2010	X	X	X	
MC1	Bell-Irving	1	2011, 2012	X	X	X	X
BIT1	Bell-Irving	NA	2011	X	X	X	
WC1	Wildfire	1	2011, 2012	X	X	X	X
WC2	Wildfire	3	2011, 2012	X	X	X	
WC3	Wildfire	4	2011, 2012	X	X	X	
DC1	Bell-Irving	NA	2011	X	X		
UR1	Unuk	1	2011	X	X	X	X
SC1	Unuk	NA	2011	X	X	X	X
WC5	Wildfire	2	2012	X	X	X	
606	Bowser	NA	2012	X			
607	Bowser	NA	2012	X			
608	Bowser	NA	2012	X			
609	Bowser	NA	2012	X			
610	Bowser	NA	2012	X			
611	Bowser	NA	2012	X			
612	Bowser	NA	2012	X			
700	Bowser	NA	2012	X			
701	Bowser	NA	2012	X			
702	Bowser	NA	2012	X			
703	Bowser	NA	2012	X			
704	Bowser	NA	2012	X			
705	Bowser	NA	2012	X			
800	Bowser	3	2012	X			

MMER (Mining Metal Effluent Regulations) = Fish tissue, diet, and effects endpoint monitoring sampling
X's indicate site was sampled
NA = site is located in a tributary or side channel off the mainstem

As with the other sites, measurements were taken using a measuring tape, a meter stick, a rangefinder, a clinometer, and handheld water chemistry probes. Qualitative characteristics such as flow and turbidity were visually assessed.

6.2.2.2 Lakes

Lake sampling was based on the *Reconnaissance (1:20,000) Fish and Fish Habitat Inventory Protocol* for lakes (RIC 2001). Information regarding the lakes' shape, size, depth, vegetation, shoreline, cover, fish access, and surrounding terrain were measured or visually estimated. Inlets and outlets were located for mapping via geographic information system (GIS) mapping. Lakes were surveyed from a small inflatable boat.

6.2.2.3 Wetlands

One wetland (site WL1) in the headwaters of Todedada Creek was included in the baseline surveys. WL1 was surveyed in June and August of 2010. The survey included transects of large wetland sections and point observations in smaller ponds. Open water width and depth were measured to gain an estimate of the amount of useable fish habitat. The dominant and subdominant substrate types were reported. Type and amount of riparian vegetation and instream cover were also estimated. Overall habitat quality for spawning, rearing, overwintering, and migration was noted.

6.2.3 Community

6.2.3.1 Streams

Each stream site where potential fish habitat was identified was evaluated for fish community composition and sampled using backpack electrofishers (i.e. Smith-Root LR-24) following the methods detailed in Johnston et al. (2007). Each site was approximately 100 m long. Single pass electrofishing with no use of stop nets was conducted to provide a relative index of abundance rather than absolute population density. Sampling was conducted by one crew leader and one dip netter. The anode ring diameter was 28 cm and the dip net was 21 cm in diameter and contained 3.2 mm mesh. A systematic sweep sampling approach was conducted at each site, in which the entire wetted width was sampled from the downstream to the upstream site boundary (Stanfield 2005). Electrofishing effort was not pre-determined due to differences in site length. Electrofisher voltage (V), duty cycle (%) and frequency (Hz) settings were varied based on site conditions in order to maximise efficiency and minimize the risk of injury to fish. The number of seconds of electrofishing effort was recorded for each site.

The assumptions of the assessment were that (Johnson et al. 2007):

- no fish movement in/out of site during the assessment;
- rate of fish catch is proportional to abundance; and
- capture efficiency is independent of field conditions within each creek.

All fish captured were placed immediately in a holding tank for recovery and biological processing. After processing (see Section 6.3.4), fish were released live back into their habitat. Lethal sampling was only undertaken in the circumstances described in Section 6.3.6.

6.2.3.2 Lakes

Lake fish communities were sampled using minnow traps in shallow littoral areas and gillnets in deeper areas of the lakes. The traps consisted of two cylinders of 6.3 mm galvanized metal mesh measuring 42 cm long and 23 cm in diameter with a 2 cm diameter opening. The cylinders were locked together using a clip attached to a rope and buoy. Minnow traps baited with commercial prawn bait were set at depths of 0.5 to 3.0 m along the shoreline and left overnight.

Gangs of sinking and floating gillnets were set at the lake surface and bottom at depths of 4 to 16 m. Each gillnet consisted of six panels of monofilament mesh tied together in the following order: Panel 1 – 25 mm; Panel 2 – 76 mm; Panel 3 – 51 mm; Panel 4 – 89 mm; Panel 5 – 38 mm; Panel 6 – 64 mm. Each panel measured 15.2 m long by 2.4 m deep for an area of 36.6 m^2. Total gillnet area was 219.6 m^2 per net.

Both types of gillnets had an upper float line with small buoys that kept the net upright in the water column. Sinking gillnets had a weighted lower lead line which forced the bottom of the net to rest along the lake bottom. Floating index gillnets did not have a weighted lead line and so their float lines rested at the lake surface.

Duration of gillnet sets ranged from 20 minutes to overnight, with shorter sets used in lakes with high fish density to reduce mortalities and overnight sets only used in lakes that had been previously sampled and were believed to be non-fish bearing.

The assumptions of the assessment were the same as previously stated for electrofishing; in addition to:

- each minnow trap/gill net is not influenced by the effort and catch of any other trap/net.

Several of the inlets and groundwater-fed channels on the delta at the western end of Bowser Lake were electrofished in a single pass with no stop nets, using the methods and assumptions described for stream sites.

Fish caught in minnow traps, gillnets, and electrofishing were processed in the same manner described for fish captured along the transmission route and were then released live.

6.2.3.3 Wetlands

The wetland was sampled following the methods used at stream sites. As there was no single defined channel, deep wetted areas throughout the wetland were sampled with the electrofisher, rather than a single continuous section.

6.2.4 Biology

Each captured fish was identified to species, counted, and measured for fork length (to the nearest 1 mm) and total weight (to the nearest 0.1 g). If external parasites were observed, then their presence was recorded. Sex and sexual maturation were not determined for most fish because doing so requires lethal sampling, but if the fish showed obvious external signs of maturation such as spawning colouration, then those signs were recorded. Incidental mortalities were dissected to determine sex and sexual maturation. Representative photographs of each species of fish were taken.

A minimum of two scales and/or pelvic fin rays were collected from a subset of fish for ageing purposes. Fin rays were used for ageing Dolly Varden and bull trout because the small scales of those species make removal and aging difficult and time consuming. Scales were used for aging all other species, with fin rays providing additional quality assurance if necessary. Scales were collected with forceps or a scalpel blade below the posterior margin of the dorsal fin on the left side of the fish. Where pelvic fin rays were used for ageing analysis, two to three rays were collected from each fish with clippers.

Aging structures from each fish were placed on wax paper and kept in a labelled envelope with the site, date, species, and unique sample and sent to North/South Consultants Inc. (Winnipeg, MB) for analysis. Age was estimated by counting the number of annuli (yearly rings) on each structure. Scales were attached to plastic fiches and annuli were counted with a microfiche reader. Fin rays were air-dried and then mounted in an epoxy medium. Microsections were cut from the fin rays using a saw and mounted on slides for inspection using a compound microscope.

6.2.5 Genetics

Genetic analysis of fish tissue samples taken during 2010 sampling was used to confirm the identification of some Dolly Varden and bull trout, which are very similar in appearance and may hybridize in the study area (Saimoto and Saimoto 1998). The adipose fin of was clipped and the tissue samples were stored in ethanol and shipped to Dr. Eric Taylor of the University of British Columbia, Zoology Department for analysis. A total of 30 samples were submitted for analysis from the Unuk River, Bowser River, Scott Creek, Todedada Creek, and Wildfire Creek watersheds. In the laboratory, DNA was extracted using standard “spin-column” protocols, and assayed at two loci that provide diagnostic differences between Dolly Varden and bull trout. Fish were classified as bull trout, Dolly Varden, or a hybrid of the two based on the alleles at those two loci.

From this point onward, char identified by genetic analysis will be referred to by their species or as “Dolly Varden-bull trout hybrids” if they showed genetic evidence of hybridization. Char for which no genetic information is available will be referred to as “Dolly Varden/bull trout” to indicate the potential uncertainty of species identification.

6.2.6 Tissue Metals

Dolly Varden/bull trout were captured in Sulphurets Creek, Unuk River, McInnes Creek, and Wildfire Creek, to allow for a more detailed examination of physiological parameters, including those recommended in the *Mining Metal Effluent Regulations* (Environment Canada 2011). Sulphurets Creek and the Unuk River are receiving environments downstream of proposed project infrastructure, and McInnes Creek and Wildfire Creek provided additional information based on its proximity to previously-proposed infrastructure. All creeks were sampled downstream of suspected fish barriers (Figure 6.2-2).

Dolly Varden/bull trout were chosen as the sentinel species due to their presence throughout the study area. Dolly Varden/bull trout are small-bodied fish that live for several years and spend their entire lives in freshwater (Environment Canada 2011). Dolly Varden/bull trout were present at all sites and were the most abundant species in the study area, allowing for site comparisons. In the study area, Dolly Varden/bull trout is only present in its resident form, which generally shows limited movement and dispersal within stream systems (Ihlenfeldt 2005; Bryant and Lukey 2004). The species possess short to medium term longevity (8 to 9 years), prefer benthic invertebrate prey, the age and length to maturation is short (3 to 5 years; 130 to 162 mm), spawning is site-specific, and their diet is primarily aquatic based (Ihlenfeldt 2005; McPhail 2007; Environment Canada 2011). In all locations, low catch-per-unit-effort (CPUE) resulted in a low number of captured fish. Only a single individual was captured in Sulphurets Creek after extensive electrofishing so the sampling effort was relocated downstream to the Unuk River mainstem.

All fish were captured by electrofishing approximately 200 m of stream length. All Dolly Varden/bull trout showing the morphology generally associated with Dolly Varden (e.g. smaller mouth, rounded profile) captured were sacrificed then measured, weighed, and dissected.

A sample of boneless, skinless tissue was removed from the left side of the fish and frozen. Frozen samples were sent to ALS Environmental in Vancouver, BC for analysis according to standardized procedures adapted from United States Environmental Protection Agency guidelines (EPA 2000). At ALS Environmental, samples were dried and moisture content was measured. Samples were then homogenized and digested in acid. Total concentrations of 25 metals in the processed samples were measured by Inductively Coupled Plasma – Mass Spectroscopy (ICP-MS). Total concentrations of mercury were measured with Cold Vapour Atomic Spectrophotometry. Metal concentrations were reported as mg/kg wet weight (wwt). Detection limits for the 30 metals are listed in Table 6.2-3.

Table 6.2-3. Whole-Body Fish Tissue Quality Variables and Detection Limits

Parameter	Abbreviation	Detection Limit (mg/kg wwt)	Parameter	Abbreviation	Detection Limit (mg/kg wwt)
Physical Tests			*Total Metals (cont'd)*		
Moisture		0.10%	Lithium	Li	0.1
Total Metals			Magnesium	Mg	1
Aluminum	Al	2	Manganese	Mn	0.01
Antimony	Sb	0.01	Mercury	Hg	0.001
Arsenic	As	0.01	Molybdenum	Mo	0.01
Barium	Ba	0.01	Nickel	Ni	0.1
Beryllium	Be	0.1	Selenium	Se	0.2
Bismuth	Bi	0.03	Silver	Ag	0.010
Cadmium	Cd	0.005	Strontium	Sr	0.01
Calcium	Ca	2	Thallium	Tl	0.01
Chromium	Cr	0.1	Tin	Sn	0.05
Cobalt	Co	0.02	Uranium	U	0.002
Copper	Cu	0.01	Vanadium	V	0.1
Lead	Pb	0.02	Zinc	Zn	0.1

6.2.7 Fecundity

Fish sacrificed for tissue metal analysis (see Section 6.2.6) were also examined for indicators of fecundity. Sex and maturity were determined by visual examination of the gonads as specified in RIC (2001). Maturity classes identified were:

- **Immature –** young individuals with underdeveloped gonads;
- **Maturing –** adult fish in which ovaries and testes have begun to increase in size, individual eggs are distinguishable;
- **Mature –** adult fish in which gonads large and developed, eggs are large and readily distinguishable, fish exhibits full or partial spawning colouration or morphology;
- **Spawning –** fish exhibits spawning colouration or morphology, eggs or milt are expelled when body cavity is pressed; and
- **Spent –** post-spawning, eggs and sperm totally or almost totally discharged.

Sexually mature gonads were removed and weighed. If captured fish were mature and female, a representative sub-sample of 20 eggs was taken and weighed, and subsequently used to estimate the total number of eggs per fish.

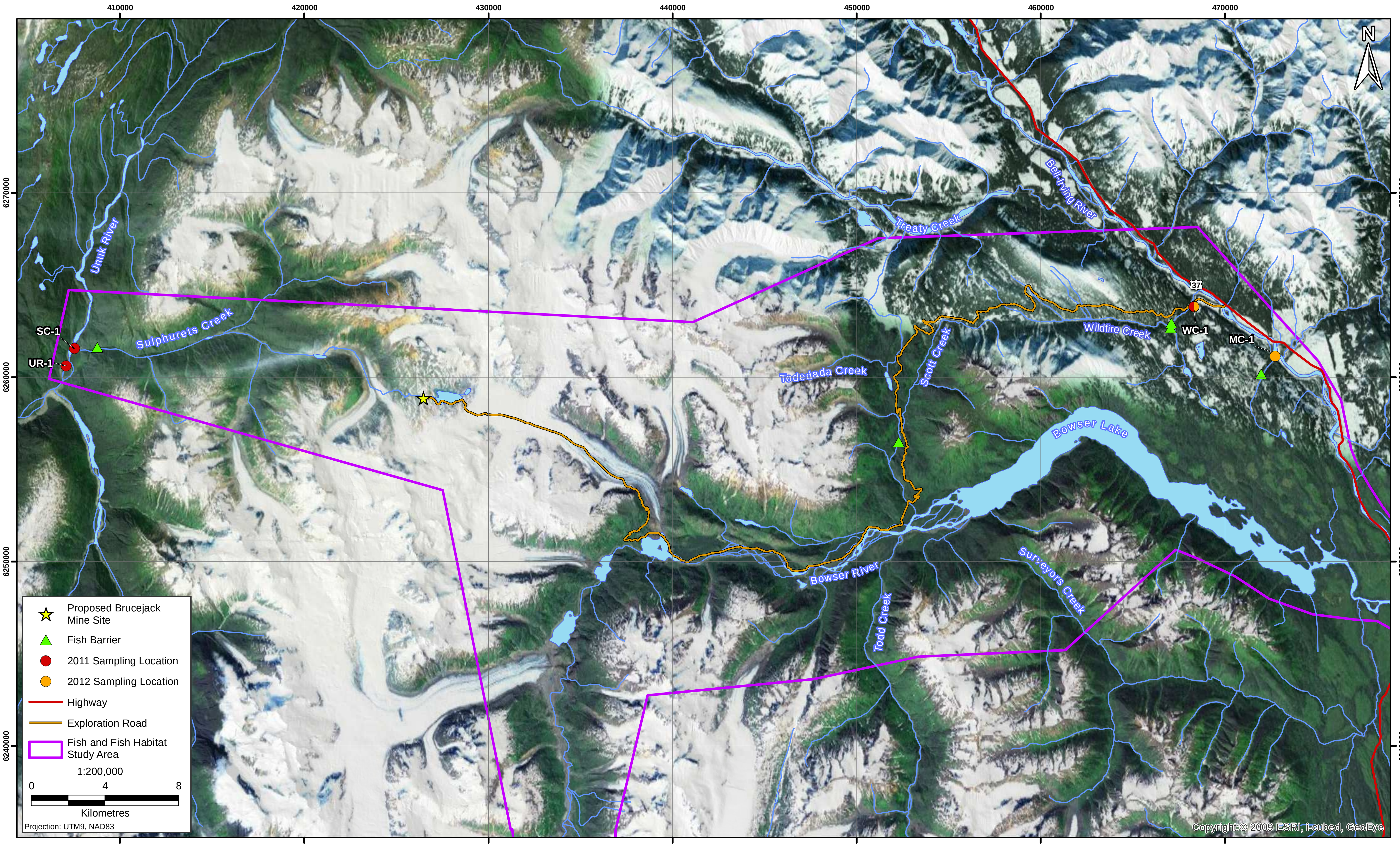

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Figure 6.2-2

Fish Tissue Metal, Diet, Fecundity, Energy Storage, Energy Use and Survival Survey Sites

6.2.8 Diet

An analysis of diet composition was also completed on fish sacrificed for tissue metal and fecundity analyses (Sections 6.2.6 and 6.2-7). Stomachs were removed from dissected fish, weighed, and then preserved in a 10% formalin solution.

The stomach samples were sent to Applied Technical Services of Victoria, BC, for enumeration and identification. Each stomach was rinsed with water to remove the preservative. The stomach was carefully slit open and the contents were removed and blotted on filter paper to remove excess moisture. They were then weighed to the nearest milligram on a Denver TL-603D electronic balance. Prey items were identified to the lowest possible taxonomic level and weighed. Where there were large numbers, a known number of each species was weighed; and the total number and weights were then extrapolated from those weights.

Stomach contents were grouped by order and major life-history group. This method was used because many taxonomic groups had so few representatives in the diet that obtaining the weight of the group was not possible. Therefore, stomach contents were organized by large taxonomic groups, (e.g., Diptera (minus Chironomidae), Chironomidae, Arachnida, and Oligochaeta). Data were presented by proportional weight of each taxonomic group and by number of individual organisms (where enumeration was possible).

6.2.9 Spawning Surveys

Salmon spawning habitat was surveyed to confirm sites previously identified, through historical data and summer field assessments, to support salmon spawning. The objective of the surveys was to determine habitat use and spawner presence and to identify areas with a relatively high abundance of spawners that may indicate critical spawning habitat. Spawning habitat was surveyed in late summer and fall 2010 for sockeye salmon and coho salmon. Both species had been previously reported to be present in the Bowser, Scott and Todedada watersheds, and juvenile sockeye and coho salmon were found during fish community sampling in 2010. The sockeye salmon spawning survey took place from September 22 to 24 in the Bowser River between Knipple Lake and Bowser Lake, the first reach of Scott Creek, and the first three reaches of Todedada Creek. Adjacent tributaries and side channels were also surveyed. The same streams were surveyed from October 19 to October 22 for coho salmon. During the spawning surveys, the mainstem and tributaries of each area were surveyed first by helicopter and then areas that had appropriate channel characteristics and substrate composition to provide good spawning habitat were further assessed on foot.

Redds or areas in which spawners were observed were identified and georeferenced. The number of redds and the number and species of adult salmon was recorded. Information regarding the condition of the spawners (e.g. fresh, showing damage from redd construction, dead) and their behaviour (e.g. lone, paired, holding on a red) was recorded. The sex of the spawners was noted when it could be identified. Notes were taken on the surrounding habitat, including substrate type, habitat unit type, and the presence and type of cover or nearby tributaries. The number, locations, condition, behaviour, and surrounding habitat of each redd or adult salmon was recorded.

6.2.10 Stream Classification

A defensible, systematic approach was adopted to classify the fish bearing status of stream crossings sampled during the linear survey. Streams were classified according to the *Forest Practices Code of British Columbia Fish-Stream Identification Guidebook* (MOF 1998). Under this procedure, streams were classified based on mean channel width (m) and fish bearing status. A summary of stream classes are presented in Table 6.2-4. The guidebook provides criteria for classifying streams as either fish-bearing (i.e., Classes S1, S2, S3, and S4) or non-fish bearing (i.e., S5 and S6). The guidebook classifies streams as non-fish bearing if the average gradient is greater than 20%. However, it is recognized that Dolly Varden and bull trout have the ability to move upstream in channels gradients up to 30% if adequate step pools are present (MOF 1998; McPhail 2007). Therefore, stream reaches were “confirmed” as non-fish bearing using gradient criteria alone if the average channel gradient was greater than 20%, channels were not defined, step-pool morphology is absent, pools are shallow and void of alluvial deposits (i.e., over-wintering habitat is absent), habitat was very marginal and no lakes were present.

Table 6.2-4. Forest Practices Code Stream Classification Width Criteria

Stream Classification	Mean Channel Width (m)	Fish Present?
S1	> 20.0	Yes
S2	5.0 to 20.0	Yes
S3	1.5 to 5.0	Yes
S4	< 1.5	Yes
S5	> 3.0	No
S6	≤ 3.0	No

Barrier searches and assessments were conducted on streams downstream of the proposed transmission line crossings. The presence of falls greater than 2 m high and steep cascades can restrict fish dispersal upstream and may “confirm” non-fish bearing status to the upstream reaches if falls are permanent and adequate sampling effort is conducted. Adequate sampling effort (based upon habitat features), in connection with habitat assessments, was conducted to confirm streams as non-fish bearing. The rationale for changing stream classifications from “default” fish-bearing to “confirmed” fish-bearing included the following criteria:

- previous records showed fish present at crossing;
- fish were observed or sampled at or upstream of the crossing;
- fish were observed or sampled downstream of the crossing;
  - TRIM map gradients demonstrated that no part of the drainage downstream of the crossing flowed through gradients greater than 20% and lack of habitat limitations discussed above; and
- fish were present downstream of a man-made obstruction (e.g., hanging culvert) and there was an absence of natural barriers upstream of the obstruction.

6.3 DATA ANALYSIS

6.3.1 Habitat

6.3.1.1 Watershed Characterization

Sites were separated into groups based on drainage systems and reaches of large streams. Site groupings are shown in Table 6.2-1. Where multiple sites were sampled in the same reach of the same stream, the reach was described by calculating the minimum, maximum, mean and standard error (SE) of each habitat variable, creating an overall description of the fish habitat within the reach.

6.3.1.2 Linear Survey

Sites were grouped into fish-bearing and non-fish bearing crossings. The habitat characteristics of both groups were summarized through calculating the mean and standard error of numerical variables. Categorical variables were summarized by calculating the proportion of sites belonging to a particular category.

As the objectives of the survey was to quantify and qualify fish habitat along the transect, statistical analyses were used as descriptive tools to describe general habitat quality.

6.3.2 Community

Fish communities were characterized using species presence and catch-per-unit-effort (CPUE) equations (Table 6.3-1). CPUE provides information on the relative abundance of fish species within the site by standardizing the catch rate to the amount of effort expended.

Table 6.3-1. Catch Per Unit Effort Calculations Used in Community Summaries

Sampling Gear	CPUE Calculation
Electrofisher	*CPUE = number of fish caught * [100/(electrofishing effort, s)]*
Minnow trap	*CPUE = number of fish caught per trap *[(24 h / (set time, h)]*
Gillnet	*CPUE = number of fish caught per net x [100 m^2/(total net area, m^2)] x [1 h/(set time, h)]*

CPUE = Catch-per-unit-effort

As with the habitat variables, CPUE was averaged among all sites in a watershed, with mean and standard error used to describe each. To avoid a non-normal distribution as a result of zero-catch sites, only sites in confirmed fish-bearing areas were used to calculate electrofishing CPUE.

As CPUE is highly dependent on sampling gear type, the CPUE for each gear type was summarized separately. CPUE was also summarized by species.

6.3.3 Biology

Biological data was analyzed for outliers using studentized residuals. As a measure of variance, studentized residuals identify the distance between individual measurements and the expected mean. For the purposes of this baseline study, a conservative approach was taken and only measurements with a score of four or greater were removed from analysis. In a normally distributed population, 99.9% of measurements should fall within this cut-off (Quinn and Keough 2003), so measurements outside of this range were likely incorrectly measured or recorded.

In most cases, the number of fish captured was insufficient to allow for reach separation when characterizing aspects of fish physiology and health. Instead, all reaches within a watershed were combined to provide an overall descriptor for the watershed. In some cases, too few fish of a particular species were captured within the entire watershed, and no analyses were undertaken. For regression analyses and frequency distributions, a sample size of 25 was considered the minimum required to ensure accurate statistical results.

Length- and age-frequency distributions provided information on the population structure of fish in the study area. Individual fish health was examined by comparing fish lengths and weights and by calculating fish condition (K). Fish condition related fish fork length and body weight and is calculated as:

$$K = (weight,\ g) \times 10^5 /\ (length,\ mm)^3$$

Fish growth was analyzed through growth models. Fish growth patterns can be summarized through several types of models. For the purposes of this study, von Bertalanffy growth models (Ricker 1975) and linear growth models were used to relate fish length and age.

The equation for the von Bertalanffy model is:

$$l_t = L_\infty(1 - exp^{-K(t - t0)})$$

where l_t is the length (mm) at age t (years), L_∞ is the length (mm) that the fish would attain if it were allowed to grow for an infinitely long time, K is a growth coefficient (year -1), and t_0 is the age (years) at zero length.

Prior to analysis, length and weight data was transformed using a natural log transformation (ln) to achieve the normal distribution required by the models. A linear model (GLM), a three-parameter von Bertalanffy model, and a two parameter von Bertalanffy model with t_0 held at 0 were run for each species, and the models compared using Akaike Information Criteria weights (AIC_w) to determine the most parsimonious model.

The weight of fish livers and gonads relative to body weight provided information regarding fish health and energy allocation. The hepatosomatic index (HSI) compares liver size to body weight, as increased liver size is related to available energy reserves and to other health effects such as exposure to toxic substances (Environment Canada 2012). The HSI is calculated as:

*HSI = (liver weight, g)/(body weight, g) * 100*

The gonadosomatic index (GSI) similarly compares gonad size to body weight as a measure of reproductive investment. The GSI is calculated as:

*GSI = (gonad weight, g)/(body weight, g) * 100*

Stomach weight relative to body weight provides information regarding food acquisition. All three indicators were first examined through the use of linear regression comparing the weight of the body part to the overall body weight, with natural log transformations to create a normal distribution necessary for regression. The mean, minimum, maximum, standard deviation, and standard error of the HSI and GSI were calculated for each site and year. Comparisons between years and sites were completed through use of analyses of variance (ANOVA) and/or t-tests as appropriate.

Tissue metal concentrations were of concern as an influence on human, fish, and ecosystem health. The concentration was described by the mean, minimum, maximum, and standard error of observed concentrations separated by year and site. In circumstances where metal concentrations did not exceed the minimum detectable limit, a value of half the minimum detectable limit was substituted for statistical purposes. If more than 90% of samples did not contain detectable concentrations of a particular metal, the metal was not included in statistical analysis.

Mercury is identified in the MMER as a metal of particular concern in fish tissue in receiving environments (MMER, SOR/2002-222). Mercury is a toxic metal with no known biological function (Eisler 1987). The Health Canada guideline for maximum allowable concentration of total mercury in fish muscle tissue is 0.5 mg/kg WW (CCME 1999; Health Canada 2001). Mercury was compared to body size through linear regression. For sites and years in which tissue mercury concentration was related to size, mercury concentrations were best described by the regression. For sites in which no significant relationship was found, mean, minimum, maximum, and standard error were used to describe mercury concentrations.

All statistical analyses were performed using SYSTAT 11 (SYSTAT 2004) or R 2.13.2 (R Development Core Team 2011). The significance level (α) = 0.05 for all statistical tests.

6.3.4 Quality Assurance/Quality Control

All data was examined in the field to ensure completeness and accuracy. Field balances were calibrated at the beginning of the field season and were kept free of excess water and sediment and regularly tared to maintain accuracy while in use. Conductivity and pH meters were calibrated prior to the start of and at least once during each sampling trip.

Sample vials and envelopes were labelled by site, sample number, and specimen identification and inventoried on a collection card. The information on the sample labels was checked against the collection cards prior to shipping and analysis as a measure of quality assurance.

After data had been transcribed to electronic formats, a subset of the data was checked against hard copies to check accuracy.

Replicates, reference material tests, and laboratory blanks were used by ALS Laboratories for quality assurance and quality control purposes (Table 6.3-2). Quality assurance was provided for aging data by analyzing multiple structures from some individual fish and comparing the age estimates derived from those structures. Additional quality assurance for fish ageing was provided by North/South Consultants by re-analyzing structures with a different analyst to test the precision of the estimates.

Table 6.3-2. Tests of Variability of Fish Tissue Metal Concentrations

Qualifier	Number of Potential RPD	Percent
RPD-NA	25	47
RPD	27	51
DUP-H	1	2
Total	53	100

RPD = Relative Percent Difference.
RPD-NA = RPD Not Available because one or both values were at or below the MDL.
DUP-H = Duplicate results outside of ALS data quality objectives due to sample heterogeneity.

7. Results

7. Results

7.1 BARRIERS

7.1.1 McInnes Creek

A barrier to fish migration is located in McInnes Creek, a small tributary that runs east into the Bell-Irving River near Wildfire Creek (Figure 7.1-1). While several small waterfalls and cascades were observed farther downstream, an approximately 2 m high waterfall 1 km from the creek mouth was determined to be the barrier nearest to the creek mouth that could be definitively labelled an impassable obstruction to fish passage (Plate 7.1-1). No fish sampling has been undertaken above the barrier, so the fish-bearing status of the upstream reaches of McInnes Creek is not known.

Plate 7.1-1. Fish migration barrier on McInnes Creek.

7.1.2 Scott Creek

Approximately 5 km upstream of its confluence with the Bowser River, Scott Creek passes through an entrenched area that is inaccessible by helicopter or on foot. While no single feature observed in Scott Creek was sufficient to prevent fish passage, this reach is comprised of a series of small cascades that coupled with the observed high gradient and high water velocity may prevent fish movement above the entrenchment (Plate 7.1-2). A total of 2,326 seconds of electrofishing effort were expended sampling the mainstem and tributaries upstream of the barrier over two seasons, during which no fish were captured. As a result, the upstream reaches of Scott Creek have been determined to be non-fish bearing.

7.1.3 Sulphurets Creek

Sulphurets Creek, a major tributary to the Unuk River, has been sampled extensively during the completion of this baseline and historically. Fish have never been captured above the 200 m cascade located approximately 300 m upstream of the Unuk River confluence (Plate 7.1-3), despite over

3,000 EF seconds of sampling, as well as 913 hours of minnow trapping effort (Rescan 2010; Rescan 2012). Sampling has been conducted immediately upstream of the barrier, in several large tributaries of Sulphurets Creek, and in Brucejack Lake. This section of Sulphurets Creek, including Brucejack Creek and Brucejack Lake, has been determined to be non-fish bearing.

Plate 7.1-2. One of several cascades in the entrenched section of Scott Creek.

Plate 7.1-3. Sulphurets Creek cascades.

PROJECT # 0194150-0009 GIS # BJP-06-019 May 15, 2013

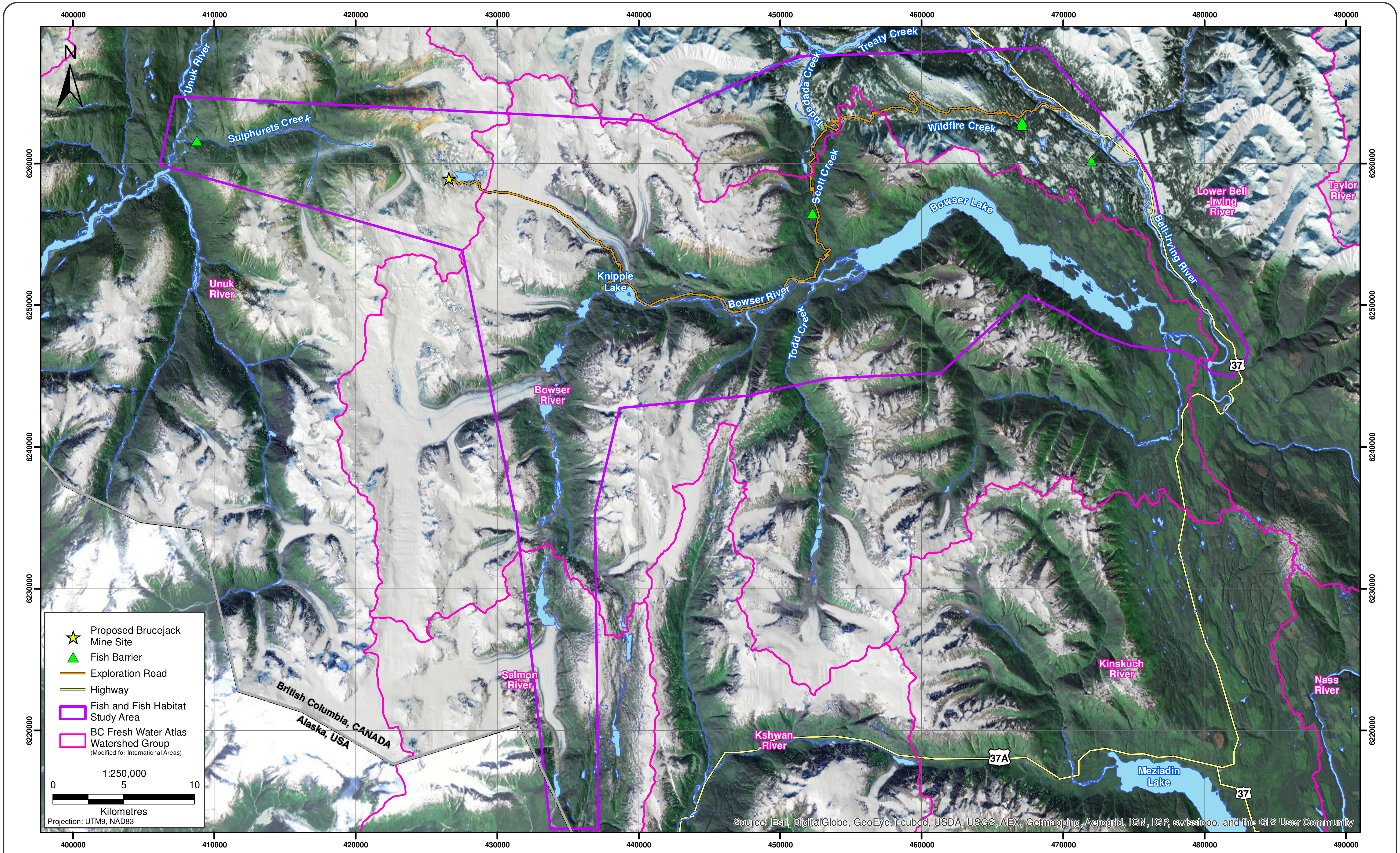

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Figure 7.1-1

Barriers to Fish Migration

7.1.4 Wildfire Creek

Approximately 1.5 km upstream of the mouth of Wildfire Creek, a series of waterfalls, steps, and cascades was observed below the confluence of the two branches of Wildfire Creek (Plates 7.1-4 and 7.1-5). While none of the features are sufficient to stop fish passage, no fish have been captured above this stretch, despite 3,707 electrofishing seconds and 1,154 hours of minnow trapping effort and 123 hours of gillnetting effort over the course of three years from 2010 to 2012 (see Section 7.4.2). In light of the lack of fish capture despite substantial effort, the sections of Wildfire Creek and the large tributary above this barrier are considered non-fish bearing.

Plate 7.1-4. Cascades and small waterfalls on Wildfire Creek approximately 2 km upstream of the confluence with the Bell-Irving River.

Plate 7.1-5. Waterfall on Reach 2 of Wildfire Creek, approximately 2 km upstream of the confluence with the Bell-Irving River.

7.2 HABITAT

7.2.1 General

The fish and fish habitat study area contains a variety of habitat types, ranging from small, high gradient, high elevation streams to large rivers including the Unuk River and Bell-Irving River. Surveyed watersheds are located in the Unuk River, Bell-Irving River, and Salmon River watersheds. Sub-watersheds of these larger watersheds include: Bowser River, Scott Creek, Sulphurets Creek, Todd Creek, Todedada Creek, and Wildfire Creek.

Fifty-five stream sites were surveyed for fish habitat from 2010 to 2012, representing mainstem, tributary and side channel habitat in seven watersheds within the study area. Appendix 7.2-1 shows the fish habitat data, and upstream and downstream photographs for each site. Appendix 7.2-2 shows the detailed habitat data collected from a subset of sites.

7.2.2 Streams

7.2.2.1 Bell-Irving Watershed Grouping

Within the study area, the Bell-Irving River is large and highly active, with regularly shifting sandbars and water clarity ranging from lightly turbid to highly turbid (Plate 7.2-1). Numerous tributaries discharge into the Bell-Irving River. Tributaries entering from the east are relatively low gradient and support fish populations. Tributaries entering the Bell-Irving River from the west are higher gradient and may contain barriers preventing fish migration past the tributary mouths. Tributaries assessed as part of the Brucejack baseline program include the Bowser River, McInnes Creek, and Wildfire Creek. The Bowser River and Wildfire Creek are further described in Sections 7.2.2.2 and 7.2.2.7.

Plate 7.2-1. Side channel of the Bell-Irving River after a flood event.

The five stream sites surveyed in the Bell-Irving watershed grouping represent four waterbodies: the Bell-Irving River, Deltaic Creek, McInnes Creek, and an unnamed creek (BIT). The Wildfire Creek watershed, Bowser River, Scott Creek and Todd Creek are also waterbodies in the Bell-Irving watershed, and are described separately below (Figure 7.2-1).

Within the study area, the Bell-Irving River is moderate in size and braided, exhibiting large-channel morphology (Table 7.2-1, Table 7.2-2). There are trace amounts of cover present, with the majority provided by the boulder-dominated substrate (Table 7.2-3). The Bell-Irving River was the only reach surveyed in the study area where bedrock was a dominant or subdominant substrate type. The deep channel has the potential to provide overwintering, rearing, and spawning habitat, while low velocity water at the edges of the channel supports rearing juvenile fish.

Deltaic Creek is comprised of braided channels showing evidence of substantial channel movement. As a result, the channel width is comparable to the Bell-Irving River, despite the narrow wetted width. All habitat units are riffle type habitat, and overwintering habitat is poor due to lack of deep pools, but there are areas of low velocity water for salmonid rearing habitat and pockets of gravel substrate appropriate for salmonid spawning habitat.

McInnes Creek is small and of higher gradient than other streams in the watershed, but numerous small and medium sized pools throughout the stream present good rearing and overwintering habitat for salmonids, and gravel-dominated glides provide good spawning habitat. A large beaver pond adjacent to the stream may provide additional habitat. Unlike many streams in the study area, the water in McInnes Creek is clear, which is beneficial for fish species that locate prey visually. A waterfall approximately 1 km upstream from the stream mouth prevents fish passage to the headwaters of the stream.

BIT is the smallest stream that was surveyed in the Bell-Irving watershed. It runs west to east, discharging into the Bell-Irving River downstream of McInnes Creek. The stream is steep and entrenched throughout the reach, and is comprised primarily of glide habitat. The surrounding coniferous forest has been affected by logging, and woody debris area dominant source of cover in the stream. Due to the high gradient, fish habitat in the stream is marginal.

7.2.2.2 Bowser River Watershed Grouping

The Bowser River Watershed Grouping contains sites assessed for watershed characterization and sites located along the Linear Survey.

Within the study area, the Bowser River and its tributaries are wide and low gradient. Side channel and off-channel habitat is common in the lower Bowser River due to the lack of confinement in the area and the erosion potential of the banks (Plate 7.2-2). Scott Creek and Todd Creek discharge into the Bowser River immediately upstream of Bowser Lake, in a highly braided reach of the Bowser River.

Knipple Lake is located at the base of the Knipple Glacier and separates the Reach 2 and Reach 3 of the Bowser River. While Reach 1 and Reach 2 of the Bowser River are braided with many side channels and tributaries providing good fish habitat, the headwater reaches of the Bowser River are more confined, follow a single channel, and have generally low fish habitat value. Most streams in the Bowser River watershed are of glacial origin, resulting in turbid water in tributaries and the mainstem.

A linear survey was conducted along a section of the upper Bowser River to examine the fish habitat potential of upper Bowser River tributaries that may be crossed by potential Project infrastructure. The results are presented below.

PROJECT #0194151-0010 GIS # BJP-06-020a May 10 2013

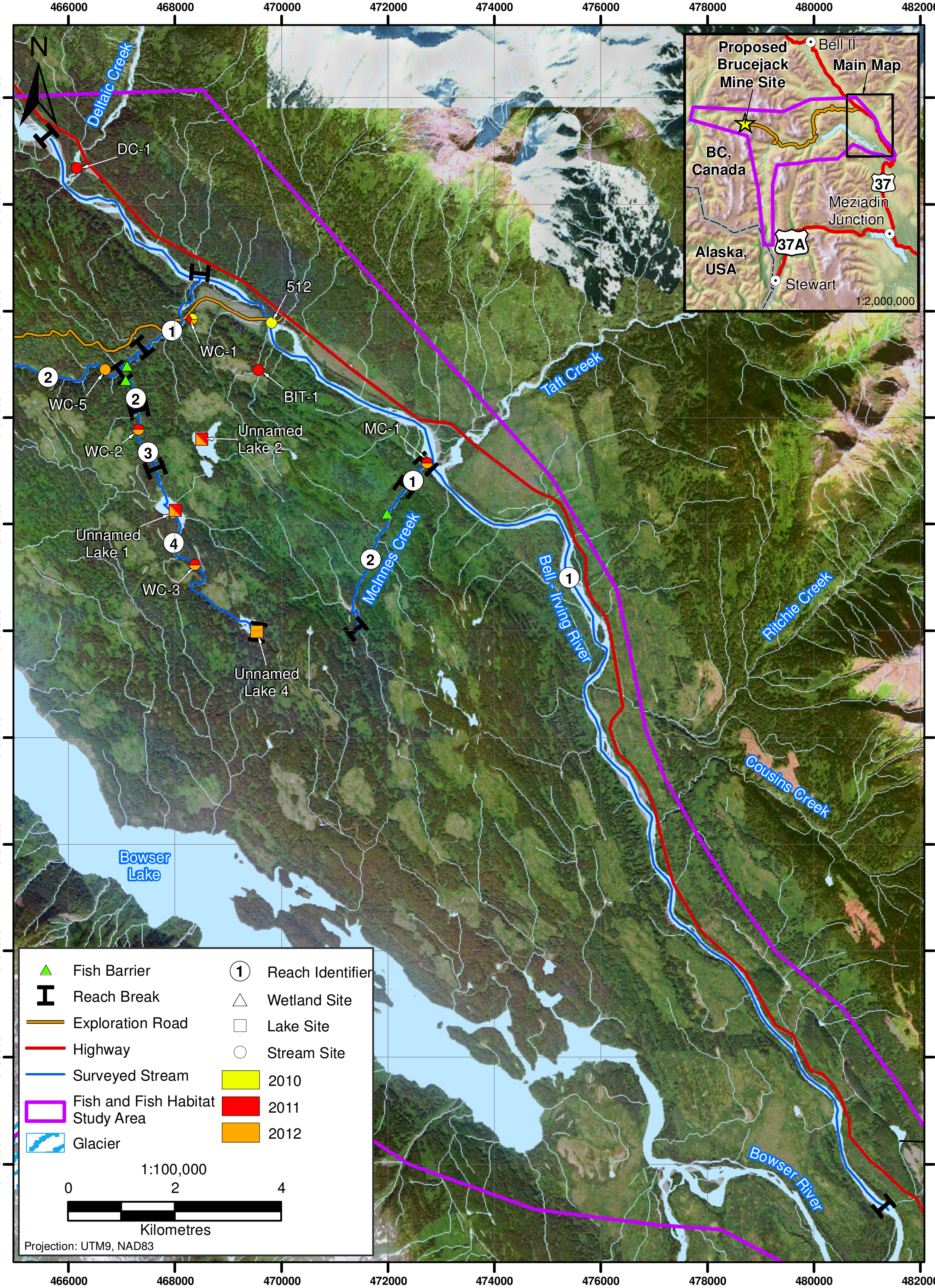

Figure 7.2-1

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Reaches Surveyed in the Bell Irving River Watershed Grouping

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Table 7.2-1. Habitat Characteristics of Stream Sites in the Bell-Irving Watershed, 2010 to 2012

		Bell-Irving River (*n* = 1)				BIT (*n* = 1)				Deltaic Creek (*n* = 1)				McInnes Creek (*n* = 2)			
Variable	Units	N	Min	Mean (±*SE*)	Max	N	Min	Mean (±*SE*)	Max	N	Min	Mean (±*SE*)	Max	N	Min	Mean (±*SE*)	Max
Channel Width	m	3	18.0	22.7 (*6.5*)	30.0	5	2.6	3.5 (*1.2*)	4.8	3	30.0	40 (*5.7*)	55.0	6	4.8	6.7 (*1.5*)	16.0
Wetted Width	m	3	17.0	16.9 (2.9)	29.0	5	2.6	3.4 (*1.1*)	5.0	3	14.0	14.7 (*0.7*)	15.0	6	3.5	7.8 (*1.3*)	16.0
Bankfull Depth	m	1	1.3	1.3	1.3	3	0.1	0.25 (*0.1*)	0.3	0	-	-	-	5	0.2	0.4 (*0.1*)	0.6
Pool Depth	m	0	-	-	-	4	0.5	0.6 (*0.1*)	0.7	0	-	-	-	2	0.5	0.8 (*0.5*)	1.0
Gradient	%	1	1.0	1.0	1.0	3	2.0	2.5 (*0.6*)	4.0	2	1.0	1 (*0.0*)	1.0	3	1.0	5 (*5*)	10.0
Temperature	°C	1	6	6	6	1	9	9	9	1	5	5	5	2	6	8 (*1*)	9
Water pH		1	7.3	7.3	7.3	1	6.6	6.6	6.6	1	8.6	8.6	8.6	1	7.7	7.7	7.7
Conductivity	μS/cm	-	-	-	-	1	20	20	20	1	120	120	120	1	30	30	30
D_{95}[1]	cm	1	40.0	40.0	40.0	1	60.0	60.0	60.0	1	55.0	55.0	55.0	2	45.0	82 (*40.4*)	120.0
D[2]	cm	1	25.0	25.0	25.0	1	8.0	8.0	8.0	1	55.0	55.0	55.0	2	40.0	30 (*12.6*)	50.0

Min = minumum value

Max = maximum value

SE = standard error of the mean

N = number of observations

- = not available

veg. = vegetation

[1] *= diameter of particle larger than 95% of observed substrate*

[2] *= diameter of largest particle showing evidence of bed load movement*

Table 7.2-2. Categorical Habitat Characteristics of Stream Sites in the Bell-Irving Watershed, 2010 to 2012

Variable	Percent of Sites Bell-Irving River (n = 1)	BIT (n = 1)	Deltaic Creek (n = 1)	McInnes Creek (n = 2)
Total Cover				
Abundant	0	0	0	50
Moderate	0	100	0	50
Trace	100	0	100	0
Canopy Cover				
0%	100	0	100	0
1-20%	0	0	0	50
21-40%	0	100	0	50
40-70%	0	0	0	0
>90%	0	0	0	0
Instream Cover Sources				
Small Woody Debris				
Dominant	0	0	0	0
Subdominant	0	100	0	100
Trace	0	0	100	0
None	100	0	0	0
Large Woody Debris				
Dominant	0	100	0	0
Subdominant	0	0	0	0
Trace	0	0	100	0
None	100	0	0	100
Boulders				
Dominant	100	0	100	50
Subdominant	0	0	0	0
Trace	0	0	0	0
None	0	100	0	50
Undercut Banks				
Dominant	0	0	0	0
Subdominant	0	0	0	0
Trace	0	0	0	50
None	100	100	100	50
Deep Pools				
Dominant	0	0	0	0
Subdominant	0	0	0	0
Trace	100	100	0	100
None	0	0	100	0
Overhanging Vegetation				
Dominant	0	0	0	50
Subdominant	0	100	100	50
Trace	100	0	0	0
None	0	0	0	0
Instream Vegetation				
Dominant	0	0	0	0
Subdominant	0	0	0	0
Trace	0	100	0	0
None	100	0	100	100
Large Woody Debris				
Abundance				
Abundant	0	100	0	0
Few	0	0	0	100
None	100	0	100	0
Distribution				
Clumped	0	0	0	100
Evenly Distributed	0	100	0	0
None	100	0	100	0
Substrate				
Dominant				
Boulder	100	0	0	50
Cobble	0	100	0	50
Fines	0	0	100	0
Gravel	0	0	0	0
Bedrock	0	0	0	0
Subdominant				
Boulder	0	0	0	50
Cobble	0	0	0	0
Fines	0	0	0	50
Gravel	0	100	100	0
Bedrock	100	0	0	0
Morphology				
Class				
Cascade-Pool	0	0	0	0
Large Channel	100	0	0	0
Riffle-Pool	0	0	100	100
Step-Pool	0	100	0	0
Pattern				
Irregular Meandering	0	0	0	0
Irregular	0	100	100	50
Meandering	0	0	0	0
Sinuous	100	0	0	50
Straight	0	0	0	0
Tortuous Meandering	0	0	0	0
Coupling				
Coupled	0	0	0	100
Decoupled	100	100	100	0
Partially Coupled	0	0	0	0
Confinement				
Confined	100	100	0	0
Entrenched	0	0	0	0
Frequently Confined	0	0	0	100
Occasionally Confined	0	0	0	0
Unconfined	0	0	100	0

n = number of sites

Table 7.2-3. Habitat Characteristics of Streams Sites from Detailed Habitat Surveys in the Bell-Irving River Watersheds

		BIT					Deltaic Creek					McInnes Creek				
Characteristic	**Units**	**N**	**Min**	**Mean**	**SE**	**Max**	**N**	**Min**	**Mean**	**SE**	**Max**	**N**	**Min**	**Mean**	**SE**	**Max**
Length surveyed	m			104					250					645		
Wetted area surveyed	m^2			304					2400					3305		
Habitat units	#			3					2					8		
Bankfull width	m	3	3.4	4.1	0.4	4.8	2.0	2.0	21.0	19.0	40.0	8.0	4.8	8.4	1.9	21.0
Bankfull depth	m	3	0.2	0.5	0.2	0.9	2.0	0.5	1.0	0.5	1.5	8.0	0.4	1.0	0.2	2.1
Wetted width	m	3	2.6	3.8	0.7	5.0	2.0	1.5	8.3	6.8	15.0	8.0	4.0	7.5	1.9	20.0
Wetted depth	m	3	0.2	0.4	0.2	0.9	2.0	0.2	0.6	0.4	1.0	8.0	0.2	0.5	0.1	1.2
Bank height	m	3	0.0	0.0	0.0	0.0	2.0	0.2	0.6	0.4	1.0	8.0	0.0	0.6	0.2	1.5
Substrate																
Sand	%	3	5	32	16	60	2	30	40	10	50	8	0	49	14	100
Gravel	%	3	30	33	3	40	2	20	35	15	50	8	0	19	8	70
Cobble	%	3	10	17	3	20	2	15	18	3	20	8	0	13	4	30
Boulder	%	3	0	10	6	20	2	5	8	3	10	8	0	19	10	70
Rock	%	3	0	8	8	25	2	0	0	0	0	8	0	1	1	10
Cover																
Pool	%	3	80	90	8	100	2	0	0	0	0	8	0	47	12	100
Boulder	%	3	0	0	0	0	2	40	50	10	60	8	0	6	3	25
Small woody debris	%	3	0	0	0	0	2	0	0	0	0	8	0	0	0	0
Large woody debris	%	3	0	35	29	70	2	30	35	5	40	8	0	32	10	80
Instream veg.	%	3	0	0	0	0	2	0	0	0	0	8	0	0	0	0
Overhead veg.	%	3	0	17	9	30	2	5	8	3	10	8	0	9	5	40
Undercut banks	%	3	0	0	-	0	2	5	8	3	10	8	0	7	3	15
Habitat type																
Glide	%	3		66			2		0			8		13		
Other	%	3		0			2		0			8		13		
Pool	%	3		0			2		0			8		25		
Riffle	%	3		33			2		100			8		38		

Min = minumum value

Max = maximum value

SE = standard error of the mean

N = number of observations

- = not available

veg. = vegetation

Plate 7.2-2. A view of the Bowser River at Site 1 with little cover and eroding banks.

Watershed Characterization

Four waterbodies in the Bowser River watershed were included in the stream habitat surveys (Figures 7.2-2a and b). Four sites in the Bowser River mainstem were located in two separate reaches, and three tributaries were surveyed as well (Side channel 100, Stream 500, and Stream 501).

Reach 1 of the Bowser River mainstem is directly upstream of Bowser Lake. In this reach, the river is low gradient and located in a flat valley bottom with a large associated flood plain (Tables 7.2-4 and 7.2-5). The substrate is primarily composed of fines and gravels, and shows evidence of high bed load movement (Table 7.2-6). The river itself is very turbid, but groundwater-fed channels in the area contain clear water.

Reach 2 of the Bowser River is also low gradient and is located in a flood plain, but unlike Reach 1, the channel in Reach 2 is not braided and there are few groundwater-fed channels entering the river.

Side channel 100 is a large side channel to Reach 1 of the Bowser River. It provides higher quality rearing and spawning habitat for salmonids than the mainstem due to lower velocity water flow, more instream cover, and a greater proportion of gravel substrate. As non-mainstem pool habitat, it may provide important shelter for fish during flood events.

Stream 500 is a steep, shallow inlet to Unnamed Lake 3. Most of the stream was classified as poor fish habitat due to the 13% gradient and shallow depth, although Dolly Varden/bull trout adults and juveniles were observed in the lower 10 m of the stream.

Stream 501 is a tributary to Reach 2 of the Bowser River, and may run through an old channel created by the Bowser River. While the stream is relatively small, the large bed material suggests previous strong flows through the channel, either as a result of large flood events or of the previous action of the Bowser River in the channel. Stream 501 has few pools for overwintering fish, but is suitable for rearing and spawning salmonids.

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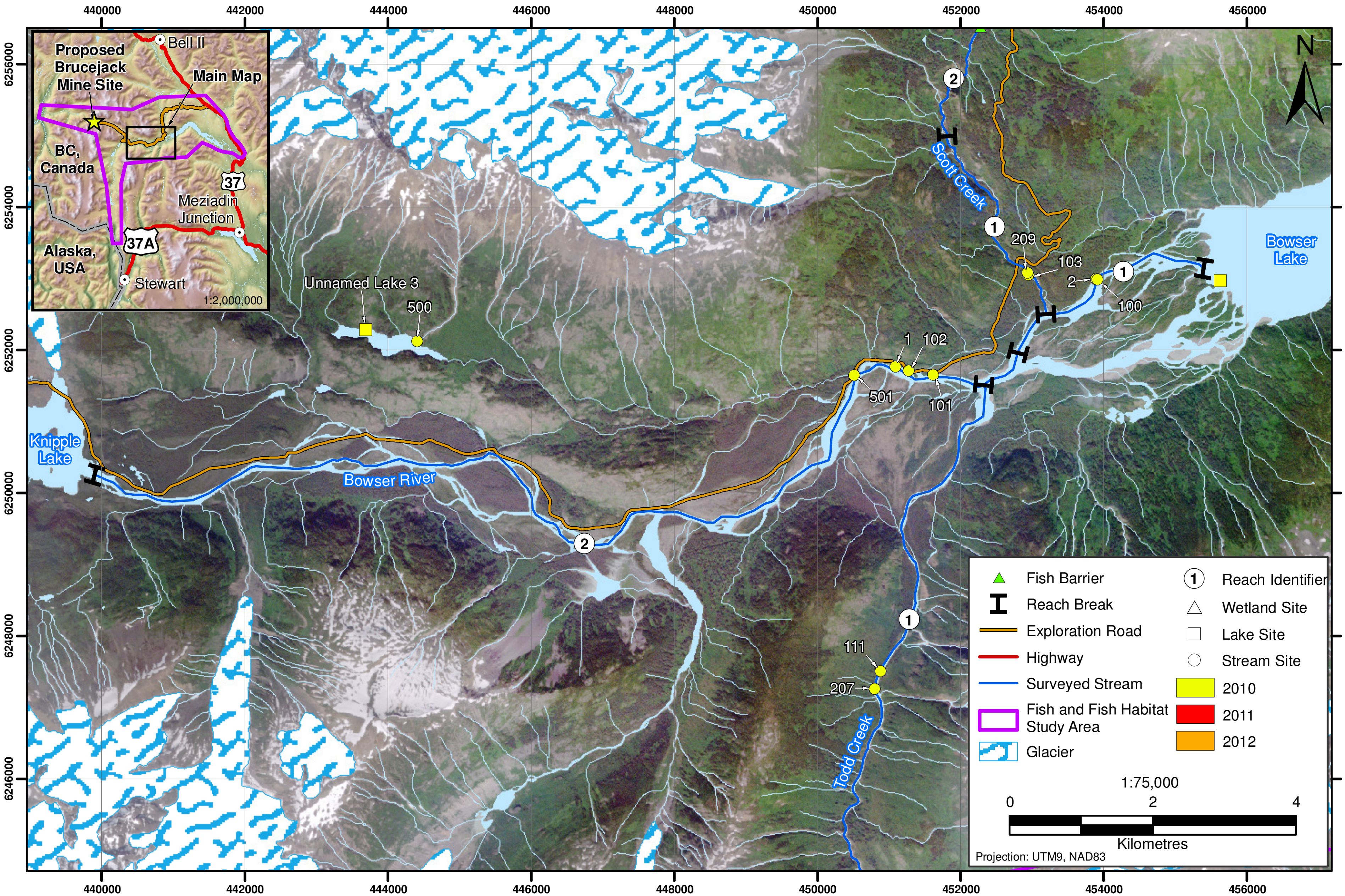

Figure 7.2-2a

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Reaches Surveyed in the Bowser River Watershed Grouping

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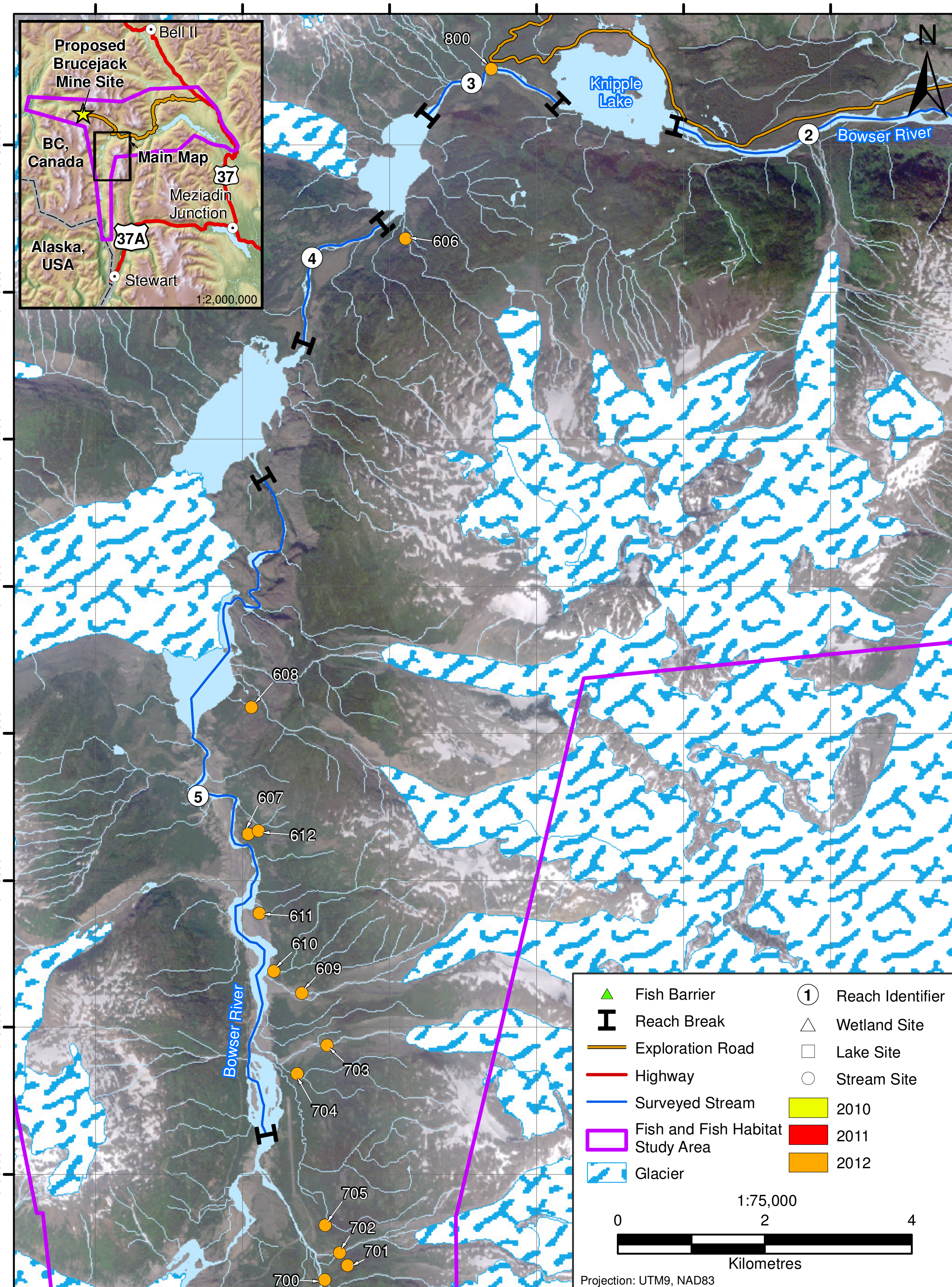

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Reaches Surveyed in the Bowser River Watershed Grouping, Headwater Reaches

Figure 7.2-2b

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Table 7.2-4. Habitat Characteristics of Stream Sites in the Bowser River Watershed Grouping

Variable	Units	Bowser River Reach 1 (*n* = 1)				Bowser River Reach 2 (*n* = 3)				Side Channel 100 (*n* = 1)			
		N	Min	Mean (±*SE*)	Max	N	Min	Mean (±*SE*)	Max	N	Min	Mean (±*SE*)	Max
Channel Width	m	6	19.2	27 (*6.5*)	32.2	12	15.8	73 (*50.6*)	111.0	3	30.0	40 (*5.7*)	55.0
Wetted Width	m	6	19.0	16.9 (*2.9*)	32.0	12	13.0	58.1 (*38.7*)	84.4	3	14.0	14.7 (*0.7*)	15.0
Bankfull Depth	m	1	0.3	0.3	0.3	4	0.4	1.4 (*1.0*)	2.4	0	-	-	-
Pool Depth	m	1	0.3	0.3	0.3	1	0.6	0.6	0.6	0	-	-	-
Gradient	%	2	1.5	1.7 (*0.1*)	1.8	3	0.5	1.1 (*0.6*)	1.7	2	1.0	1 (*0.0*)	1.0
Temperature	°C	1	6	6	6	3	5	5.6 (*0.2*)	6	1	5	5	5
Water pH		1	8.6	8.6	8.6	3	6.6	6.6	6.6	1	8.6	8.6	8.6
Conductivity	µS/cm	1	100	100	100	3	60	87 (*23*)	100	1	120	120	120
D_{95}[1]	cm	1	9.9	9.9	9.9	3	0.2	13.7 (*5.8*)	27.0	1	55.0	55.0	55.0
D[2]	cm	1	9.9	9.9	9.9	3	0.2	10.7 (*5.4*)	20.0	1	55.0	55.0	55.0

Variable	Units	Stream 500 (*n* = 1)				Stream 501 (*n* = 1)			
		N	Min	Mean (±*SE*)	Max	N	Min	Mean (±*SE*)	Max
Channel Width	m	6	4.8	6.7 (*1.5*)	16.0	6	4.8	6.7 (*1.5*)	16.0
Wetted Width	m	6	3.5	7.8 (*1.3*)	16.0	6	3.5	7.8 (*1.3*)	16.0
Bankfull Depth	m	5	0.2	0.4 (*0.1*)	0.6	5	0.2	0.4 (*0.1*)	0.6
Pool Depth	m	2	0.5	0.8 (*0.5*)	1.0	2	0.5	0.8 (*0.5*)	1.0
Gradient	%	3	1.0	5 (*5*)	10.0	3	1.0	5 (*5*)	10.0
Temperature	°C	2	6	8 (*1*)	9	2	6	8 (*1*)	9
Water pH		1	7.7	7.7	7.7	1	7.7	7.7	7.7
Conductivity	µS/cm	1	30	30	30	1	30	30	30
D_{95}[1]	cm	2	45.0	82 (*40.4*)	120.0	2	45.0	82 (*40.4*)	120.0
D[2]	cm	2	40.0	30 (*12.6*)	50.0	2	40.0	30 (*12.6*)	50.0

Min = minumum value

Max = maximum value

SE = standard error of the mean

N = number of observations

- = not available

veg. = vegetation

[1] *= diameter of particle larger than 95% of observed substrate*

[2] *= diameter of largest particle showing evidence of bed load movement*

Table 7.2-5. Categorical Habitat Characteristics of Stream Sites in the Bowser River Watershed Grouping

Variable	Percent of Sites				
	Bowser River Reach 1 (*n* = 1)	Bowser River Reach 2 (*n* = 3)	Side channel 100 (*n* = 1)	Stream 500 (*n* = 1)	Stream 501 (*n* = 1)
Total Cover					
Abundant	0	0	0	50	50
Moderate	0	50	0	50	50
Trace	100	50	100	0	0
Canopy Cover					
0%	0	0	100	0	0
1-20%	100	100	0	50	50
21-40%	0	0	0	50	50
40-70%	0	0	0	0	0
>90%	0	0	0	0	0
Instream Cover Sources					
Small Woody Debris					
Dominant	0	0	0	0	0
Subdominant	0	66	0	100	100
Trace	100	0	100	0	0
None	0	33	0	0	0
Large Woody Debris					
Dominant	100	0	0	0	0
Subdominant	0	0	0	0	0
Trace	0	33	100	0	0
None	0	66	0	100	100
Boulders					
Dominant	0	0	100	50	50
Subdominant	0	0	0	0	0
Trace	0	0	0	0	0
None	100	100	0	50	50
Undercut Banks					
Dominant	0	0	0	0	0
Subdominant	0	0	0	0	0
Trace	100	33	0	50	50
None	0	66	100	50	50
Deep Pools					
Dominant	0	0	0	0	0
Subdominant	0	0	0	0	0
Trace	100	33	0	100	100
None	0	66	100	0	0
Overhanging Vegetation					
Dominant	0	0	0	50	50
Subdominant	100	100	100	50	50
Trace	0	0	0	0	0
None	0	0	0	0	0
Instream Vegetation					
Dominant	0	0	0	0	0
Subdominant	0	0	0	0	0
Trace	100	33	0	0	0
None	0	66	100	100	100

(continued)

Table 7.2-5. Categorical Habitat Characteristics of Stream Sites in the Bowser River Watershed Grouping (completed)

Variable	Percent of Sites				
	Bowser River Reach 1 (*n* = 1)	Bowser River Reach 2 (*n* = 3)	Sidechannel 100 (*n* = 1)	Stream 500 (*n* = 1)	Stream 501 (*n* = 1)
Large Woody Debris					
Abundance					
Abundant	0	0	0	0	0
Few	100	33	100	100	100
None	0	66	0	0	0
Distribution					
Clumped	0	0	0	0	0
Evenly Distributed	100	33	100	100	100
None	0	66	0	0	0
Substrate					
Dominant					
Boulder	0	0	0	0	0
Cobble	0	66	0	0	100
Fines	0	33	100	0	0
Gravel	100	0	0	100	0
Bedrock	0	0	0	0	0
Subdominant					
Boulder	0	0	0	0	0
Cobble	100	33	0	100	0
Fines	0	0	0	0	0
Gravel	0	66	100	0	100
Bedrock	0	0	0	0	0
Morphology					
Class					
Cascade-Pool	0	0	100	0	0
Large Channel	0	0	0	0	0
Riffle-Pool	100	100	0	100	100
Step-Pool	0	0	0	0	0
Pattern					
Irregular Meandering	0	0	0	0	0
Irregular	0	0	0	0	0
Meandering	0	33	0	0	0
Sinuous	100	66	100	0	0
Straight	0	0	0	100	100
Tortuous Meandering	0	0	0	0	0
Coupling					
Coupled	0	0	0	100	0
Decoupled	100	66	100	0	100
Partially Coupled	0	33	0	0	0
Confinement					
Confined	0	0	0	0	0
Entrenched	0	0	0	0	0
Frequently Confined	100	33	0	0	0
Occasionally Confined	0	66	100	100	0
Unconfined	0	0	0	0	100

n = number of sites

Table 7.2-6. Habitat Characteristics of Streams Sites from Detailed Habitat Surveys in the Bowser River Watershed

		Bowser River Reach 1					Bowser River Reach 2					Stream 100				
Characteristic	**Units**	**N**	**Min**	**Mean**	**SE**	**Max**	**N**	**Min**	**Mean**	**SE**	**Max**	**N**	**Min**	**Mean**	**SE**	**Max**
Length surveyed	m			255					487					200		
Wetted area surveyed	m^2			5680					23603.6					5440		
Habitat units	#			3					6					1		
Bankfull width	m	3.0	17.0	27.3	33.0	12.0	6.0	5.3	43.0	5.2	111.0	1.0	25.1	25.1	-	25.1
Bankfull depth	m	3.0	0.2	0.5	0.2	0.2	6.0	0.1	0.6	0.4	2.3	1.0	0.3	0.3	-	0.3
Wetted width	m	3.0	16.0	21.3	2.9	26.0	6.0	4.9	34.9	15.7	92.0	1.0	27.2	27.2	-	27.2
Wetted depth	m	3.0	0.2	0.3	0.1	0.4	6.0	0.1	0.3	0.1	0.8	1.0	0.2	0.2	-	0.2
Bank height	m	3.0	0.1	0.3	0.2	0.7	6.0	0.2	0.5	0.1	0.8	1.0	0.4	0.4	-	0.4
Substrate																
Sand	%	3	8	39	30	100	6	10	23	8	60	1	70	70	-	70
Gravel	%	3	0	27	15	50	6	30	43	5	60	1	30	30	-	30
Cobble	%	3	0	27	13	40	6	10	28	5	40	1	0	0	-	0
Boulder	%	3	0	7	6	20	6	0	8	4	20	1	0	0	-	0
Rock	%	3	0	0	0	0	6	0	0	0	0	1	0	0	-	0
Cover																
Pool	%	3	45	65	18	100	6	0	33	13	85	1	80	80	-	80
Boulder	%	3	0	28	14	45	6	0	40	10	75	1	0	0	-	0
Small woody debris	%	3	0	0	0	0	6	0	0	0	0	1	20	20	-	20
Large woody debris	%	3	0	7	3	10	6	0	20	6	45	1	0	0	-	0
Instream veg.	%	3	0	0	0	0	6	0	2	2	10	1	0	0	-	0
Overhead veg.	%	3	0	0	0	0	6	0	3	2	10	1	0	0	-	0
Undercut banks	%	3	0	0	0	0	6	0	2	1	5	1	0	0	-	0
Habitat type																
Glide	%	3		0			6		17			1		0		
Other	%	3		33			6		0			1		0		
Pool	%	3		0			6		33			1		100		
Riffle	%	3		66			6		50			1		0		

Min = minumum value

Max = maximum value

SE = standard error of the mean

N = number of observations

- = not available

veg. = vegetation

Upper Bowser Linear Survey

The linear survey transect was completed from the proposed mine site at Brucejack Lake to the Long Lake Hydro Project Transmission Line in the Salmon River watershed (a development under construction unrelated to the Brucejack Gold Mine Project). Sections of the route on the Knipple and Salmon glaciers or with slopes greater than 50% gradient were determined to be non-fish bearing based upon a desktop exercise and confirmed by ground truthing. Streams which discharge directly into or under Knipple Glacier or Salmon Glacier were also determined to be non-fish bearing based on obstruction by the glaciers and an aerial survey that found no evidence of fish habitat above the glaciers.

Sections of the route in which stream gradients were less than 50% were surveyed. Fourteen streams were identified and assessed for fish habitat and community potential along the survey transect (Appendix 7.2-3). All stream crossings with the potential to contain fish habitat were assessed (Figure 7.2-3).

One of the fourteen assessed crossings was determined to be fish-bearing. The fish-bearing crossing is located where the survey transect crossed the Bowser River. At the crossing, the river is wide, cold, and turbid from glacial run-off. The river reach has large substrates and trace cover and is poor spawning, rearing, and overwintering habitat. Dolly Varden are the only species confirmed to occur in this reach of the river. Habitat information for this crossing is presented in Table 7.2-7.

Table 7.2-7. Fish Habitat Description of Fish-Bearing Crossing along the Upper Bowser Linear Survey

Site	**800**
Classification	S1
Date	31/Aug/12
UTM (Zone 9)	
Easting	437339
Northing	6250967
Width (m)	
Channel	65
Wetted	60
Gradient (%)	1
Turbidity	Turbid
Bed Material	
Dominant	Boulder
Sub-Dominant	Cobble
Channel Shape	
Morphology	Large channel
Channel Pattern	Irregular
Coupling	Coupled
Confinement	Occasionally confined
Cover Type	
Small woody debris	none
Large woody debris	T
Boulders	D

(continued)

Table 7.2-7. Fish Habitat Description of Fish-Bearing Crossing along the Upper Bowser Linear Survey (completed)

Site	800
Classification	S1
Date	31/Aug/12
Cover Type (cont'd)	
Undercut banks	none
Deep pools	none
Overhanging vegetation	T
Instream vegetation	none
Crown closure	0
Instream vegetation	algae
Bank	
Shape	sloping
Dominant substrate	fines
Sub-dominant substrate	boulder
Vegetation	none
Vegetation stage	none
Features	none
Notes	Mainstem of Bowser River. Very large, previously sampled and confirmed fish-bearing

All other assessed crossings are high gradient streams with measured gradients in excess of 20%. None of the sites with gradients in the 20% to 30% range exhibit a channel morphology suitable for Dolly Varden or other fish. Steep gradients, waterfalls, or cascades near the mouth of many streams prevent fish access to any upstream reaches. Most streams contain little cover and are cold and turbid due to their glacial origins. Bedrock substrate is common along the transect, and where gravel or cobble substrates were observed, the stream channel had carved away substrate creating deep banks. A summary of the stream classification for the non-fish bearing crossings is presented in Table 7.2-8.

Table 7.2-8. Stream Classification of Non-Fish Bearing Crossings

Classification	Number of Crossings	Percent of Total Sites Assessed
S5	6	54%
S6	5	46%

7.2.2.3 Scott Creek Watershed Grouping

The headwaters of Scott Creek drain water from the mountains east and west of the main valley (Figure 7.2-4). Two main tributaries converge to flow south towards Bowser River. After the confluence of these branches, Scott Creek passes through an entrenched area that is inaccessible by helicopter or on foot. Stream gradient in this reach is high and numerous small cascades may prevent fish movement above the entrenchment. Below this point, Scott Creek becomes less confined and of lower gradient.

Assessed areas in the Scott Creek watershed include three reaches of Scott Creek (Reach 1, Reach 2, and Reach 3) and three tributary streams (Streams 208, 502, and 507).

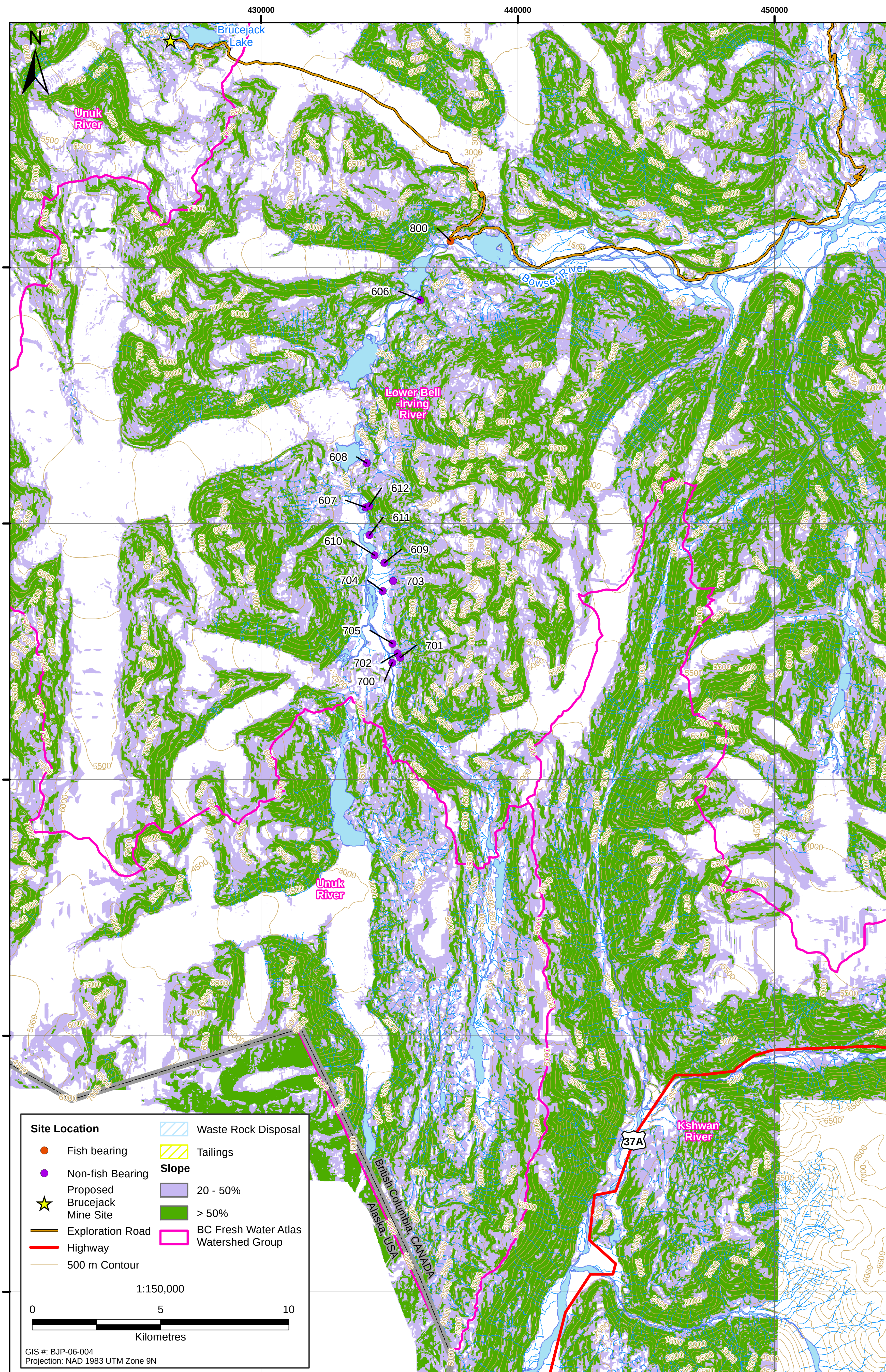

Figure 7.2-3

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Sites On Upper Bowser River Survey Transect

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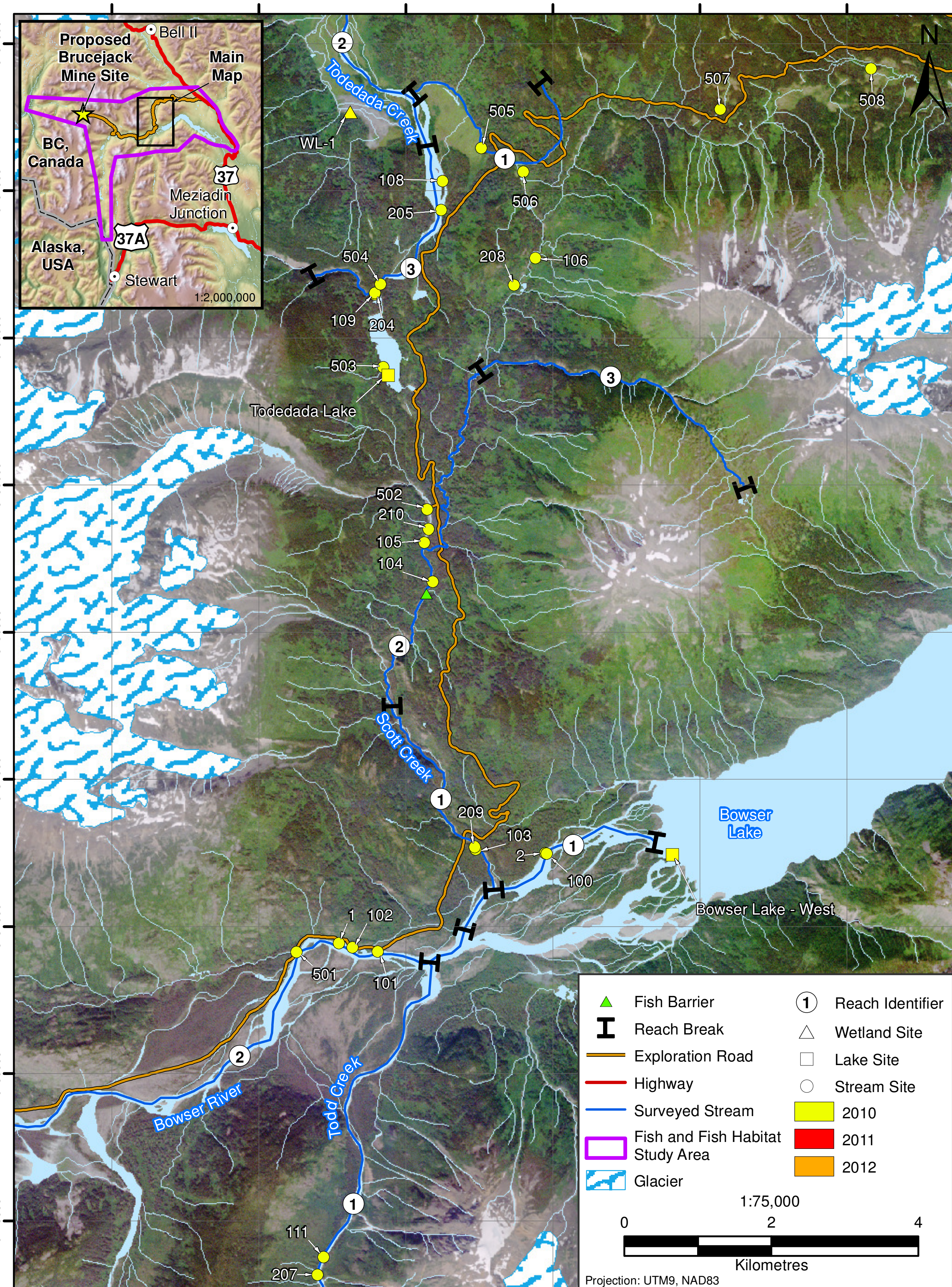

Figure 7.2-4

Reaches Surveyed in the Scott Creek Watershed Grouping

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Reach 1 of Scott Creek is moderate in gradient (1.6%) with few pools (Table 7.2-9). Fish habitat in the mainstem is of fair to poor quality due to high water velocity, but secondary channels and side channels provide pool and glide habitat with lower water velocity and abundant fish cover (Table 7.2-10). Woody debris, undercut banks, and overhanging vegetation are the dominant cover types (Table 7.2-11).

Reach 2 of the Scott Creek mainstem is higher gradient than Reach 1 and contains less instream cover and more riffle habitat (Plate 7.2-3). Substrate in Reach 2 is larger, and more cover is provided by boulders. Rearing habitat in Reach 2 is limited to small areas where boulders or large woody debris blocked water flow and created pools. The upstream end of the reach is marked by a section where the creek is confined in a narrow channel, creating a series of cascades interspersed with microhabitats of fast flowing water. Although there is no distinct barrier to fish passage such as a waterfall, this constriction likely provides an obstacle to upstream migration and may mark the end of fish use in the watershed. No fish have been captured upstream of this point during these baseline studies or in historical studies (Rescan 2010).

Plate 7.2-3. High water velocity habitat in Reach 2 of Scott Creek.

Reach 3 of the Scott Creek mainstem is located upstream of a large tributary, and the channel is smaller than the downstream reaches. Reach 3 is also high gradient (5.5%), with high velocity water and trace amounts of instream and canopy cover.

Stream 208 is a small tributary to Reach 3 of the Scott Creek mainstem, discharging into the mainstem upstream of the barrier to fish passage in Reach 2. Although it was assessed as good spawning, rearing and overwintering habitat due to the abundance of pools, gravel substrates, and instream cover, it is located in a potential non-fish bearing section of stream and is not used by fish.

Stream 502 is a tributary to Reach 2 of the Scott Creek mainstem, below the Reach 2 fish barrier. It is steep (up to 10% gradient within the assessed site and increasing in gradient upstream), turbid, and cold. There is little instream cover, no gravel substrate, and marginal fish habitat.

Table 7.2-9. Habitat Characteristics of Stream Sites in the Scott Creek Watershed, 2010 to 2012

		Scott Creek Reach 1 (n = 2)				Scott Creek Reach 2 (n = 2)				Scott Creek Reach 3 (n = 1)			
Variable	Units	N	Min	Mean (±*SE*)	Max	N	Min	Mean (±*SE*)	Max	N	Min	Mean (±*SE*)	Max
Channel Width	m	10	16.5	25.7 (*4.6*)	31.6	6	14.3	23.7 (*50.6*)	22.8	4	20.0	25.7 (*5.7*)	37.7
Wetted Width	m	10	6.0	16.9 (*0.7*)	18.4	6	11.3	58.1 (*38.7*)	15.9	4	15.4	14.7 (*0.7*)	17.3
Bankfull Depth	m	4	0.7	0.3	1.3	2	0.7	1.4 (*0.9*)	2.0	1	1.1	1.1	1.1
Pool Depth	m	2	0.1	0.1	0.2	2	0.2	.2 (*0.1*)	0.2	1	1.0	1.0	1.0
Gradient	%	3	0.5	1.6 (*0.1*)	2.5	2	4.0	5 (*0.5*)	6.0	1	5.5	5.5	5.5
Temperature	°C	2	5	5 (*0*)	5	2	6	6 (*0.0*)	6	1	5	5	5
Water pH		2	7.4	7.8 (*0.4*)	8.1	2	7.3	7.6 (*0.1*)	8.0	1	8.1	8.1	8.1
Conductivity	μS/cm	2	100	105 (*0.5*)	110	2	90	90 (*0*)	90	1	120	120	120
D_{95}[1]	cm	2	28.0	32.5 (*7.6*)	37.0	2	0.3	36.1 (*18.2*)	72.0	0	-	-	-
D[2]	cm	2	26.0	31.1 (*7.2*)	37.0	2	0.3	28.1 (*12.3*)	56.0	1	0.2	0.2	0.2

		Stream 208 (n = 1)				Stream 502 (n = 1)				Stream 507 (n = 1)			
Variable	Units	N	Min	Mean (±*SE*)	Max	N	Min	Mean (±*SE*)	Max	N	Min	Mean (±*SE*)	Max
Channel Width	m	6	3.2	4.6 (*1.5*)	32.0	6	13.0	4.6 (*1.5*)	32.0	6	1.1	1.5 (*1.5*)	2.5
Wetted Width	m	6	9.0	7.8 (*1.3*)	29.0	6	9.0	7.8 (*1.3*)	29.0	6	1.0	7.8 (*1.3*)	2.0
Bankfull Depth	m	5	0.1	0.9 (*0.1*)	0.3	2	0.8	0.9 (*0.1*)	1.0	3	0.1	1.5 (*0.2*)	0.2
Pool Depth	m	3	0.2	-	0.3	0	-	-	-	6	0.2	0.8 (*0.5*)	0.4
Gradient	%	1	2.0	2.0	2.0	2	5.0	8 (*3*)	10.0	2	8.0	9 (*.5*)	10.0
Temperature	°C	1	9	9	9	1	5	5	5	1	15	15	15
Water pH		1	8.1	8.1	8.1	1	8.2	8.2	8.2	1	8.3	8.3	8.3
Conductivity	μS/cm	1	130	130	130	1	130	130	130	0	-	-	-
D_{95}[1]	cm	1	35.0	35.0	35.0	1	75.0	75.0	75.0	1	19.0	19.0	19.0
D[2]	cm	1	10.0	10.0	10.0	1	35.0	35.0	35.0	1	6.0	6.0	6.0

Min = minumum value

Max = maximum value

SE = standard error of the mean

N = number of observations

- = not available

veg. = vegetation

[1] = diameter of particle larger than 95% of observed substrate

[2] = diameter of largest particle showing evidence of bed load movement

Table 7.2-10. Categorical Habitat Characteristics of Stream Sites in the Scott Creek Watershed

Variable	Percent of Sites					
	Scott Creek Reach 1 (*n* = 2)	Scott Creek Reach 2 (*n* = 2)	Scott Creek Reach 3 (*n* = 1)	Stream 208 (*n* = 1)	Stream 502 (*n* = 1)	Stream 507 (*n* = 1)
Total Cover						
Abundant	50	0	0	100	0	0
Moderate	50	50	0	0	0	100
Trace	0	50	100	0	100	0
Canopy Cover						
0%	0	50	100	0	100	0
1-20%	100	50	0	0	0	100
21-40%	0	0	0	0	0	0
40-70%	0	0	0	0	0	0
>90%	0	0	0	100	0	0
Instream Cover Sources						
Small Woody Debris						
Dominant	0	0	0	0	0	0
Subdominant	100	50	100	100	0	100
Trace	0	0	0	0	0	0
None	0	50	0	0	100	0
Large Woody Debris						
Dominant	50	50	0	0	0	0
Subdominant	0	50	100	100	0	0
Trace	0	0	0	0	100	100
None	50	0	0	0	0	0
Boulders						
Dominant	0	50	100	0	100	0
Subdominant	0	50	0	0	0	0
Trace	100	0	0	100	0	0
None	0	0	0	0	0	100
Undercut Banks						
Dominant	0	0	0	0	0	0
Subdominant	50	0	0	0	0	0
Trace	50	0	0	100	0	0
None	0	100	100	0	100	100
Deep Pools						
Dominant	0	0	0	0	0	0
Subdominant	50	0	0	100	0	0
Trace	50	100	0	0	0	0
None	0	0	100	0	100	100
Overhanging Vegetation						
Dominant	50	0	0	100	0	100
Subdominant	50	0	0	0	0	0
Trace	0	100	100	0	100	0
None	0	0	0	0	0	0
Instream Vegetation						
Dominant	0	0	0	0	0	0
Subdominant	0	0	0	0	0	0
Trace	50	0	0	100	0	100
None	50	100	100	0	100	0

(continued)

Table 7.2-10. Categorical Habitat Characteristics of Stream Sites in the Scott Creek Watershed (completed)

Variable	Percent of Sites					
	Scott Creek Reach 1 (*n* = 2)	Scott Creek Reach 2 (*n* = 2)	Scott Creek Reach 3 (*n* = 1)	Stream 208 (*n* = 1)	Stream 502 (*n* = 1)	Stream 507 (*n* = 1)
Large Woody Debris						
Abundance						
Abundant	100	50	0	100	0	0
Few	0	50	100	0	0	0
None	0	0	0	0	100	100
Distribution						
Clumped	50	0	0	0	0	0
Evenly Distributed	50	100	100	100	0	0
None	0	0	0	0	100	100
Substrate						
Dominant						
Boulder	0	0	0	0	100	0
Cobble	0	66	100	0	0	0
Fines	0	33	0	0	0	100
Gravel	100	0	0	100	0	0
Bedrock	0	0	0	0	0	0
Subdominant						
Boulder	0	0	100	0	0	0
Cobble	100	33	0	0	0	0
Fines	0	0	0	100	0	0
Gravel	0	66	0	0	100	100
Bedrock	0	0	0	0	0	0
Morphology						
Class						
Cascade-Pool	0	0	0	0	100	0
Large Channel	0	0	0	0	0	0
Riffle-Pool	100	100	100	100	0	0
Step-Pool	0	0	0	0	0	100
Pattern						
Irregular Meandering	0	100	0	0	0	0
Irregular	0	0	0	0	0	100
Meandering	0	0	0	0	0	0
Sinuous	50	0	0	100	100	0
Straight	0	0	0	0	0	0
Tortuous Meandering	50	0	100	0	0	0
Coupling						
Coupled	0	0	0	100	100	0
Decoupled	50	50	0	0	0	100
Partially Coupled	50	50	100	0	0	0
Confinement						
Confined	0	0	0	100	0	0
Entrenched	0	0	0	0	0	0
Frequently Confined	0	50	0	0	100	0
Occasionally Confined	100	50	100	0	0	100
Unconfined	0	0	0	0	0	0

n = number of sites

Table 7.2-11. Habitat Characteristics of Streams Sites from Detailed Habitat Surveys in the Scott Creek Watershed Grouping

		Reach 1					Reach 2					Stream 208				
Characteristic	Units	N	Min	Mean	SE	Max	N	Min	Mean	SE	Max	N	Min	Mean	SE	Max
Length surveyed	m			236					219					100		
Wetted area surveyed	m^2			3,729					1,970					-		
Habitat units	#			3					4					1		
Bankfull width	m	3	20.0	24.3	2.4	28.3	4	6.6	15.2	4.4	21.0	0	-	-	-	-
Bankfull depth	m	3	1.0	1.1	0.1	1.2	4	0.2	0.7	0.4	1.5	1	0.2	0.2	-	0.2
Wetted width	m	3	15.5	16.2	0.6	17.3	4	2.1	8.3	2.7	14.8	0	-	-	-	-
Wetted depth	m	3	0.2	0.2	0.0	0.3	4	0.1	0.4	0.1	0.7	1	11.4	11.4	-	11.4
Bank height	m	3	0.5	0.5	0.0	0.5	3	0.3	0.6	0.2	1.0	1	13.0	13.0	-	13.0
Substrate																
Sand	%	3	15	20	5	30	4	5	19	10	50	1	20	20	-	20
Gravel	%	3	40	40	0	40	4	10	24	9	50	1	40	40	-	40
Cobble	%	3	30	33	2	35	4	0	21	7	30	1	20	20	-	20
Boulder	%	3	0	7	2	10	4	0	35	4	50	1	20	20	-	20
Rock	%	3	0	0	0	0	4	0	0	0	0	1	0	0	-	0
Cover																
Pool	%	3	10	17	3	20	4	5	35	22	100	1	20	20	-	20
Boulder	%	3	5	8	2	10	3	70	73	3	80	1	10	10	-	10
Small woody debris	%	3	0	0	0	0	3	0	0	0	0	1	5	5	-	5
Large woody debris	%	3	5	22	10	40	3	0	4	2	7	1	35	35	-	35
Instream veg.	%	3	0	7	7	20	3	0	0	0	0	1	5	5	-	5
Overhead veg.	%	3	20	33	11	55	3	0	6	3	10	1	15	15	-	15
Undercut banks	%	3	10	13	3	20	3	0	3	3	10	1	10	10	-	10
Habitat type																
Glide	%	3		33			3		0			1		0		
Other	%	3		0			3		0			1		0		
Pool	%	3		33			3		25			1		0		
Riffle	%	3		33			3		75			1		100		

Min = minumum value

Max = maximum value

SE = standard error of the mean

N = number of observations

- = not available

veg. = vegetation

Stream 507 is located in the headwaters of Scott Creek. It is a small, steep stream draining a small wetland into Reach 3 of the mainstem. While instream cover and pools are present, there is poor connectivity between pools and between the stream, the wetland and the mainstem due to very shallow sections that may not be permanently wetted.

7.2.2.4 Todd Creek Watershed Grouping

Todd Creek flows north from its headwaters in the mountains to the Bowser River directly upstream of Bowser Lake. Todd Creek and its tributaries are primarily steep and glacial in origin. As a result, water clarity in the watershed is generally low (Plate 7.2-4). There are no significant lakes or wetlands in the watershed.

Plate 7.2-4. Todd Creek Watershed Reach 1.

Within the study area, Todd Creek is comprised of a single reach (Figure 7.2-5). The mainstem is large and moderately deep (Table 7.2-12). Cover is infrequent and the absence of cover contributes to the marginal habitat value in the mainstem, but fair quality habitat was observed in side channels (Table 7.2-13). Infrequent pools were the only observed source of overwintering habitat. Most habitat units are riffles (Table 7.2-14).

Table 7.2-12. Habitat Characteristics of Stream Sites in the Todd Creek Watershed, 2010 to 2012

		Todd Creek Reach 1 (*n* = 2)			
Variable	**Units**	**N**	**Min**	**Mean (±*SE*)**	**Max**
Channel Width	m	8	49.3	64.8 (*8.8*)	79.0
Wetted Width	m	8	34.0	40.2 (6.*7*)	45.5
Bankfull Depth	m	4	0.2	0.85 (*0.7*)	1.2
Pool Depth	m	4	0.2	0.6 (*0.4*)	0.7
Gradient	%	3	0.5	1.0 (*0.3*)	1.5
Temperature	°C	1	8	8	8
Water pH		1	7.9	7.9	7.9
Conductivity	µS/cm	1	90	90	90
D_{95}[1]	cm	2	1.3	16.7 (*0.9*)	32.0
D^2	cm	2	0.8	16.4 (*0.9*)	32.0

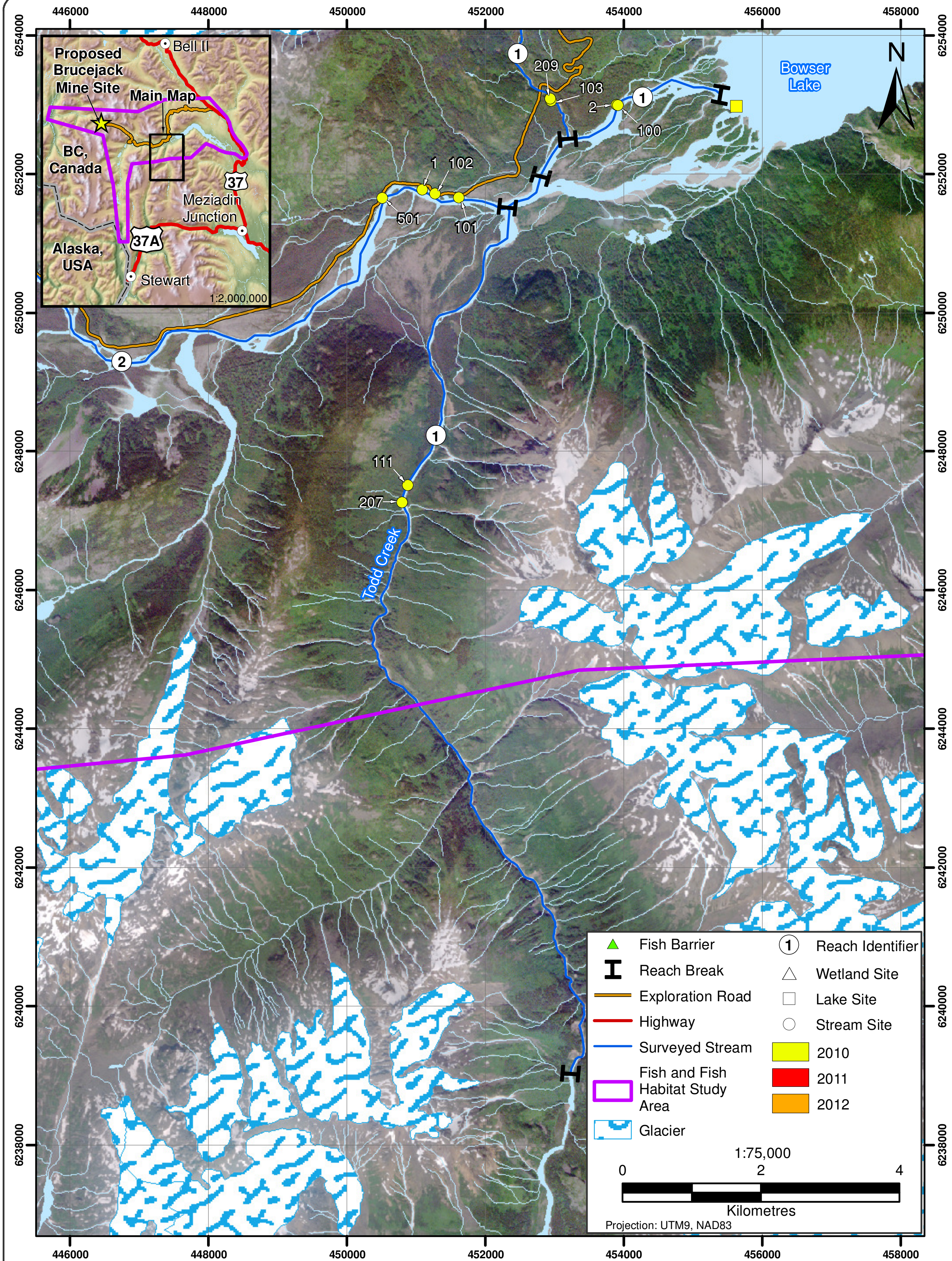

Figure 7.2-5

Reaches Surveyed in the Todd Creek Watershed Grouping

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Table 7.2-13. Categorical Habitat Characteristics of Stream Sites in the Todd Creek Watershed

Variable	Percent of Sites Todd Creek Reach 1 (*n* = 2)	Variable	Percent of Sites Todd Creek Reach 1 (*n* = 2)
Total Cover		**Large Woody Debris**	
Abundant	0	Abundance	
Moderate	0	Abundant	50
Trace	100	Few	50
Canopy Cover		None	0
0%	50	Distribution	
1-20%	50	Clumped	50
21-40%	0	Evenly Distributed	50
40-70%	0	None	0
>90%	0	**Substrate**	
Instream Cover Sources		Dominant	
Small Woody Debris		Boulder	50
Dominant	0	Cobble	0
Subdominant	0	Fines	0
Trace	100	Gravel	50
None	0	Bedrock	0
Large Woody Debris		Subdominant	
Dominant	0	Boulder	0
Subdominant	0	Cobble	50
Trace	100	Fines	50
None	0	Gravel	0
Boulders		Bedrock	0
Dominant	0	**Morphology**	
Subdominant	100	Class	
Trace	0	Cascade-Pool	0
None	0	Large Channel	0
Undercut Banks		Riffle-Pool	100
Dominant	0	Step-Pool	0
Subdominant	0	Pattern	
Trace	0	Irregular Meandering	0
None	100	Irregular	50
Deep Pools		Meandering	0
Dominant	50	Sinuous	0
Subdominant	50	Straight	50
Trace	0	Tortuous Meandering	0
None	0	Coupling	
Overhanging Vegetation		Coupled	50
Dominant	50	Decoupled	0
Subdominant	50	Partially Coupled	50
Trace	0	Confinement	
None	0	Confined	0
Instream Vegetation		Entrenched	0
Dominant	0	Frequently Confined	100
Subdominant	0	Occasionally Confined	0
Trace	50	Unconfined	0
None	50		

n = number of sites

Table 7.2-14. Habitat Characteristics of Streams Sites from Detailed Habitat Surveys in the Todd Creek Watershed Grouping

		Reach 1				
Characteristic	**Units**	**N**	**Min**	**Mean**	**SE**	**Max**
Length surveyed	m			345		
Wetted area surveyed	m^2			5,829		
Habitat units	#			3		
Bankfull width	m	3	10.6	30.3	18.4	67.0
Bankfull depth	m	3	0.5	0.8	0.2	1.2
Wetted width	m	3	3.7	16.6	11.2	39.0
Wetted depth	m	3	0.2	0.3	0.1	0.4
Bank height	m	3	0.6	1.5	0.8	3.0
Substrate						
Sand	%	3	10	37	20	75
Gravel	%	3	15	25	8	40
Cobble	%	3	5	22	10	40
Boulder	%	3	5	15	3	30
Rock	%	3	0	2	2	5
Cover						
Pool	%	3	20	50	17	80
Boulder	%	3	10	30	10	40
Small woody debris	%	3	0	0	0	0
Large woody debris	%	3	0	17	12	40
Instream veg.	%	3	0	0	0	0
Overhead veg.	%	3	0	2	2	5
Undercut banks	%	3	0	2	2	5
Habitat type						
Glide	%	3		0		
Other	%	3		0		
Pool	%	3		33		
Riffle	%	3		66		

Min = minumum value

Max = maximum value

SE = standard error of the mean

N = number of observations

- = not available

veg. = vegetation

7.2.2.5 Todedada Creek Watershed Grouping

The Todedada Creek mainstem is divided into four reaches, three of which were assessed during the baseline studies (Figure 7.2-6; Reach 2, Reach 3, Reach 4). Additionally, five tributary streams were assessed in the headwaters of the watershed (Streams 106, 503, 504, 505, and 506).

Reach 2 of Todedada Creek runs through a large wetland area (Plate 7.2-5). The creek mainstem forms a distinct, flowing channel through the wetland, but the surrounding area is flooded, filled with small permanent and temporary wetted channels, and influenced by substantial overland water flow. The substrate in the mainstem is primarily fines and gravel with trace amounts of larger substrates (Tables 7.2-15 and 7.2-16). Good quality fish habitat is available for rearing, spawning, and overwintering purposes. Habitat in Reach 2 is heterogenous, as the reach contains riffle, glide and pool habitat types.

Plate 7.2-5. Reach 2 of Todedada Creek flowing through wetland.

Reach 3 is upstream of the wetland that characterized Reach 2. Todedada Creek is higher gradient in Reach 3 than in Reach 2, and is larger in width (Reach 2: 12.1 m mean wetted width; Reach 3: 20.5 m mean wetted width). The substrate in Reach 3 is a mixture of sand, gravel, and cobble (Table 7.2-17). Stream banks show evidence of erosion. Although all mainstem habitat units are of riffle morphology, a few pool microhabitats provide fair quality overwintering habitat. Patches of gravel and small, slow secondary channels provide fair quality rearing and spawning habitat.

Reach 4 is differentiated from Reach 3 primarily as a result of differences in wetted width. Reach 4 is upstream of several moderate-sized tributaries that enter Reach 3, and as a result it is narrower than Reach 3 (11.3 m mean wetted width). It is also steeper than the downstream reaches (5% gradient). Boulders are the dominant substrate type. The upstream boundary of Reach 4 is Todedada Lake, and the entire stream is confirmed fish bearing. Pool, riffle, and cascade habitats were observed in Reach 4.

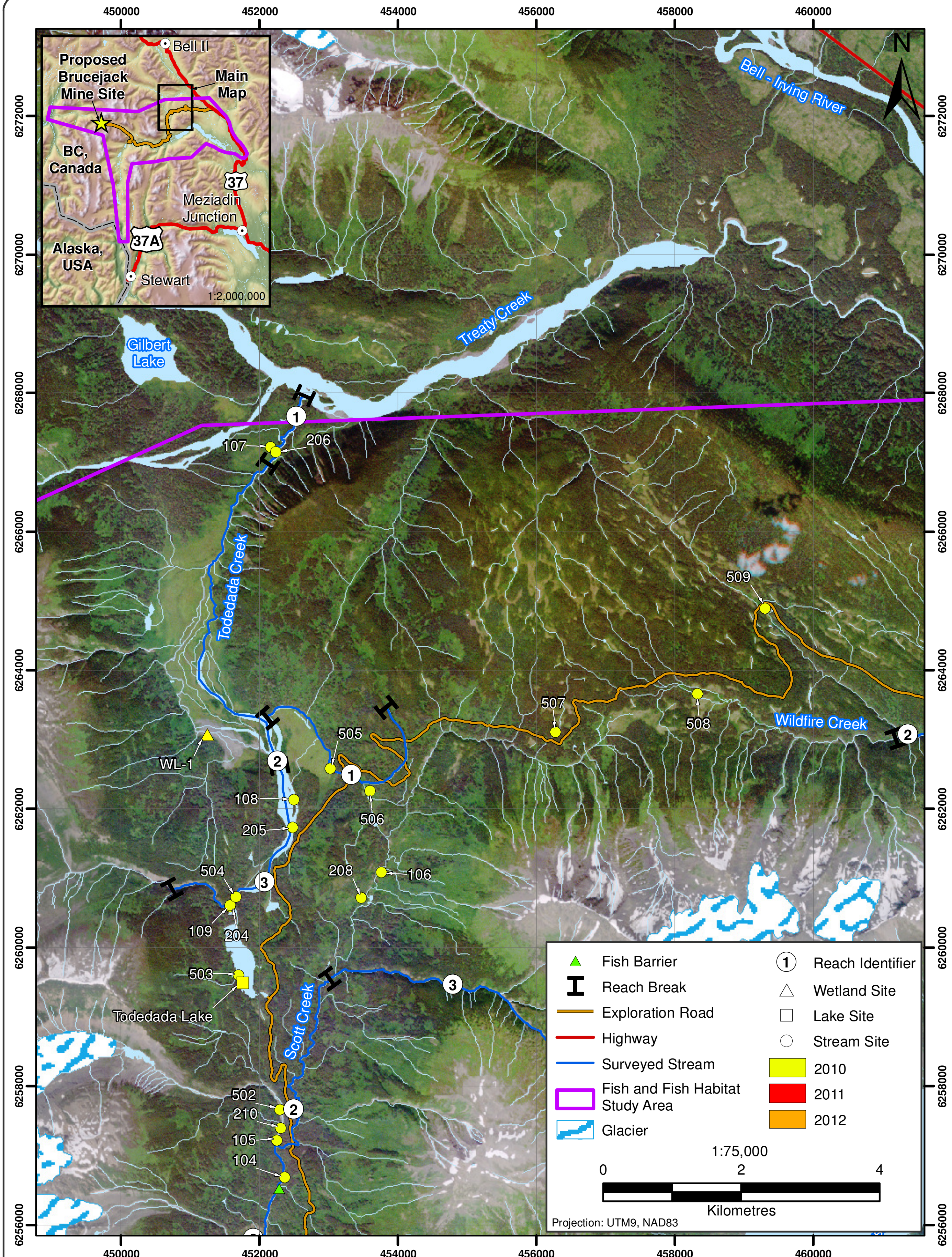

Figure 7.2-6

Reaches Surveyed in the Todedada Creek Watershed Grouping

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Table 7.2-15. Habitat Characteristics of Stream Sites in the Todedada Creek Watershed, 2010 to 2012

		Todedada Creek Reach 2 (*n* = 2)				Todedada Creek Reach 3 (*n* = 1)				Todedada Creek Reach 4 (*n* = 3)				Stream 106 (*n* = 1)			
Variable	Units	N	Min	Mean (±*SE*)	Max	N	Min	Mean (±*SE*)	Max	N	Min	Mean (±*SE*)	Max	N	Min	Mean (±*SE*)	Max
Channel Width	m	12	11.0	16.4 (*0.8*)	20.0	4	32.7	37.8 (*2.6*)	39.4	17	11.0	18.1 (*4.2*)	25.9	6	3.3	5.4 (*1.3)*	7.7
Wetted Width	m	12	8.0	12.1 (*1.2*)	18.0	4	13.3	20.5 (*3.3*)	27.1	17	6.0	11.3 (*1.3*)	20.9	6	3.5	5.8 (*1.5*)	8.1
Bankfull Depth	m	4	0.6	0.74 (*0.1*)	1.0	2	0.6	0.7 (*0.2*)	0.8	4	0.3	1.2 (*0.7*)	1.4	2	0.8	0.9 (*0.1*)	1.0
Pool Depth	m	4	0.5	1.1 (*0.2*)	1.5	2	0.1	0.1 (*0.1*)	0.1	5	0.1	0.3 (*0.7*)	1.4	0	-	-	-
Gradient	%	3	1.0	1 (*0.0*)	1.0	2	2.0	2.5 (*0.5*)	3.0	11	2.0	5.0 (*2.0*)	12.0	2	5.0	8 (*3*)	10.0
Temperature	°C	1	7	7	7	1	6	6	6	3	2	3.3 (*0.3*)	4	1	5	5	5
Water pH		0	-	-	-	1	8.1	8.1	8.1	3	8.0	8.3 (*0.1*)	8.5	1	8.2	8.2	8.2
Conductivity	µS/cm	1	110	110	110	1	100	100	100	1	100	110 (*0.7*)	120	1	130	130	130
D_{95}[1]	cm	2	24.0	28.5 (*0.9*)	33.0	1	29.0	29.0	29.0	3	0.7	52.9 (*42.1*)	120.0	1	75.0	75.0	75.0
D[2]	cm	2	23.0	24 (*0.1*)	25.0	1	27.0	27.0	27.0	1	0.7	37.9 (*32.2*)	75.0	1	35.0	35.0	35.0

		Stream 503 (*n* = 1)				Stream 504 (*n* = 1)				Stream 505 (*n* = 1)				Stream 506 (*n* = 1)			
Variable	Units	N	Min	Mean (±*SE*)	Max	N	Min	Mean (±*SE*)	Max	N	Min	Mean (±*SE*)	Max	N	Min	Mean (±*SE*)	Max
Channel Width	m	6	0.8	1.1 (*0.5*)	1.5	6	2.6	3.2 (*0.5*)	4.0	6	8.0	11.5 (*0.7*)	15.0	6	3.2	4.6 (*1.5*)	32.0
Wetted Width	m	6	0.7	1.1 (*0.4)*	1.4	6	2.1	3.0 (*0.5)*	3.7	6	6.0	9.8 (*0.6)*	14.0	6	9.0	7.8 (*1.3)*	29.0
Bankfull Depth	m	3	0.3	0.4 (*0.0*)	0.5	2	0.3	0.3 (*0.1*)	0.4	3	0.4	0.6 (*0.2*)	1.0	5	0.1	0.9 (*0.1*)	0.3
Pool Depth	m	3	0.1	0.2 (*0.3*)	0.3	3	0.1	0.2 (*0.6*)	1.7	1	1.0	1.0	1.0	3	0.2	-	0.3
Gradient	%	2	3.0	11 (*2.1*)	19.0	3	1.0	2 (*.7*)	4.0	1	8.0	8.0	8.0	1	2.0	2.0	2.0
Temperature	°C	1	6	6	6	1	15	15	15	1	9	9	9	1	9	9	9
Water pH		1	8.7	8.7	8.7	1	7.7	7.7	7.7	1	8.2	8.2	8.2	1	8.1	8.1	8.1
Conductivity	µS/cm	1	170	170	170	1	150	150	150	0	-	-	-	1	130	130	130
D_{95}[1]	cm	1	5.0	5.0	5.0	1	70.0	70.0	70.0	1	40.0	40.0	40.0	1	35.0	35.0	35.0
D[2]	cm	1	5.0	5.0	5.0	1	8.0	8.0	8.0	1	23.0	23.0	23.0	1	10.0	10.0	10.0

Min = minumum value

Max = maximum value

SE = standard error of the mean

N = number of observations

- = not available

veg. = vegetation

[1] *= diameter of particle larger than 95% of observed substrate*

[2] *= diameter of largest particle showing evidence of bed load movement*

Table 7.2-16. Categorical Habitat Characteristics of Stream Sites in the Todedada Creek Watershed

	Percent of Sites							
Variable	Todedada Creek Reach 2 (*n* = 2)	Todedada Creek Reach 3 (*n* = 1)	Todedada Creek Reach 4 (*n* = 3)	Stream 106 (*n* = 1)	Stream 503 (*n* = 1)	Stream 504 (*n* = 1)	Stream 505 (*n* = 1)	Stream 506 (*n* = 1)
Total Cover								
Abundant	50	0	0	0	0	100	0	100
Moderate	0	0	33	0	100	0	100	0
Trace	50	100	66	100	0	0	0	0
Canopy Cover								
0%	0	0	33	100	0	0	0	0
1-20%	100	100	66	0	100	0	100	0
21-40%	0	0	0	0	0	0	0	100
40-70%	0	0	0	0	0	0	0	0
>90%	0	0	0	0	0	100	0	0
Instream Cover Sources								
Small Woody Debris								
Dominant	100	0	0	0	0	0	0	0
Subdominant	0	0	0	0	0	100	0	100
Trace	100	100	0	0	100	0	0	0
None	0	0	100	100	0	0	100	0
Large Woody Debris								
Dominant	0	0	0	0	100	0	100	0
Subdominant	100	100	0	0	0	100	0	0
Trace	0	0	100	100	0	0	0	100
None	0	0	0	0	0	0	0	0
Boulders								
Dominant	0	100	66	100	0	0	0	0
Subdominant	100	0	33	0	0	0	0	0
Trace	0	0	0	0	0	100	100	0
None	0	0	0	0	100	0	0	100
Undercut Banks								
Dominant	0	0	0	0	0	0	0	0
Subdominant	0	0	0	0	100	0	0	0
Trace	50	100	0	0	0	100	100	100
None	50	0	100	100	0	0	0	0
Deep Pools								
Dominant	50	0	0	0	0	0	0	0
Subdominant	50	0	66	0	0	0	100	100
Trace	0	100	33	0	0	0	0	0
None	0	0	0	100	100	100	0	0
Overhanging Vegetation								
Dominant	0	0	33	0	0	100	0	100
Subdominant	50	0	33	0	100	0	0	0
Trace	50	100	33	100	0	0	100	0
None	0	0	0	0	0	0	0	0
Instream Vegetation								
Dominant	0	0	0	0	0	0	0	0
Subdominant	0	0	0	0	0	0	0	100
Trace	50	0	33	0	0	0	0	0
None	50	100	66	100	100	100	100	0

(continued)

Table 7.2-16. Categorical Habitat Characteristics of Stream Sites in the Todedada Creek Watershed (completed)

Variable	Percent of Sites							
	Todedada Creek Reach 2 (*n* = 2)	Todedada Creek Reach 3 (*n* = 1)	Todedada Creek Reach 4 (*n* = 3)	Stream 106 (*n* = 1)	Stream 503 (*n* = 1)	Stream 504 (*n* = 1)	Stream 505 (*n* = 1)	Stream 506 (*n* = 1)
Large Woody Debris								
Abundance								
Abundant	0	0	0	0	100	0	0	0
Few	100	100	100	0	0	100	100	0
None	0	0	0	100	0	0	0	100
Distribution								
Clumped	100	0	0	0	0	0	100	0
Evenly Distributed	0	100	100	0	100	100	0	0
None	0	0	0	100	0	0	0	100
Substrate								
Dominant								
Boulder	0	0	0	100	0	0	0	0
Cobble	50	100	100	0	0	0	100	0
Fines	50	0	0	0	0	100	0	100
Gravel	0	0	0	0	100	0	0	0
Bedrock	0	0	0	0	0	0	0	0
Subdominant								
Boulder	0	100	100	0	0	0	100	0
Cobble	0	0	0	0	0	0	0	0
Fines	100	0	0	0	100	0	0	0
Gravel	0	0	0	100	0	100	0	100
Bedrock	0	0	0	0	0	0	0	0
Morphology								
Class								
Cascade-Pool	0	0	0	100	0	0	100	0
Large Channel	0	0	0	0	0	0	0	0
Riffle-Pool	100	100	100	0	100	100	0	0
Step-Pool	0	0	0	0	0	0	0	0
Pattern								
Irregular Meandering	0	0	0	0	0	0	0	0
Irregular	0	0	0	0	100	0	0	0
Meandering	0	100	0	0	0	0	0	0
Sinuous	50	0	0	100	0	100	100	0
Straight	0	0	0	0	0	0	0	0
Tortuous Meandering	50	0	100	0	0	0	0	0
Coupling								
Coupled	50	0	0	100	0	0	100	0
Decoupled	50	100	0	0	100	0	0	100
Partially Coupled	0	0	100	0	0	100	0	0
Confinement								
Confined	50	0	0	0	0	0	100	0
Entrenched	0	0	0	0	0	0	0	0
Frequently Confined	50	0	0	100	0	0	0	0
Occasionally Confined	0	100	100	0	100	100	0	0
Unconfined	0	0	0	0	0	0	0	100

n = number of sites

Table 7.2-17. Habitat Characteristics of Streams Sites from Detailed Habitat Surveys in the Todedada Creek Watershed Grouping

		Todedada Creek Watershed																			
		Reach 2					Reach 3					Reach 4					Stream 106				
Characteristic	Units	N	Min	Mean	SE	Max	N	Min	Mean	SE	Max	N	Min	Mean	SE	Max	N	Min	Mean	SE	Max
Length surveyed	m			177					120					396					145		
Wetted area surveyed	m^2			2,112					2,460					4,430					523		
Habitat units	#			4					1					6					2		
Bankfull width	m	4	15.0	17.5	1.2	20.0	1	37.8	37.8	-	37.8	6	0.0	16.7	3.8	25.0	2	3.5	4.1	0.6	4.7
Bankfull depth	m	4	0.7	0.9	0.1	1.1	1	0.7	0.7	-	0.7	6	0.3	0.8	0.1	1.2	2	0.3	0.4	0.1	0.5
Wetted width	m	4	9.0	11.5	1.3	14.0	1	20.5	20.5	-	20.5	6	2.6	11.8	2.6	20.9	2	3.2	3.7	0.5	4.1
Wetted depth	m	4	0.2	0.4	0.1	0.5	1	0.2	0.2	-	0.2	6	0.1	0.4	0.1	0.5	2	0.3	0.3	0.0	0.3
Bank height	m	4	0.3	0.4	0.1	0.6	1	0.3	0.3	-	0.3	6	0.3	0.7	0.1	1.0	2	0.3	0.4	0.1	0.4
Substrate																					
Sand	%	4	20	38	8	55	1	20	20	-	20	6	0	8	2	15	2	40	50	10	60
Gravel	%	4	20	21	1	25	1	30	30	-	30	6	5	10	2	15	2	35	43	8	50
Cobble	%	4	15	38	9	55	1	40	40	-	40	6	10	27	5	40	2	5	8	3	10
Boulder	%	4	0	1	5	9	1	10	10	-	10	6	40	55	2	80	2	0	0	0	0
Rock	%	4	0	0	0	0	1	0	0	-	0	6	0	0	0	0	2	0	0	0	0
Cover																					
Pool	%	4	10	21	7	40	1	5	5	-	5	5	5	17	5	30	2	20	25	5	30
Boulder	%	4	10	20	8	45	1	50	50	-	50	5	20	52	9	70	2	0	0	0	0
Small woody debris	%	4	0	0	0	0	1	0	0	-	0	5	0	0	0	0	2	0	3	3	5
Large woody debris	%	4	10	35	13	70	1	5	5	-	5	5	0	29	13	75	2	40	40	0	40
Instream veg.	%	4	0	1	1	5	1	5	5	-	5	5	0	0	0	0	2	0	3	3	5
Overhead veg.	%	4	0	11	5	20	1	30	30	-	30	5	0	2	2	10	2	15	18	3	20
Undercut banks	%	4	0	11	7	25	1	5	5	-	5	5	0	0	0	0	2	10	13	3	15
Habitat type																					
Glide	%	4		50			1		0			5		0			2		50		
Other	%	4		0			1		0			5		13			2		0		
Pool	%	4		25			1		0			5		33			2		0		
Riffle	%	4		25			1		100			5		50			2		50		

Min = minumum value

Max = maximum value

SE = standard error of the mean

N = number of observations

- = not available

veg. = vegetation

Stream 106 is located at the headwaters of a major tributary to Todedada Creek. The stream is small, and when it was assessed it had flooded its banks, resulting in a larger wetted width than channel width (5.8 m and 5.4 m respectively). The stream was assessed as good quality fish habitat due to high channel complexity, abundant instream cover, deep pools, and microhabitats that contained holding areas and spawning gravel.

Stream 503 is a small, shallow inlet to Todedada Lake, upstream of Reach 4. The upstream end of the assessed reach increases in gradient to 19%, and while it is fish passable, the gradient reduces the habitat value for fish. The downstream end of the reach is separated from the lake by a 1.5 m drop through a beaver dam, which may restrict fish migration into the stream from the fish-bearing lake.

Stream 504 is a tributary to Todedada Creek, discharging into the mainstem in Reach 4. There is abundant cover in Stream 504, and crown closure is greater than 90%. Habitat for spawning and overwintering is of poor quality due to the absence of spawning gravels and deep pools. Habitat for rearing is of good quality. A beaver pond and associated 1.0 m high beaver dam was observed at the upstream end of the site. The water temperature in the stream was high (15˚C) compared to the cold, glacial streams common throughout the rest of the study area.

Stream 505 receives water from Stream 106 and Stream 506. The stream is large and steep. The reach is bounded at the upper end of the assessed reach by a 15 m cascade and a 2 m waterfall that results in a barrier to fish passage. The downstream end of the reach flowed into the wetland surrounding Reach 2 through an avulsion. Large woody debris is abundant in the stream, primarily of clumped distribution in the form of a large log jam. Fish habitat is of marginal quality throughout the stream.

Stream 506 drains the north end of a moderate sized wetland that also discharges water south to Scott Creek. Water velocity in Stream 506 was low, and there were ponds and low velocity areas of deep water that may provide overwintering habitat for fish. Spawning habitat in the stream is of low quality due to the abundance of fines overlying all gravel substrate. The stream provides abundant, high quality rearing habitat due to the presence of ponded water and instream cover.

7.2.2.6 Unuk River Watershed

The largest streams in the study area are the Unuk River and Sulphurets Creek. Sulphurets Creek discharges west into the Unuk River, which flows primarily south and west into Alaska. While the Unuk River itself is large, it is braided in several areas and contains small, shallow side channels and tributaries. Water in the Unuk River watershed is turbid and cold due to glacial influences (Plate 7.2-6).

One reach of the Unuk River was included in the study area (Figure 7.2-7). Within that reach, the mainstem and two side channels were assessed (Side channels 113 and 212). Sulphurets Creek, a tributary to the Unuk River, and Brucejack Lake in the headwaters of Sulphurets Creek, were also assessed. Results for Brucejack Lake are described in Section 7.2.3.

The Unuk River mainsteam reach that was assessed has a maximum channel width of 176 m and a maximum wetted width of 107.0 m. This reach is the widest reach that was assessed within the study area (Table 7.2-18). Cover in the Unuk River is infrequent and the majority of instream cover is created by overhanging vegetation at the river edge and instream boulders (Table 7.2-19). Rearing habitat for salmonids is of fair quality and is primarily limited to river edges, while spawning and overwintering habitat is of good quality. Riffle, glide, and pool habitat types are all represented in Reach 1 (Table 7.2-20).

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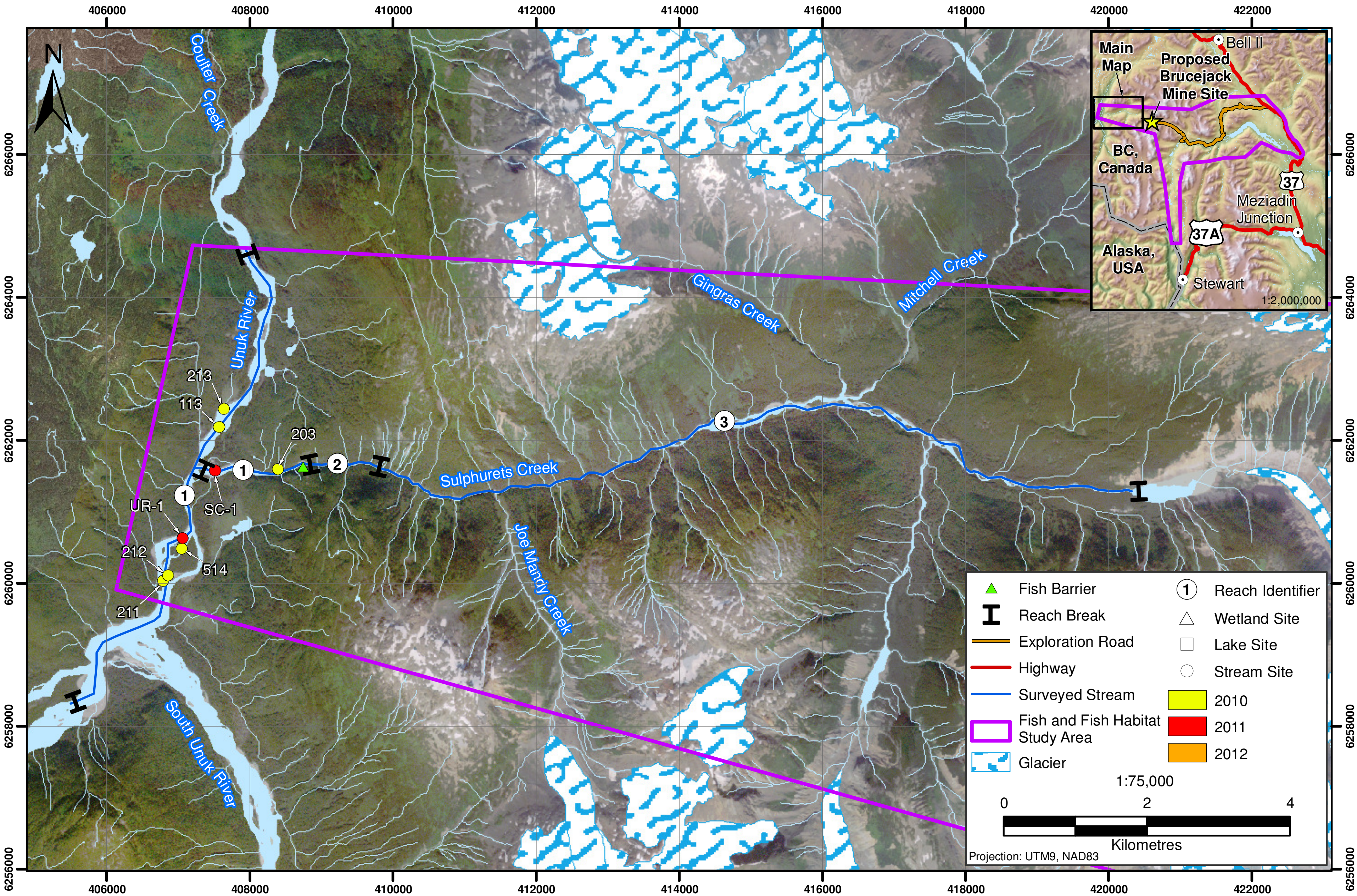

Figure 7.2-7

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Reaches Surveyed in the Unuk River Watershed Grouping

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Table 7.2-18. Habitat Characteristics of Stream Sites in the Unuk River Watershed Grouping

		Unuk River Reach 1 (*n* = 3)				Sulphurets Creek Reach 1 (*n* = 2)				Sulphurets Creek Reach 2 (*n* = 1)			
Variable	Units	N	Min	Mean (±*SE*)	Max	N	Min	Mean (±*SE*)	Max	N	Min	Mean (±*SE*)	Max
Channel Width	m	9	50.0	120 (*38.2*)	176.0	3	62.0	76.2 (*25.2*)	90.0	4	39.6	42.1 (*2.9*)	44.5
Wetted Width	m	9	18.0	52.7 (*22.6*)	107.0	12	22.7	41.4 (*18.7*)	75.3	12	23.7	27.3 (*1.1*)	29.0
Bankfull Depth	m	4	1.0	1.14 (*3.8*)	1.6	3	0.8	1.1 (*1.2*)	2.4	2	0.8	1.0 (*0.3*)	1.6
Pool Depth	m	0	-	-	-	2	0.1	1 (*0.4*)	1.6	1	0.2	0.2	0.2
Gradient	%	7	0.5	0.9 (*0.1*)	1.0	2	1.0	1.5 (*0.2*)	2.0	1	2.5	2.5	2.5
Temperature	°C	2	4	4 (*0.4*)	5	2	5	4 (*0.1*)	6	1	3	3	3
Water pH		2	7.8	8.0 (*0.3*)	8.2	2	8.0	8.1 (*0.0*)	8.2	1	8.2	8.2	8.2
Conductivity	µS/cm	1	110	110	110	2	150	160 (*18*)	170	1	100	100	100
D_{95}[1]	cm	3	19.0	27.0 (*5.4*)	36.0	2	20.0	30.5 (*4.8*)	35.0	1	110.0	110.0	110.0
D[2]	cm	3	19.0	27.0 (*5.4*)	36.0	2	20.0	30.5 (*4.8*)	35.0	1	35.0	35.0	35.0

		Side Channel 113 (*n* = 1)				Side Channel 212 (*n* = 1)			
Variable	Units	N	Min	Mean (±*SE*)	Max	N	Min	Mean (±*SE*)	Max
Channel Width	m	0	-	-	-	0	-	-	-
Wetted Width	m	7	3.1	4 (*1.4*)	8.6	6	0.6	0.9 (*0.7*)	1.2
Bankfull Depth	m	0	-	-	-	0	-	-	-
Pool Depth	m	1	0.3	0.3	0.3	2	0.0	0.1 (*0.0*)	0.1
Gradient	%	1	2.5	2.5	2.5	1	1.0	1.0	1.0
Temperature	°C	1	14	14	14	1	5	5	5
Water pH		0	-	-	-	1	7.5	7.5	7.5
Conductivity	µS/cm	0	-	-	-	1	330	330	330
D_{95}[1]	cm	1	0.2	0.2	0.2	1	24.0	24.0	24.0
D[2]	cm	1	0.1	0.1	0.1	1	5.5	5.5	5.5

Min = minumum value

Max = maximum value

SE = standard error of the mean

N = number of observations

- = not available

veg. = vegetation

[1] *= diameter of particle larger than 95% of observed substrate*

[2] *= diameter of largest particle showing evidence of bed load movement*

Table 7.2-19. Categorical Habitat Characteristics of Stream Sites in the Unuk River Watershed Grouping

Variable	Percent of Sites				
	Unuk River Reach 1 (*n* = 3)	Sulphurets Creek Reach 1 (*n* = 2)	Sulphurets Creek Reach 2 (*n* = 1)	Side Channel 113 (*n* = 1)	Side Channel 212 (*n* = 1)
Total Cover					
Abundant	0	0	0	0	0
Moderate	33	50	0	0	100
Trace	66	50	100	0	0
Canopy Cover					
0%	66	100	0	0	0
1-20%	33	0	100	0	0
21-40%	0	0	0	0	100
40-70%	0	0	0	0	0
>90%	0	0	0	0	0
Instream Cover Sources					
Small Woody Debris					
Dominant	0	0	0	0	0
Subdominant	66	50	0	0	0
Trace	0	50	0	0	100
None	33	0	50	100	0
Large Woody Debris					
Dominant	33	100	0	0	0
Subdominant	33	0	0	100	0
Trace	33	0	0	0	100
None	0	0	100	0	0
Boulders					
Dominant	33	0	100	0	0
Subdominant	0	50	0	0	100
Trace	66	50	0	100	0
None	0	0	0	0	0
Undercut Banks					
Dominant	0	0	0	0	0
Subdominant	0	0	0	0	0
Trace	0	0	0	0	0
None	100	100	100	100	100
Deep Pools					
Dominant	0	0	0	100	0
Subdominant	33	50	100	0	100
Trace	0	0	0	0	0
None	66	50	0	0	0
Overhanging Vegetation					
Dominant	33	0	0	0	100
Subdominant	0	0	0	0	0
Trace	33	100	100	0	0
None	33	0	0	100	0
Instream Vegetation					
Dominant	0	0	0	0	0
Subdominant	0	0	0	0	100
Trace	0	0	0	0	0
None	100	100	100	100	0

(continued)

Table 7.2-19. Categorical Habitat Characteristics of Stream Sites in the Unuk River Watershed Grouping (completed)

Variable	Percent of Sites				
	Unuk River Reach 1 (*n* = 3)	Sulphurets Creek Reach 1 (*n* = 2)	Sulphurets Creek Reach 2 (*n* = 1)	Sidechannel 113 (*n* = 1)	Sidechannel 212 (*n* = 1)
Large Woody Debris					
Abundance					
Abundant	0	0	0	0	100
Few	100	100	100	100	0
None	0	0	0	0	0
Distribution					
Clumped	100	0	0	0	0
Evenly Distributed	0	100	100	100	100
None	0	0	0	0	0
Substrate					
Dominant					
Boulder	0	0	0	0	0
Cobble	50	100	100	100	0
Fines	50	0	0	0	0
Gravel	0	0	0	0	100
Bedrock	0	0	0	0	0
Subdominant					
Boulder	0	100	100	100	0
Cobble	0	0	0	0	0
Fines	100	0	0	0	100
Gravel	0	0	0	0	0
Bedrock	0	0	0	0	0
Morphology					
Class					
Cascade-Pool	0	0	0	0	0
Large Channel	0	0	0	0	0
Riffle-Pool	100	100	100	100	100
Step-Pool	0	0	0	0	0
Pattern					
Irregular Meandering	0	0	0	0	0
Irregular	0	0	0	0	0
Meandering	0	100	100	0	0
Sinuous	50	0	0	0	100
Straight	0	0	0	0	0
Tortuous Meandering	50	0	0	100	0
Coupling					
Coupled	50	0	0	0	100
Decoupled	50	100	100	0	0
Partially Coupled	0	0	0	100	0
Confinement					
Confined	50	0	0	0	100
Entrenched	0	0	0	0	0
Frequently Confined	50	0	0	0	0
Occasionally Confined	0	100	100	100	0
Unconfined	0	0	0	0	0

n = number of sites

Table 7.2-20. Habitat Characteristics of Streams Sites from Detailed Habitat Surveys in the Unuk River Watershed Grouping

		Unuk River Watershed																			
		Unuk River Reach 1					Sulphurets Creek Reach 1					Sulphurets Creek Reach 2					Side Channels				
Characteristic	**Units**	**N**	**Min**	**Mean**	**SE**	**Max**	**N**	**Min**	**Mean**	**SE**	**Max**	**N**	**Min**	**Mean**	**SE**	**Max**	**N**	**Min**	**Mean**	**SE**	**Max**
Length surveyed	m			870					350					180					408		
Wetted area surveyed	m^2			35,501					14,200					4,914					5,081		
Habitat units	#			7					2					1					8		
Bankfull width	m	6	48.0	82.4	14.7	160.0	2	62.0	76.0	13.9	90.0	1	42.1	42.1	-	90.0	8	0.0	24.0	24.0	168.0
Bankfull depth	m	6	1.0	1.4	0.1	1.6	2	1.0	1.5	0.5	2.0	1	1.3	1.3	-	1.3	7	0.3	1.1	0.3	2.5
Wetted width	m	6	20.0	43.6	7.7	76.0	2	40.0	41.0	2.6	42.0	1	27.3	27.3	-	27.3	8	0.7	8.8	3.4	32.0
Wetted depth	m	6	0.5	0.9	0.1	1.2	2	0.5	1.0	0.5	1.5	1	0.5	0.5	-	0.5	8	0.1	0.3	0.1	0.5
Bank height	m	2	0.5	0.7	0.2	0.8	2	0.6	0.9	0.3	1.2	1	1.0	1.0	-	1.0	4	0.3	0.9	0.3	1.6
Substrate																					
Sand	%	7	5	26	9	70	2	10	20	10	30	1	5	5	-	5	8	10	75	10	100
Gravel	%	7	5	14	4	30	2	10	18	8	25	1	10	10	-	10	8	0	16	7	65
Cobble	%	7	10	52	11	80	2	20	28	8	35	1	60	60	-	60	8	0	9	3	25
Boulder	%	7	2	7	1	10	2	25	33	2	40	1	20	20	-	20	8	0	1	2	5
Rock	%	7	0	0	0	0	2	0	3	3	5	1	5	5	-	5	8	0	0	0	0
Cover																					
Pool	%	7	0	1	1	10	2	0	5	5	10	1	10	10	-	10	3	15	20	5	30
Boulder	%	7	0	38	14	90	2	70	75	5	80	1	85	85	-	85	3	5	20	15	50
Small woody debris	%	7	0	0	0	0	2	0	0	0	0	1	0	0	-	0	8	0	33	16	100
Large woody debris	%	7	5	35	11	75	2	10	15	5	20	1	5	5	-	5	8	0	43	15	100
Instream veg.	%	7	0	0	0	0	2	0	0	0	0	1	0	0	-	0	8	0	0	0	0
Overhead veg.	%	7	0	23	9	60	2	0	5	5	10	1	0	0	-	0	8	0	10	9	70
Undercut banks	%	7	0	3	3	20	2	0	0	0	0	1	0	0	-	0	8	0	0	0	0
Habitat type																					
Glide	%	7		14			2		0			1		0			8		13		
Other	%	7		0			2		0			1		0			8		0		
Pool	%	7		29			2		0			1		100			8		13		
Riffle	%	7		57			2		100			1		0			8		75		

Min = minumum value

Max = maximum value

SE = standard error of the mean

N = number of observations

- = not available

veg. = vegetation

Plate 7.2-6. Reach 1 of the Unuk River showing extensive riffle habitat.

Side channels 113 and 212 are small streams running through islands on the Unuk River. Side channel 113 is located upstream of the confluence with Sulphurets Creek. Rearing habitat in Side channel 113 is of good quality, as it contains deep pools, gentle riffles, and abundant instream cover. Side channel 212 is located on an island downstream of the Sulphurets Creek confluence. There are two habitat units in Side channel 212: a narrow riffle at the downstream end and a wider pool habitat unit upstream. Both habitat units provide good rearing habitat due to abundant overhanging vegetative cover, boulder instream cover, and instream vegetation. The pool habitat is deep and would be suitable as overwintering habitat and to provide shelter during flood events. No spawning habitat was observed in either side channel.

Sulphurets Creek is a large creek that runs west from Sulphurets Glacier to the Unuk River, and receives water from Brucejack Lake, Brucejack Creek, and several other large tributaries of glacial origin. Two reaches of Sulphurets Creek were identified and assessed. Reach 1 is dominated by extensive riffle habitat. Instream cover is present in trace amounts. The gradient is low, ranging from 1% to 2%. Reach 2 is upstream of a series of cascades obstructing fish passage (see Section 7.1.3).

Reach 2 is higher gradient than Reach 1 (2.5%). The channel and wetted width are smaller (42.1 m and 27.3 m, respectively). Reach 2 includes pool habitat units and large substrate (D_{95} = 110 cm). In both reaches, the presence of only trace amounts of cover results in marginal quality rearing habitat, although fair quality spawning habitat was observed. Observed water temperatures were low throughout the creek (3˚C to 6˚C).

7.2.2.7 Wildfire Creek Watershed

Wildfire Creek is a medium-sized tributary of the Bell-Irving River. Near the mouth, Wildfire Creek is of moderate gradient. Farther upstream, the gradient increases and the channel is comprised of riffle and cascade morphology. At approximately two kilometers upstream of the creek mouth, a second branch of Wildfire Creek discharges into the mainstem from the south (Figure 7.2-8). The southern branch originates on a plateau with numerous small ponds and wetlands. At the confluence of the two branches there is a stretch of cascades and small waterfalls described in Section 7.1.

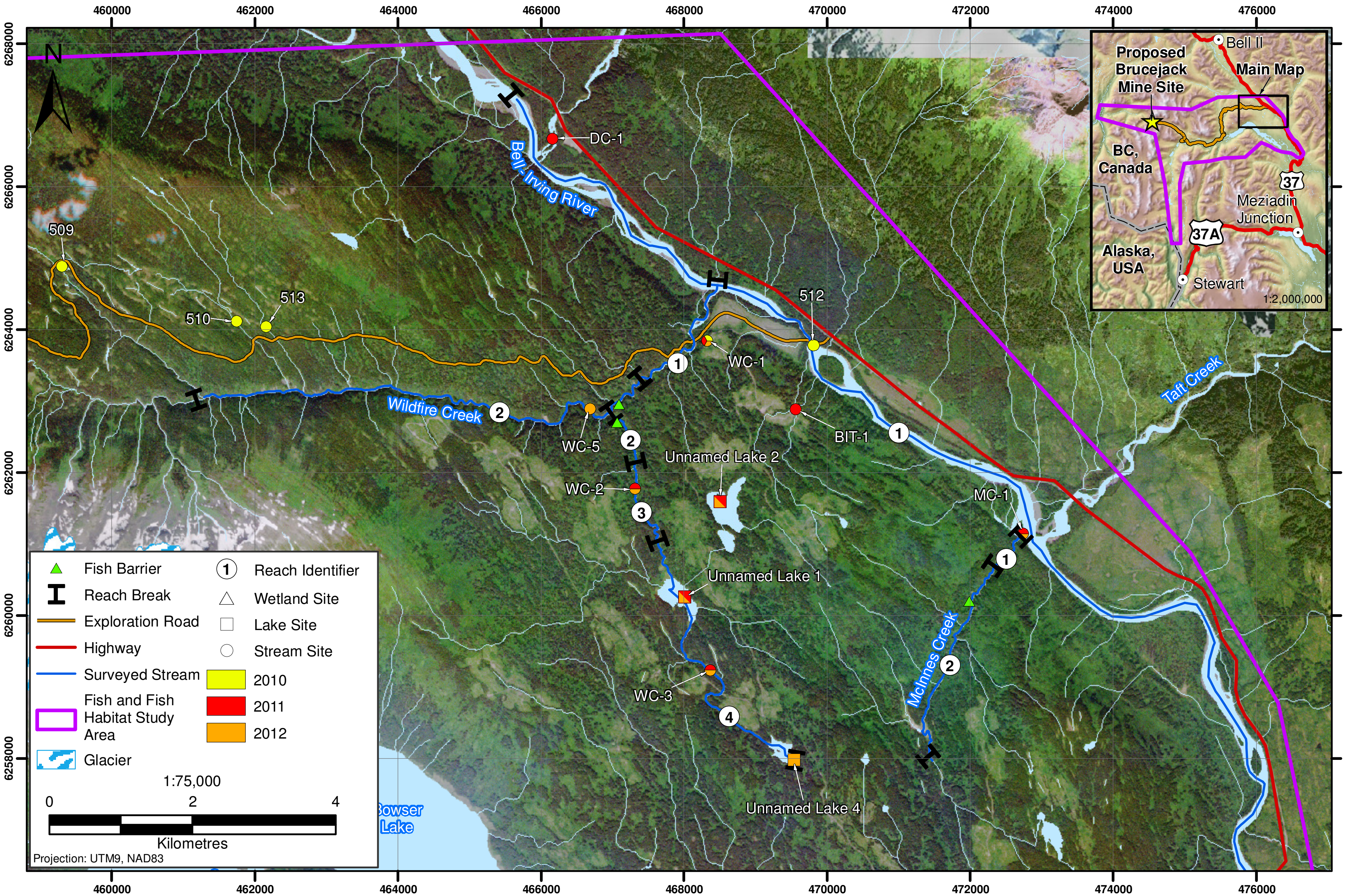

Figure 7.2-8

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Reaches Surveyed in the Wildfire Creek Watershed Grouping

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Four reaches were identified and surveyed in Wildfire Creek watershed (Reaches 1, 2, 3, and 4). Four tributary streams in Reach 2 were also assessed (Streams 508, 509, 510, and 513).

Reach 1 of Wildfire Creek is the only confirmed fish-bearing reach of Wildfire Creek. It is the widest reach in Wildfire Creek (mean wetted width = 21.2 m; Table 7.3-21). It is a low gradient reach with fair quality rearing, spawning and overwintering habitat for salmonids (Table 7.2-22). All habitat units identified in Reach 1 were riffle habitats, although pool microhabitats were observed within the large riffle habitat units (Table 7.2-23). The majority of the instream cover observed in Reach 1 was created by these pools or by instream boulders.

Reach 2 of Wildfire Creek includes the entire west branch of Wildfire Creek and 150 m of the south branch of Wildfire Creek directly upstream of the confluence with the west branch. A series of cascades, small waterfalls, and high-gradient steps is located at the downstream end of Reach 2. These features form a barrier to fish migration and all reaches upstream of the barrier (Reach 2, Reach 3 and Reach 4) have been confirmed non-fish bearing. Above the barrier, Reach 2 is high gradient (maximum gradient = 8%), high velocity, and is dominated by cascade and riffle habitat. Reach 2 flows through a canyon which limits access to the channel and confines lateral movement of the channel.

Reach 3 of Wildfire Creek is narrow (mean wetted width = 2.4 m) and low gradient. The habitat is heterogenous, with riffle and pool habitats observed. Moderate amounts of cover were observed, including overhanging and instream vegetation, boulders, pools, undercut banks and small woody debris.

Reach 4 of Wildfire Creek is located on a plateau. In this reach, the creek is a deep, slow channel flowing through grass dominated riparian areas. The creek flows through or near several small ponds and wetlands. The substrate in Reach 4 is entirely fine organic sediment and sand. Instream vegetation, overhanging vegetation, and woody debris are the dominant habitat types, and abundant instream cover is available (Plate 7.2-7).

Plate 7.2-7. Instream vegetation in Reach 5 of Wildfire Creek.

Table 7.2-21. Habitat Characteristics of Stream Sites in the Wildfire Creek Watershed, 2010 to 2012

		Wildfire Creek Reach 1 (*n* = 2)				Wildfire Creek Reach 2 (*n* = 1)				Wildfire Creek Reach 3 (*n* = 2)				Wildfire Creek Reach 4 (*n* = 2)			
Variable	Units	N	Min	Mean (±*SE*)	Max	N	Min	Mean (±*SE*)	Max	N	Min	Mean (±*SE*)	Max	N	Min	Mean (±*SE*)	Max
Channel Width	m	10	15.0	35.9 (10.1)	60.0	3	15.0	6.5 (0.8)	18.0	6	8.0	9.8 (2.3)	12.0	7	2.5	3.8 (1.3)	5.0
Wetted Width	m	9	7.0	21.2 (9.6)	40.0	3	4.5	8.9 (1.0)	10.0	6	1.8	6.4 (2.6)	10.0	7	4.0	8.9 (1.4)	15.0
Bankfull Depth	m	2	0.5	0.6 (0.1)	0.6	3	0.8	1.2 (0.5)	1.5	2	0.0	0.6 (0.6)	1.1	3	0.4	1.1 (0.7)	1.2
Pool Depth	m	0	-	-	-	1	0.5	0.5	0.5	2	0.9	1.5 (0.4)	2.0	0	-	-	-
Gradient	%	3	1.0	1.3 (0.1)	2.0	3	2.0	5.5 (0.8)	8.0	4	1.0	2.6 (0.7)	5.0	4	0.0	1 (0.3)	1.0
Temperature	°C	2	6	8 (0.5)	9	1	4	4	4	2	1	5 (0.9)	10	2	8	10 (2.0)	12
Water pH		2	7.2	7.7 (0.2)	8.2	0	-	-	-	1	7.9	7.9	7.9	1	7.6	7.6	7.6
Conductivity	µS/cm	1	30	30	30	1	60	60	60	2	20	20 (0)	20	1	20	20	20
D_{95}[1]	cm	2	19.0	30.5 (11.0)	42.0	1	110.0	110.0	110.0	2	0.5	6.3 (1.8)	12.0	1	0.0	0.0	0.0
D[2]	cm	2	19.0	22.0 (9.1)	25.0	1	95.0	95.0	95.0	2	0.2	6.1 (1.3)	12.0	1	0.0	0.0	0.0

		Stream 508 (*n* = 1)				Stream 509 (*n* = 1)				Stream 510 (*n* = 1)				Stream 513 (*n* = 1)			
Variable	Units	N	Min	Mean (±*SE*)	Max	N	Min	Mean (±*SE*)	Max	N	Min	Mean (±*SE*)	Max	N	Min	Mean (±*SE*)	Max
Channel Width	m	6	3.2	5.6 (2.1)	9.9	6	1.6	2.6 (0.7)	3.3	6	1.8	3.1 (1.7)	5.4	6	3.0	4.0 (1.0)	5.3
Wetted Width	m	6	2.1	3.5 (1.6)	5.8	6	1.3	1.9 (0.6)	2.4	6	1.6	2.8 (1.5)	5.3	6	2.2	3.1 (0.8)	4.9
Bankfull Depth	m	3	0.3	0.3 (0.1)	0.4	3	0.4	0.5 (0.1)	0.7	2	0.3	0.4 (0.1)	0.4	2	0.5	0.6 (0.1)	0.6
Pool Depth	m	4	0.1	0.4 (0.3)	0.5	0	-	-	-	0	-	-	-	2	0.0	0.1 (0.0)	0.1
Gradient	%	2	1.0	2.0 (0.2)	2.0	1	2.0	2.0	2.0	2	1.0	2.0 (0.2)	2.0	2	4.0	5.0 (0.1)	5.0
Temperature	°C	1	8	8	8	1	10	10	10	1	7	7	7	1	7	7	7
Water pH		1	8.0	8.0	8.0	1	7.2	7.2	7.2	1	7.5	7.5	7.5	1	7.6	7.6	7.6
Conductivity	µS/cm	0	-	-	-	0	-	-	-	0	-	-	-	0	-	-	-
D_{95}[1]	cm	1	20.0	20.0	20.0	1	32.0	32.0	32.0	1	145.0	145.0	145.0	1	85.0	85.0	85.0
D[2]	cm	1	8.0	8.0	8.0	1	7.0	7.0	7.0	1	7.0	7.0	7.0	1	21.0	21.0	21.0

Min = minumum value

Max = maximum value

SE = standard error of the mean

N = number of observations

- = not available

veg. = vegetation

[1] *= diameter of particle larger than 95% of observed substrate*

[2] *= diameter of largest particle showing evidence of bed load movement*

Table 7.2-22. Categorical Habitat Characteristics of Stream Sites in the Wildfire Creek Watershed

Variable	Percent of Sites							
	Wildfire Creek Reach 1 (*n* = 2)	Wildfire Creek Reach 2 (*n* = 1)	Wildfire Creek Reach 3 (*n* = 2)	Wildfire Creek Reach 4 (*n* = 2)	Stream 508 (*n* = 1)	Stream 509 (*n* = 1)	Stream 510 (*n* = 1)	Stream 513 (*n* = 1)
Total Cover								
Abundant	0	0	0	50	100	0	0	100
Moderate	0	0	100	50	0	0	100	0
Trace	100	100	0	0	0	100	0	0
Canopy Cover								
0%	0	100	0	100	0	100	0	0
1-20%	100	0	0	0	0	0	100	100
21-40%	0	0	100	0	100	0	0	0
40-70%	0	0	0	0	0	0	0	0
>90%	0	0	0	0	0	0	0	0
Instream Cover Sources								
Small Woody Debris								
Dominant	0	0	0	0	0	0	0	0
Subdominant	0	100	0	0	0	0	0	100
Trace	50	0	50	0	100	0	0	0
None	50	0	50	100	0	100	100	0
Large Woody Debris								
Dominant	0	0	0	0	100	0	0	100
Subdominant	0	0	0	0	0	0	0	0
Trace	100	0	0	50	0	0	100	0
None	0	100	100	50	0	100	0	0
Boulders								
Dominant	50	100	0	0	0	0	0	0
Subdominant	0	0	0	0	0	0	0	100
Trace	0	0	50	0	0	100	100	0
None	50	0	50	100	100	0	0	0
Undercut Banks								
Dominant	0	0	0	0	0	0	0	0
Subdominant	0	0	0	0	100	0	0	0
Trace	50	0	100	50	0	100	100	0
None	50	100	0	50	0	0	0	100
Deep Pools								
Dominant	50	0	0	50	0	0	0	0
Subdominant	0	0	50	50	0	0	0	0
Trace	0	0	50	0	0	0	0	0
None	50	100	0	0	100	100	100	100
Overhanging Vegetation								
Dominant	0	0	100	0	0	100	100	0
Subdominant	100	0	0	50	0	0	0	0
Trace	0	100	0	0	100	0	0	100
None	0	0	0	50	0	0	0	0
Instream Vegetation								
Dominant	0	0	0	50	0	0	0	0
Subdominant	0	0	0	50	0	0	0	0
Trace	0	0	50	0	100	100	0	0
None	100	100	50	0	0	0	100	100

(continued)

Table 7.2-22. Categorical Habitat Characteristics of Stream Sites in the Wildfire Creek Watershed (completed)

	Percent of Sites							
Variable	Wildfire Creek Reach 1 (*n* = 2)	Wildfire Creek Reach 2 (*n* = 1)	Wildfire Creek Reach 3 (*n* = 2)	Wildfire Creek Reach 4 (*n* = 2)	Stream 508 (*n* = 1)	Stream 509 (*n* = 1)	Stream 510 (*n* = 1)	Stream 513 (*n* = 1)
Large Woody Debris								
Abundance								
Abundant	0	0	0	0	100	0	0	0
Few	50	0	50	100	0	0	100	100
None	50	100	50	0	0	100	0	0
Distribution								
Clumped	50	0	0	0	100	0	0	0
Evenly Distributed	0	0	50	100	0	0	100	100
None	50	100	50	0	0	100	0	0
Substrate								
Dominant								
Boulder	0	100	0	0	0	0	0	100
Cobble	50	0	50	0	0	100	100	0
Fines	0	0	0	100	0	0	0	0
Gravel	50	0	50	0	100	0	0	0
Bedrock	0	0	0	0	0	0	0	0
Subdominant								
Boulder	50	0	50	0	0	0	0	0
Cobble	0	100	0	0	100	0	0	100
Fines	50	0	50	0	0	0	0	0
Gravel	0	0	0	100	0	100	100	0
Bedrock	0	0	0	0	0	0	0	0
Morphology								
Class								
Cascade-Pool	0	0	0	0	0	0	0	0
Large Channel	0	0	0	50	0	0	0	0
Riffle-Pool	100	100	100	50	100	100	100	0
Step-Pool	0	0	0	0	0	0	0	100
Pattern								
Irregular Meandering	0	0	0	50	0	100	0	0
Irregular	50	0	50	0	0	0	0	100
Meandering	0	0	0	50	0	0	0	0
Sinuous	50	100	50	0	100	0	100	0
Straight	0	0	0	0	0	0	0	0
Tortuous Meandering	0	0	0	0	0	0	0	0
Coupling								
Coupled	0	100	0	0	0	0	0	0
Decoupled	50	0	100	100	100	100	100	100
Partially Coupled	50	0	0	0	0	0	0	0
Confinement								
Confined	0	0	50	0	0	0	0	100
Entrenched	0	100	0	0	0	0	0	0
Frequently Confined	50	0	0	0	0	0	0	0
Occasionally Confined	0	0	50	0	0	0	100	0
Unconfined	50	0	0	100	100	100	0	0

n = number of sites

Table 7.2-23. Habitat Characteristics of Streams Sites from Detailed Habitat Surveys in the Wildfire Creek Watershed Grouping

		Wildfire Creek																			
		Reach 1					Reach 2					Reach 3					Reach 4				
Characteristic	Units	N	Min	Mean	SE	Max	N	Min	Mean	SE	Max	N	Min	Mean	SE	Max	N	Min	Mean	SE	Max
Length surveyed	m			200					110					63					278		
Wetted area surveyed	m^2			3,332					950					504					1,025		
Habitat units	#			6					4					2					5		
Bankfull width	m	6	8.0	18.2	6.8	45.0	4	15.0	16.8	0.8	18.0	2	8.0	8.0	0.0	8.0	5	2.5	4.0	0.4	5.0
Bankfull depth	m	4	0.8	1.2	0.3	2.0	4	1.0	1.2	0.1	1.5	2	1.0	1.3	0.3	1.5	5	0.3	0.9	0.2	1.7
Wetted width	m	6	0.3	9.6	4.4	30.0	4	4.5	8.1	1.3	10.0	2	8.0	8.0	0.0	8.0	5	2.5	4.1	0.4	5.0
Wetted depth	m	4	0.2	0.5	0.2	1.0	4	0.4	0.5	0.0	0.6	2	1.0	1.3	0.3	1.5	5	0.3	0.9	0.2	1.7
Bank height	m	6	0.1	0.8	0.3	2.0	3	0.5	0.5	0.0	0.5	2	0.0	0.0	0.0	0.0	5	0.0	0.0	0.0	0.0
Substrate																					
Sand	%	6	5	23	8	60	4	5	31	23	100	1	60	60	-	60	5	90	98	2	100
Gravel	%	6	15	31	5	40	4	0	9	3	15	1	20	20	-	20	5	0	2	2	10
Cobble	%	6	0	24	7	45	4	0	24	8	35	1	20	20	-	20	5	0	0	0	0
Boulder	%	6	0	23	4	60	4	0	31	4	50	1	0	0	-	0	5	0	0	0	0
Rock	%	6	0	0	0	0	4	0	5	3	10	1	0	0	-	0	5	0	0	0	0
Cover																					
Pool	%	6	0	42	19	100	4	0	38	23	90	2	25	63	38	100	5	0	0	0	0
Boulder	%	6	0	23	14	90	4	0	58	23	100	2	0	0	0	0	5	0	0	0	0
Small woody debris	%	6	0	0	0	0	4	0	3	3	10	2	0	0	0	0	5	40	68	10	90
Large woody debris	%	6	0	4	3	15	4	0	0	0	0	2	0	37	37	73	5	10	28	7	50
Instream veg.	%	6	0	3	2	15	4	0	3	3	10	2	0	0	0	0	5	0	2	2	10
Overhead veg.	%	6	0	23	11	60	4	0	0	0	0	2	0	1	1	2	5	0	2	2	10
Undercut banks	%	6	0	5	3	20	4	0	0	0	0	2	0	0	0	0	5	0	0	0	0
Habitat type																					
Glide	%	6		0			4		25			2		0			5		60		
Other	%	6		0			4		0			2		50			5		0		
Pool	%	6		0			4		25			2		50			5		0		
Riffle	%	6		100			4		50			2		0			5		40		

Min = minumum value

Max = maximum value

SE = standard error of the mean

N = number of observations

- = not available

veg. = vegetation

Stream 508 is a tributary discharging south from a small wetland into Reach 2 of Wildfire Creek. It is a low gradient stream with riffle-pool morphology. The substrate is primarily gravel and cobble. The stream contains abundant cover, including abundant woody debris and undercut banks.

Stream 509 drains several small ponds and wetlands and flows south into Reach 2 of Wildfire Creek. It is of moderate gradient and relatively deep. The surrounding riparian area is dominated by small shrubs and grasses.

Stream 510 is located in an alpine area north of Reach 2 of Wildfire Creek. It drains several small wetlands. It contains riffle and glide habitat but no pools.

Stream 513 is located approximately 500 m east of Stream 510 in similar alpine habitat. Like Stream 510, it drains several small wetlands south into Reach 2 of Wildfire Creek. Stream 513 exhibits step-pool morphology, with a number of small steps and cascades in between abundant pools. Small and large woody debris provided additional instream cover.

7.2.3 Lakes

7.2.3.1 Bowser Lake

Bowser Lake is a large (3,455 ha surface area), deep lake (152 m maximum depth) located in the Bowser River watershed. The upper reaches of Bowser River discharge into Bowser Lake. The lower reaches of Bowser River, below Bowser Lake, discharge into the Bell-Irving River. When surveyed, the water within the lake was highly turbid due to glacial silt, restricting visibility to approximately 5 cm.

Habitat assessments in Bowser Lake were restricted to the west end of the lake which would receive water from upstream tributaries and is closest to potential project infrastructure.

While the majority of the lake is bounded by steep bedrock shorelines and occasional small gravel beaches, the western end is characterized by a large alluvial fan created by the Bowser River (Figure 7.2-9). The shoreline in this section is comprised of gradually sloping sandbars and mud flats vegetated with sparse grass and shrubs (Plate 7.2-8). The Bowser River is heavily braided at its outlet, creating numerous small inflows to the lake. Groundwater seepage channels provide additional fish habitat along the shoreline. Gravel and fines are the primary substrates in these channels. There is trace amounts of woody debris or other sources of habitat cover along the shoreline, but woody debris provides cover in the inlets and channels.

The alluvial fan, which forms a delta, provides the only substantial littoral zone in the western half of Bowser Lake. Alluvial deposits have created a shallow (< 2 m deep) shelf that stretches approximately 30 m out from the shoreline. Beyond this shelf, the lake depth rapidly increases. The maximum depth of this portion of the lake could not be determined because high turbidity interfered with the depth sounder.

Lake habitat survey data can be found in Appendices 7.2-4 and 7.2-5.

7.2.3.2 Brucejack Lake

Brucejack Lake is located at high elevation (masl = 1,370 m) in the headwaters of Sulphurets Creek and is non-fish bearing above the barrier described in Section 7.1-3. The single outlet for the lake discharges west and passes beneath Sulphurets Glacier before entering Sulphurets Creek. The lake is fed entirely by run-off from the surrounding glaciers and hill-slopes, entering the lake via four permanent inlets and many small ephemeral inlets. As a result of its glacial and snow-melt origins, the lake water is cold. Brucejack Lake is deep with a maximum depth greater than 80 m. The lake is surrounded by an alpine landscape, with no large vegetation to provide woody debris and no aquatic or overhanging vegetation to provide fish cover (Plate 7.2-9). The shoreline is comprised of steep bedrock and boulder slopes with avalanche slope beaches that are primarily gravel and sand (Figure 7.2-10).

Plate 7.2-8. Sandbars on the delta near the outlets of upper Bowser River and Scott Creek into Bowser Lake.

Plate 7.2-9. Steep rock shoreline and gravel beaches at Brucejack Lake.

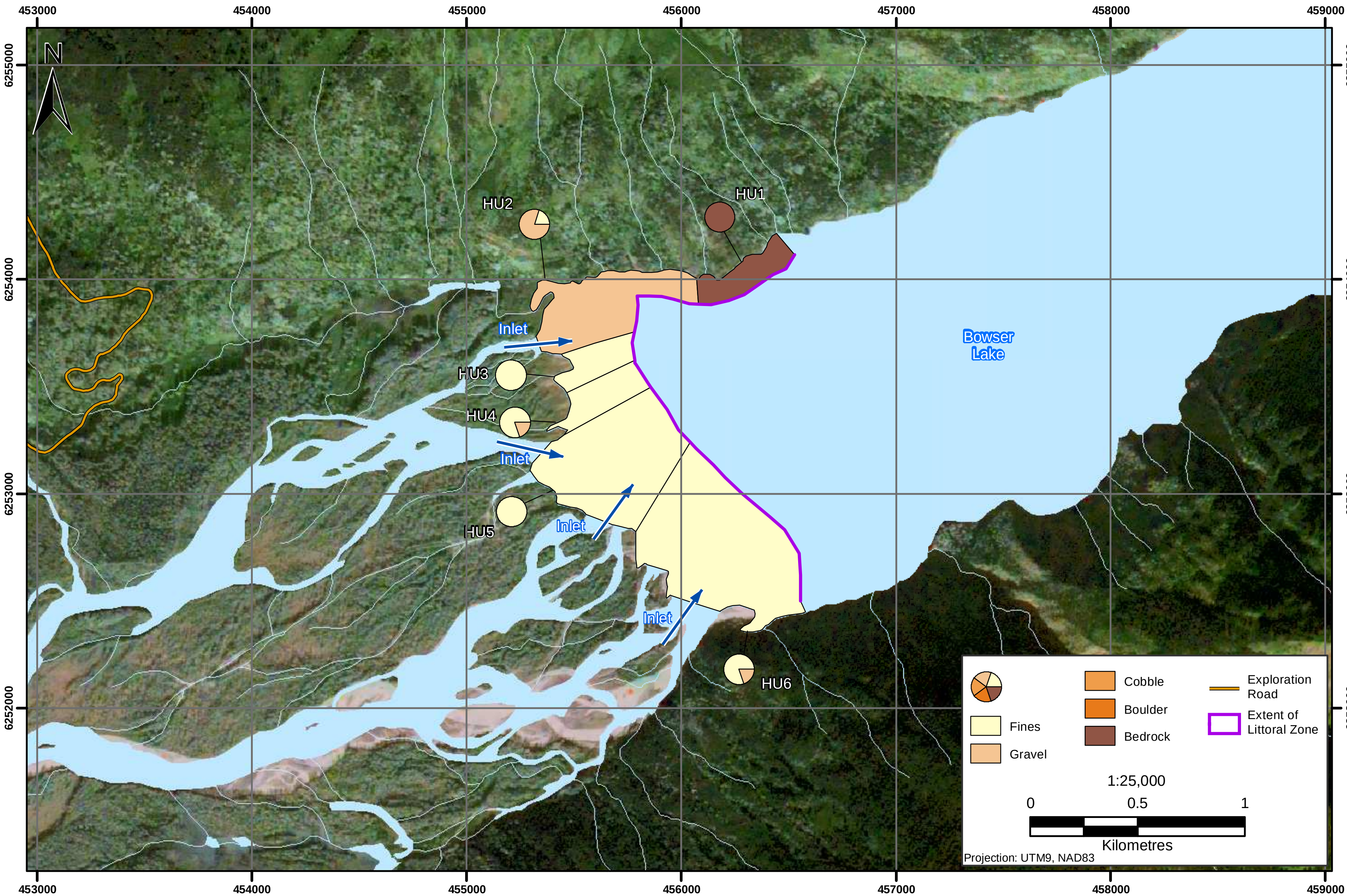

Figure 7.2-9

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Habitat Units in Bowser Lake

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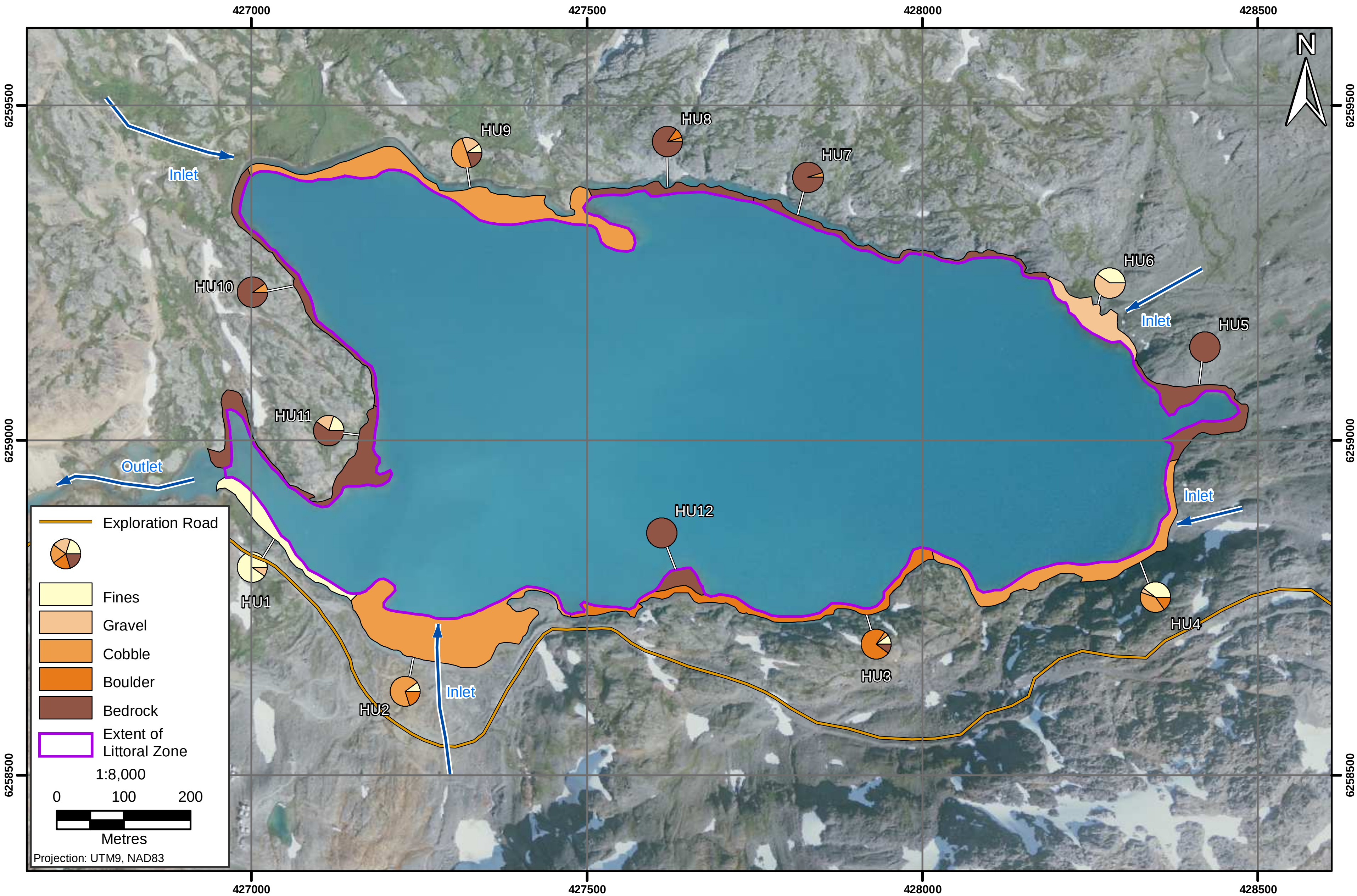

Figure 7.2-10

PRETIVM

Habitat Units in Brucejack Lake

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7.2.3.3 Todedada Lake

Todedada Lake is a headwater lake located in the Todedada Creek watershed at an elevation of 681 masl (Figure 7.2-11). It is a small (23.5 ha surface area), clear lake with a maximum depth of approximately 17 m. Eight inlets were identified, three permanent, and five ephemeral. The lake has a single outlet. Most of the inlets are steep and therefore unlikely to provide habitat for fish. The primary inlet, located on an avalanche chute on the west side of the lake, is an exception and may be used by fish as spawning habitat. The shorelines are also steep with substrates dominated by fines and cobbles. Most spawning activity likely takes place in the lake outlet. The shoreline vegetation is primarily coniferous trees and shrub understory.

The littoral zone in Todedada Lake is narrow, in many places extending less than 5 m from the shore. Large woody debris and submerged vegetation are abundant in the littoral zone, providing extensive cover for fish (Plate 7.2-10).

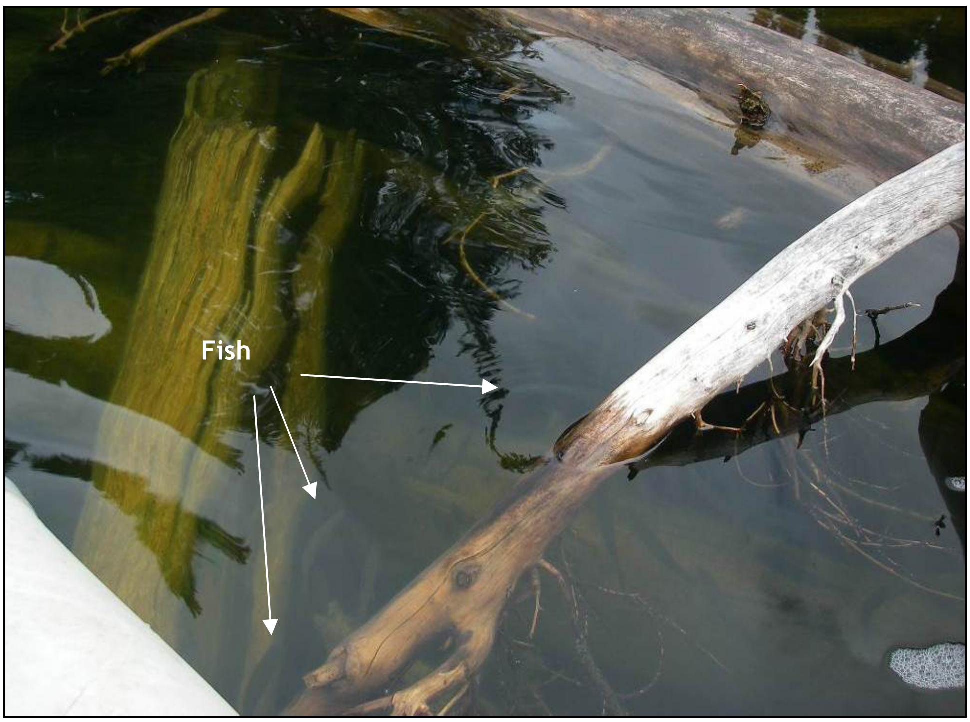

Plate 7.2-10. Fish sheltering in large woody debris along the Todedada Lake shoreline.

7.2.3.4 Unnamed Lake 1

Unnamed Lake is a small lake (16.6 ha) discharging north into the largest Wildfire Creek tributary (Figure 7.2-12). It is located on a plateau to the west of Bell-Irving River, on relatively flat terrain at an elevation of 675 masl. It is approximately five meters deep, with a narrow littoral zone composed of fines and organic substrate. A small gravel and sandbar at the northwest inlet is the only area where non-organic substrates comprise a noticeable portion of the substrate. The location of the bar—directly in front of a small inlet which was stagnant even during a flood event—suggests that at one time higher flows at the inlet may have created an alluvial fan in the lake. Salmonid spawning habitat requires gravel substrate, and no habitat appropriate for spawning was observed in the lake, its inlets, or its outlets. Cover is abundant in Unnamed Lake 1 in the form of aquatic vegetation and LWD along the lake edges (Plate 7.2-11). Large aquatic invertebrates are numerous in the lake and can be seen throughout the lake.

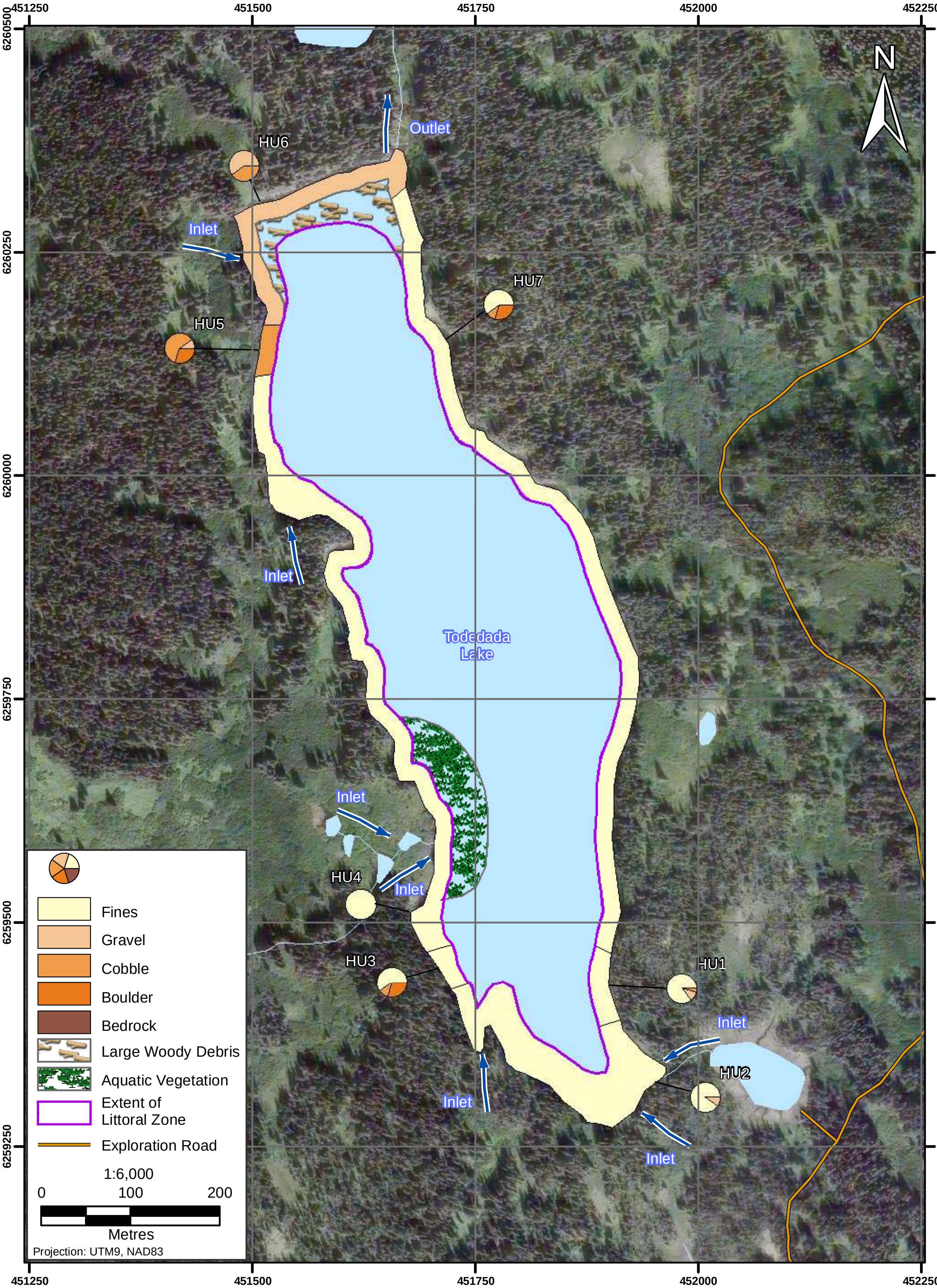

Figure 7.2-11

Habitat Units in Todedada Lake

PRETIVM

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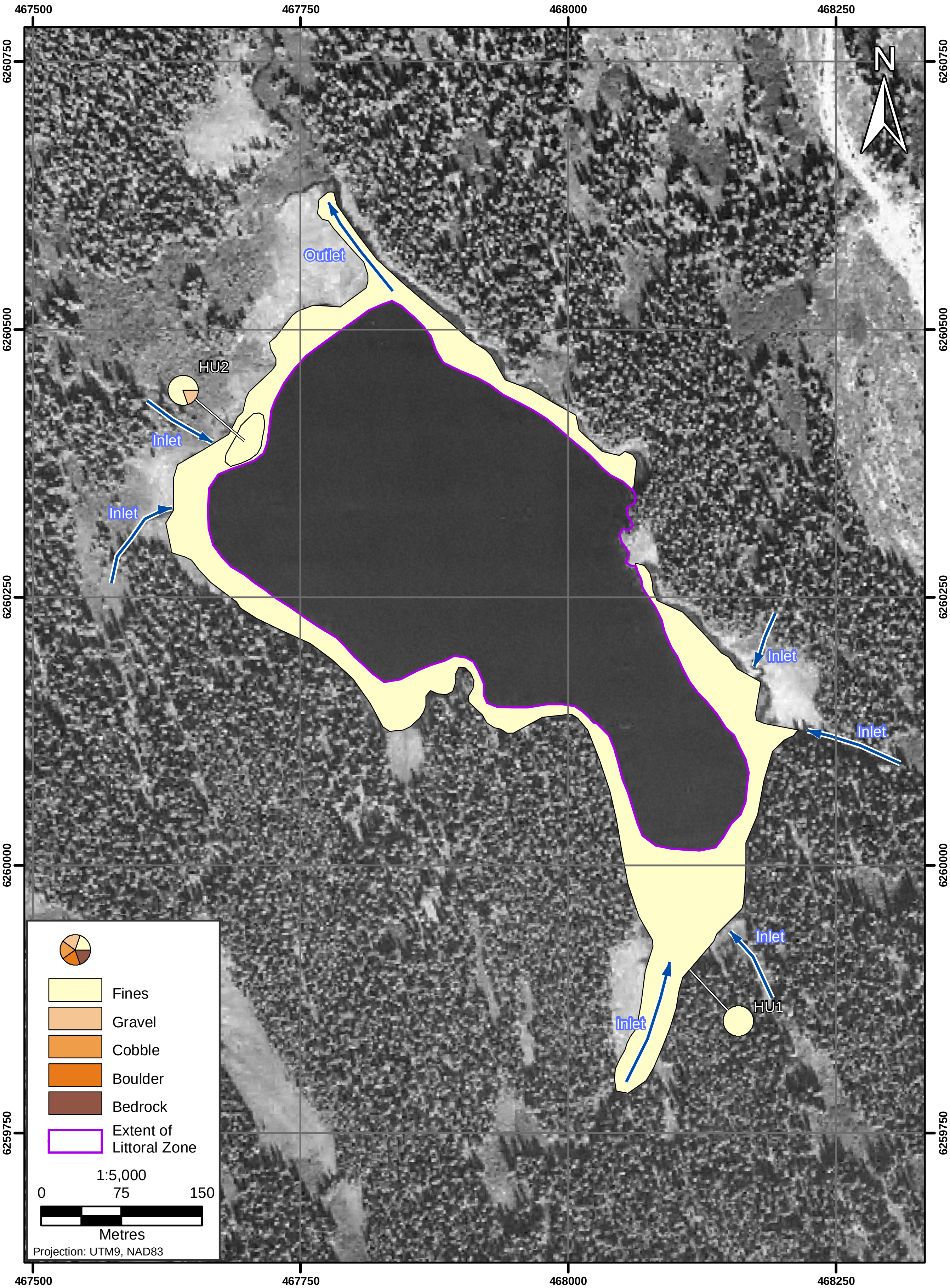

Figure 7.2-12

PRETIVM

Habitat Units in Unnamed Lake 1

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Plate 7.2-11. Aquatic vegetation in Unnamed Lake 1.

7.2.3.5 Unnamed Lake 2

Unnamed Lake 2 has a surface area of 20.8 ha, and is located on the same plateau as Unnamed Lake 1 near the watershed divide between the Wildfire Creek watershed and the Bell-Irving River watershed (Figure 7.2-13). As with Unnamed Lake 1, the substrate of Unnamed Lake 2 is primarily organic fines. There is a shallow bar mid-lake in which the fines are mixed with small boulders. This bar marks the transition between the shallow north-east arm of the lake from the deeper south and west portions. The north-east arm of the lake is extensively populated by aquatic vegetation. The remainder of the littoral zone contains abundant LWD and aquatic vegetation (Plate 7.2-12).

Plate 7.2-12. Aquatic vegetation and woody debris at Unnamed Lake 2.

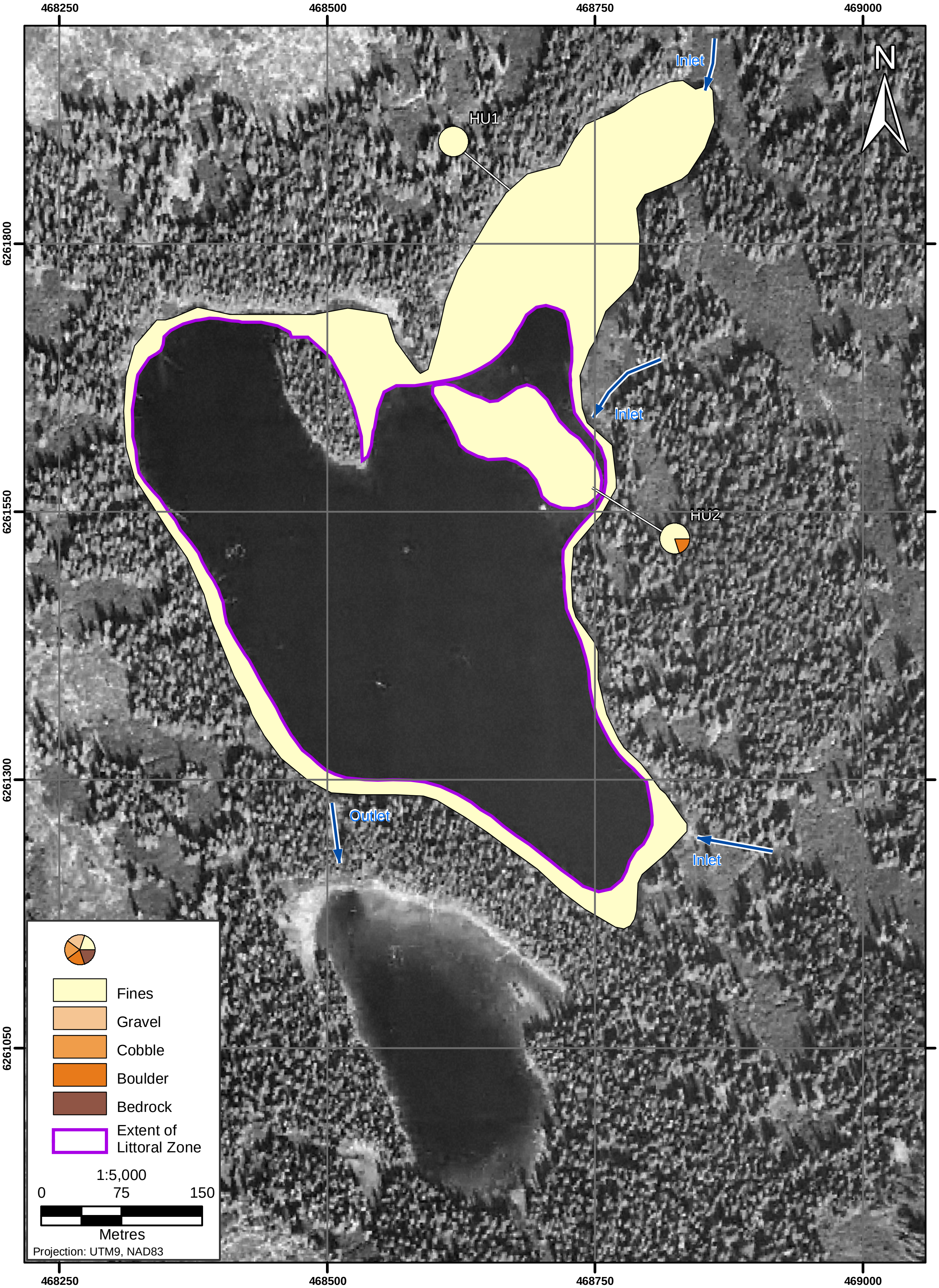

Figure 7.2-13

Habitat Units in Unnamed Lake 2

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Three inlets were identified in Unnamed Lake 2, but all were small with low discharge at the time of the survey, which took place during a flood event. A single outlet discharges Unnamed Lake 2 into a wetland to the south. The area surrounding Unnamed Lake 2 has been extensively logged, although the logging has not extended to the water's edge.

7.2.3.6 Unnamed Lake 3

Unnamed Lake 3 is a small headwater lake on a tributary of the Bowser River with 20.1 ha of surface area (Figure 7.2-14). The maximum depth recorded in this lake was 16.5 m. Unnamed Lake 3 has three permanent inlets and a single outlet. Steep, rocky walls characterize the north and south shorelines, and in these sections there is no littoral zone (Plate 7.2-13). The shoreline at the east and west ends of the lake, near the primary inlets and outlet, is shallow and sloping and may provide good habitat for spawning and rearing fish. Shoreline vegetation is a mixture of young deciduous forest and mature coniferous forest. There is evidence of a forest fire along the south side of the lake.

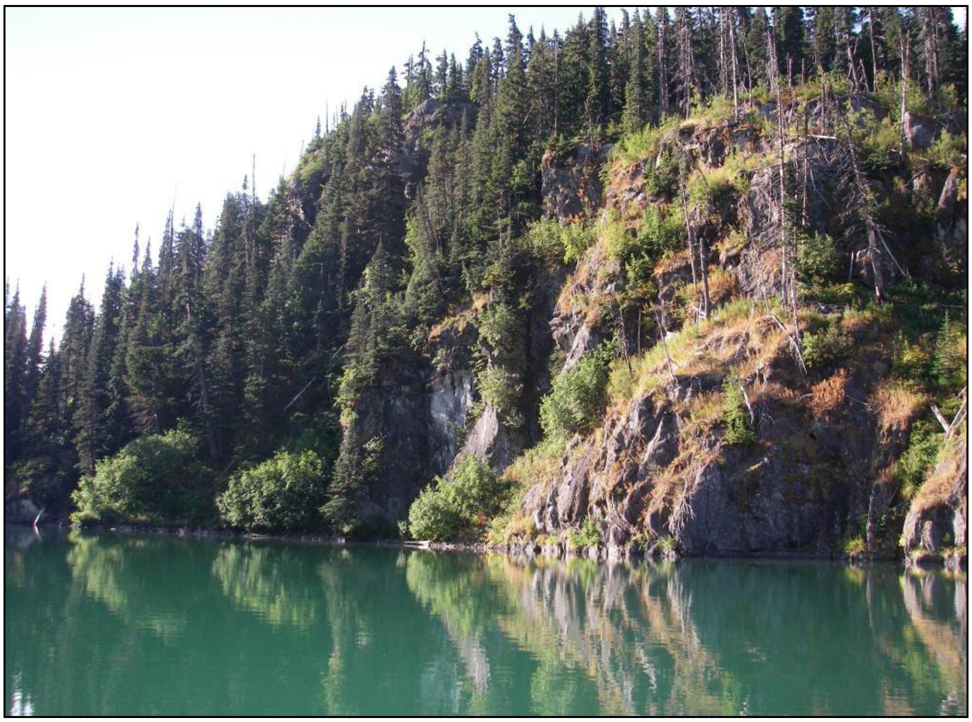

Plate 7.2-13. Steep, rocky walls at Unnamed Lake 3.

Unnamed Lake 3 is strongly coupled to the surrounding hillside. There are several active avalanche chutes on the north side of the lake and abundant large woody debris that had been swept into the lake from the surrounding forest. Beavers were active in the area during the habitat survey, as shown by several large lodges on the east end of the lake.

7.2.3.7 Unnamed Lake 4

Unnamed Lake 4 is located upstream of Unnamed Lake 1 (Figure 7.2-15). It is small (< 10 ha), shallow (approximately 4 m maximum depth), and covered with emergent vegetation. LWD is abundant through much of the lake. The substrate is dominated by fine sediments with small amounts of boulder and cobble substrate.

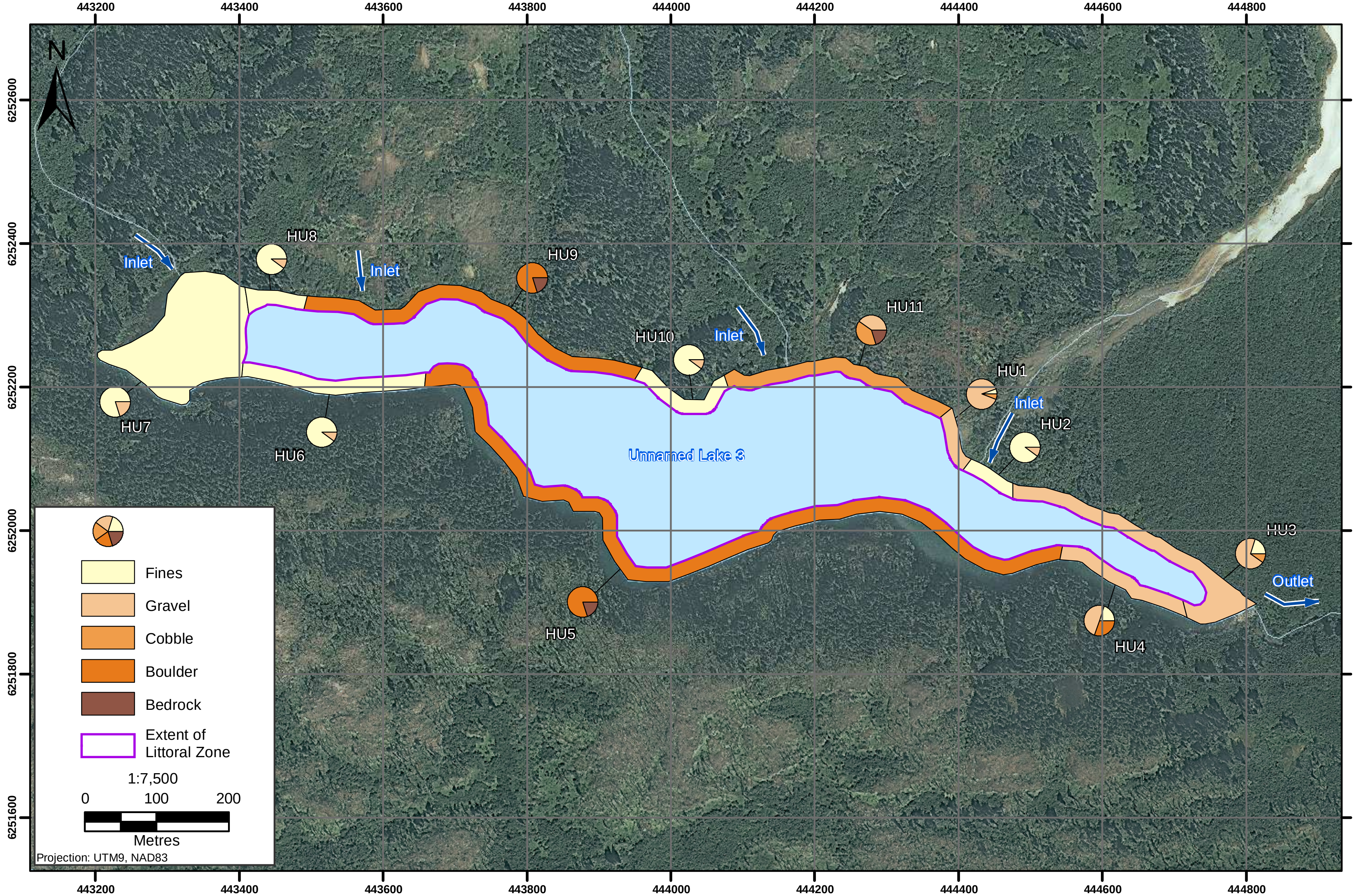

Figure 7.2-14

PRETIVM

Habitat Units in Unnamed Lake 3

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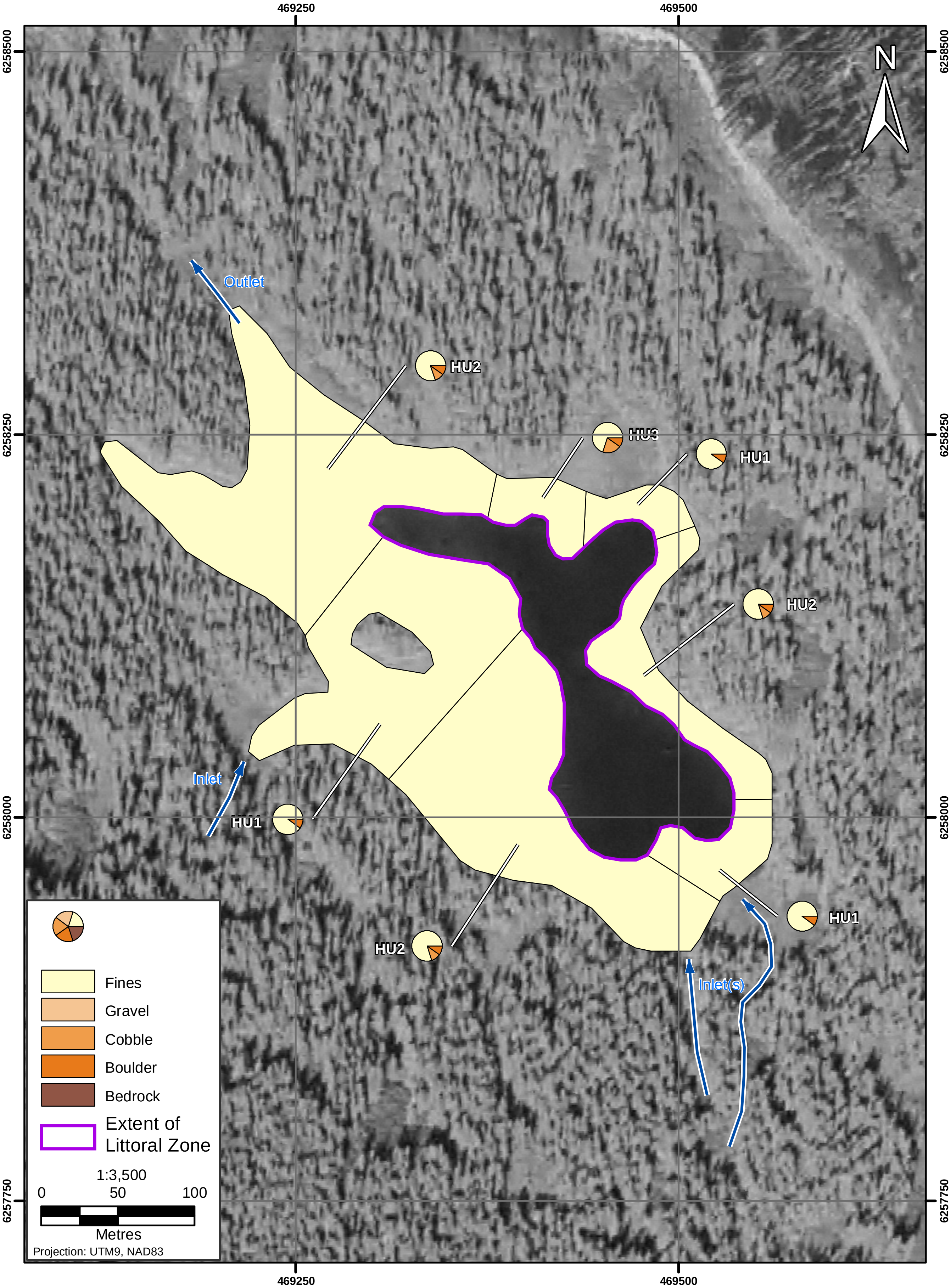

Figure 7.2-15

PRETIVM

Habitat Units in Unnamed Lake 4

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Three small inlets are located to the south and west of the lake (Plate 7.2-14). The lake drains to the north-west through two outflows. The gradient of both inflows and outflows is low (< %1); and the fine organic sediment provides no spawning habitat for salmonids.

Plate 7.2-14. Unnamed Lake 4 inlet.

7.2.4 Wetlands

One wetland (WL1) was included in the baseline study. WL1 is a large wetland within the Todedada Creek watershed (Plate 7.2-15). Primary inputs to the wetland include runoff from surrounding hillsides and the outflow from Todedada Lake. Additional water is contributed by groundwater seepage and a tributary that discharges into the wetland from the east. The wetland consists of multiple channels and deep pools of open water. Appendix 7.2-6 shows the habitat data collected from wetland WL1.

Cover is abundant in the wetland. Deep pools, overhead vegetation, instream vegetation and large woody debris all provide cover and habitat for fish (Plate 7.2-16). The surrounding vegetation is primarily shrubs and willows, with some herbs and rushes. It provides excellent rearing and overwintering habitat with some sections suitable for spawning.

7.3 COMMUNITY

7.3.1 Genetic Identification of Dolly Varden and Bull Trout

Genetic analysis was used for species confirmation from a subset of Dolly Varden/bull trout captured in the study area (Table 7.3-1 and Figure 7.3-1). Appendix 7.3-1 presents the interpretive report of the genetic analysis. Five of the thirty tissue samples were too small to be analyzed for species confirmation.

Plate 7.2-15. Aerial view of WL1 wetland looking north.

Plate 7.2-16. Abundant instream cover in WL1.

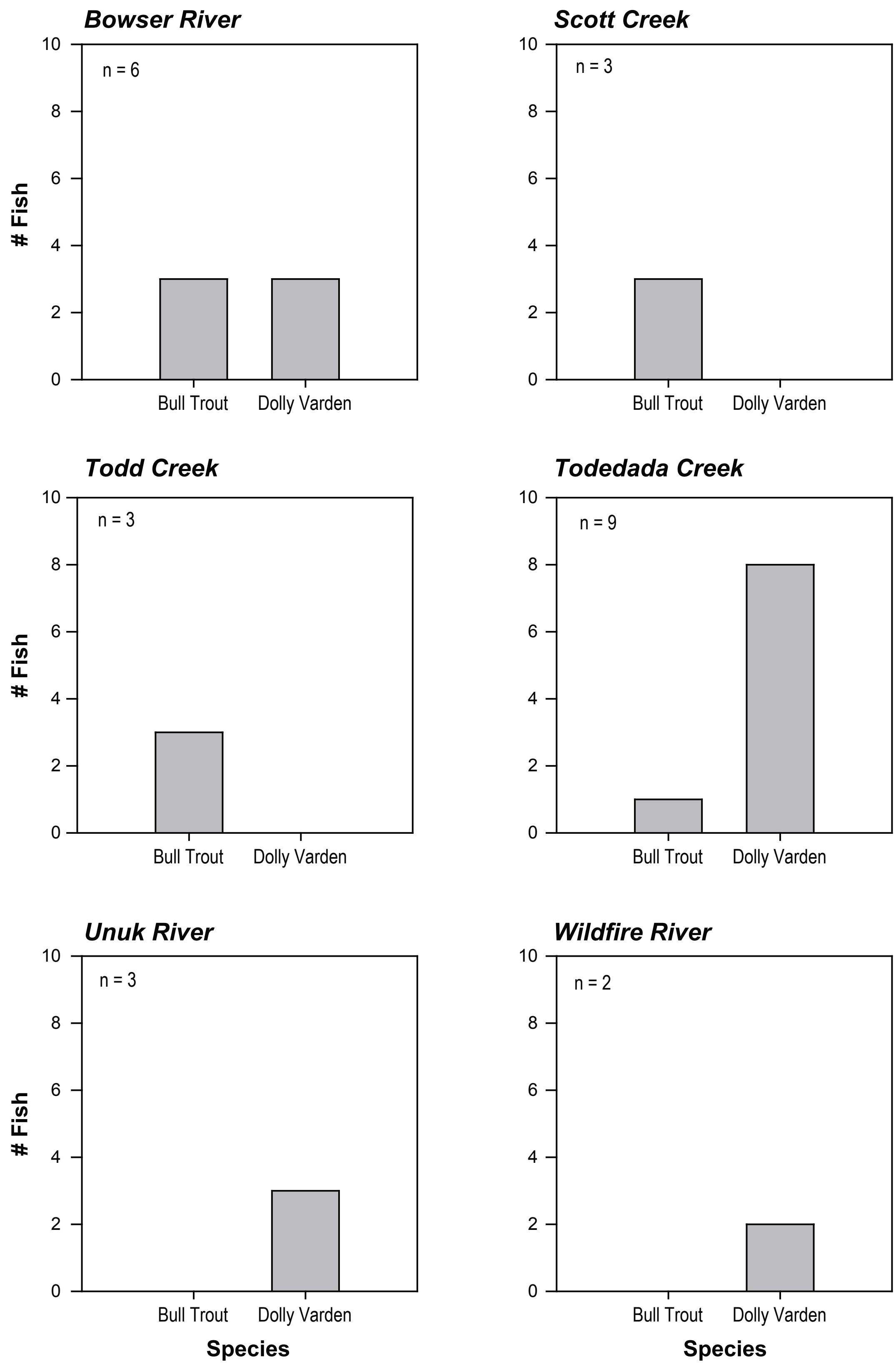


Figure 7.3-1

Species of Genetically-analyzed Fish from the Fish and Fish Habitat Study Area

Table 7.3-1. Genetic Analysis of Dolly Varden and Bull Trout Tissue Samples

Watershed	Site ID	Sample No.	Locus 1 (GH)[1]	Locus 2 (MTB)[2]	Species
Bowser River	100	23	555	675	BT
Bowser River	100	11	555	675	BT
Bowser River	100	12	633	527	DV
Bowser River	102	21	555	675	BT
Bowser River	501	5	633	527	DV
Bowser River	501	failed	NA	NA	NA
Bowser River	101	25	633	675	DV
Scott Creek	103	3	555	675	BT
Scott Creek	103	2	555	675	BT
Scott Creek	104	6	555	675	BT
Todd Creek	111	7	555	675	BT
Todd Creek	111	27	555	675	BT
Todedada Creek	107	20	633	527	DV
Todedada Creek	107	10	633	527	DV
Todedada Creek	108	15	633	527	DV
Todedada Creek	108	9	633	527	DV
Todedada Creek	110	14	555	675	BT
Todedada Creek	110	8	633	527	DV
Todedada Creek	503	failed	NA	NA	NA
Todedada Creek	108	17	633	527	DV
Todedada Creek	109	24	633	527	DV
Todedada Creek	WL1	4	633	527	DV
Unuk River	113	29	633	527	DV
Unuk River	113	failed	NA	NA	NA
Unuk River	513	failed	NA	NA	NA
Unuk River	513	failed	NA	NA	NA
Unuk River	113	30	633	675	DV
Unuk River	113	1	633	527	DV
Wildfire Creek	510	19	633	527	DV
Wildfire Creek	510	28	633	527	DV

[1] 555 base pairs indicates bull trout; 633 base pairs indicates Dolly Varden
[2] 675 base pairs indicates bull trout; 527 base pairs indicates Dolly Varden
NA = data not available
Failed = sample unable to be processed/read
BT = bull trout
DV = Dolly Varden

Both Dolly Varden and bull trout were found in the study area. Fish analyzed from Todd Creek and Scott Creek watersheds were all found to be bull trout, while all fish from the Unuk River watershed, all fish from the Wildfire Creek watershed, and most fish from the Todedada Creek watershed were found to be Dolly Varden. Dolly Varden and bull trout were found in the Bowser River watershed in equal proportions. There was no evidence of Dolly Varden/bull trout hybridization in any of the analyzed fish, although previously reported genetic analysis of in Scott Creek indicated the presence of hybrids (Rescan 2010).

Bull trout have not been previously reported in the Unuk River system (FISS 2012, Rescan 2010), and were not found in this study. Bull trout in British Columbia are generally found in interior drainages east of the Coast Mountains (McPhail and Baxter 1996; McPhail 2007). Although there are exceptions to this rule, such exceptions tend to be large drainage systems with headwaters east of the Coast Mountains. The Unuk River drainage is entirely coastal and is not generally considered to be part of the range of bull trout (McPhail 2007). Given the findings of the genetic analysis and the lack of historical evidence of their presence, all char in the Unuk River system are likely to be Dolly Varden.

As both species are demonstratively present in the Bell-Irving system, individuals which were not identifiable to the species level will be considered unknown and as such, Dolly Varden and bull trout will be grouped for all further analyses and will be referred to as Dolly Varden/bull trout.

7.3.2 Streams

Of the 36 reaches sampled between 2010 and 2012, fish were captured in 20, confirming their fish-bearing status: two in the Bell-Irving River watershed, five in the Bowser River watershed, one in the Scott Creek watershed, one in the Todd Creek watershed, six in the Todedada Creek watershed, four in the Unuk River watershed, and one in the Wildfire Creek watershed. Dolly Varden, bull trout, rainbow trout, mountain whitefish, chinook salmon, coho salmon, and sockeye salmon were captured in the study area. Dolly Varden/bull trout were the only species caught in all of the watersheds sampled (Table 7.3-2). Stream sampling effort and catch data are reported in Appendix 7.3-2.

Table 7.3-2. Fish Species Present in the Fish and Fish Habitat Study Area Watersheds

Species	Scientific names	Bell-Irving River	Bowser River	Scott Creek	Todd Creek	Todedada Creek	Unuk River	Wildfire Creek
Dolly Varden/ Bull Trout	*Salvelinus malma/ S. confluentus*	X	X	X	X	X	X	X
Rainbow Trout/Steelhead	*Oncorhynchus mykiss*	X	X	-	-	X	-[2]	X
Coho Salmon	*Oncorhynchus kisutch*	X	X[1]	-	-	X[1]	X	-
Chinook Salmon	*Oncorhynchus tshawytscha*	X	-[2]	-	-	-	X	X
Sockeye Salmon	*Oncorhynchus nerka*	-[2]	X	-	-	X[1]	-[2]	-
Mountain Whitefish	*Prosopium williamsoni*	-[2]	X	-[2]	-	X	-	-[2]
Chum salmon	*Oncorhynchus keta*	-	-	-	-	-	-[2]	-
Pink salmon	*Oncorhynchus gorbuscha*	-	-	-	-	-	-[2]	-
Cutthroat trout	*Oncorhynchus clarkii*	-	-	-	-	-	-[2]	-

[1] species presence confirmed during spawning surveys only
[2] not captured, presence indicated by historical data
- = not captured
** Steelhead have been documented historically in the region. As juvenile steelhead are indistinguishable from juvenile rainbow trout morphologically and genetically, identification is not possible.*

The study area contains a variety of habitat types, which is necessary for an area to provide habitat for multiple species and life stages. Table 7.3-3 shows a periodicity table indicates the life stages and the timing of types of habitat use for species in the study area.

The electrofishing CPUE in the region were generally low in all watersheds. In most cases, 2 or fewer fish were captured per 100 seconds of effort. Table 7.3-4 presents a summary of the CPUE in the sampled watersheds. Non-fish bearing reaches were not included in the CPUE summary to create a more accurate calculation of species specific relative abundance.

Table 7.3-3. Fish Life History Periodicity Table for Species Identified within Fish and Fish Habitat Study Area

Species	Life Stage	Month											
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Bull Trout	Spawning												
	Fry Rearing												
	Parr Overwintering												
	Adult Migration												
Chinook Salmon	Spawning												
	Fry Rearing												
	Parr Overwintering												
	Adult Migration												
Coho Salmon	Spawning												
	Fry Rearing												
	Parr Overwintering												
	Adult Migration												
Dolly Varden	Spawning												
	Fry Rearing												
	Parr Overwintering												
	Adult Migration												
Mountain Whitefish	Spawning												
	Fry Rearing												
	Parr Overwintering												
	Adult Migration												
Rainbow Trout	Spawning												
	Fry Rearing												
	Parr Overwintering												
	Adult Migration												
Sockeye Salmon	Spawning												
	Fry Rearing												
	Parr Overwintering												
	Adult Migration												

Note: periodicity based on observations from the study area and historical information from other watersheds in the region

Table 7.3-4. Single Pass Electrofishing Standard and Bootstrap CPUE Summary Statistics, Fish-bearing Stream Sites in the Fish and Fish Habitat Study Area

			Standard CPUE (fish/100 s)							Bootstrapped CPUE (fish/100 s)				
Watershed	**Species**	**Year**	**n**	**Mean**	**SD**	**SE**	**Median**	**Lower CI**	**Upper CI**	**Mean**	**SD**	**Median**	**Lower CI**	**Upper CI**
Bell-Irving River	Chinook	2011	2	0.14	0.20	0.14	0.14	0.01	0.28	0.14	0.10	0.14	0.00	0.28
	Dolly Varden/Bull Trout	2011	2	0.14	0.20	0.14	0.14	0.01	0.28	0.14	0.10	0.14	0.00	0.28
		2012	1	0.57	NA	NA	0.57	0.57	0.57	NA	NA	NA	NA	NA
	Rainbow Trout	2011	2	1.28	1.81	1.28	1.28	0.06	2.50	1.29	0.91	1.28	0.00	2.56
		2012	1	3.14	NA	NA	NA	3.14	3.14	NA	NA	NA	NA	NA
Bowser River	Coho	2010	11	0.05	0.17	0.05	0.00	0.00	0.43	0.05	0.05	0.05	0.00	0.15
	Dolly Varden/Bull Trout	2010	11	0.65	0.92	0.28	0.41	0.00	2.70	0.65	0.26	0.63	0.23	1.23
	Mountain Whitefish	2010	11	1.08	1.94	0.58	0.27	0.00	5.10	1.09	0.56	1.06	0.15	2.35
	Rainbow Trout	2010	11	0.06	0.13	0.04	0.00	0.00	0.36	0.06	0.04	0.06	0.00	0.14
	Sockeye	2010	11	0.22	0.39	0.12	0.00	0.00	1.07	0.22	0.11	0.21	0.05	0.47
Scott Creek	Dolly Varden/Bull Trout	2010	2	1.01	0.45	0.32	1.01	0.70	1.31	1.01	0.23	1.01	0.69	1.33
Todd Creek	Dolly Varden/Bull Trout	2010	2	0.38	0.54	0.38	0.38	0.02	0.75	0.38	0.27	0.38	0.00	0.77
Todedada Creek	Dolly Varden/Bull Trout	2010	8	1.19	0.93	0.33	1.18	0.06	2.56	1.19	0.30	1.18	0.61	1.79
	Mountain Whitefish	2010	9	0.03	0.08	0.03	0.00	0.00	0.19	0.03	0.03	0.03	0.00	0.08
	Rainbow Trout	2010	8	0.15	0.22	0.08	0.00	0.00	0.51	0.15	0.07	0.14	0.00	0.30
Unuk River	Chinook	2010	4	0.07	0.17	0.07	0.00	0.00	0.37	0.07	0.06	0.07	0.00	0.21
	Coho	2010	4	0.96	1.58	0.64	0.23	0.00	3.67	0.95	0.59	0.88	0.08	2.22
	Dolly Varden/Bull Trout	2010	4	1.98	1.64	0.82	1.74	0.36	4.02	1.98	0.72	1.98	0.70	3.51
		2011	2	1.61	2.04	1.44	1.61	0.24	2.98	1.62	1.03	1.61	0.17	3.05
Wildfire Creek	Chinook	2011	1	1.13	NA	NA	1.13	1.13	1.13	NA	NA	NA	NA	NA
	Dolly Varden/Bull Trout	2010	1	0.12	NA	NA	0.12	0.12	0.12	NA	NA	NA	NA	NA
		2011	1	1.89	NA	NA	1.89	1.89	1.89	NA	NA	NA	NA	NA
		2012	1	0.35	NA	NA	0.35	0.35	0.35	NA	NA	NA	NA	NA
	Rainbow Trout	2010	1	0.12	NA	NA	0.12	0.12	0.12	NA	NA	NA	NA	NA
		2011	1	1.89	NA	NA	1.89	1.89	1.89	NA	NA	NA	NA	NA
		2012	1	0.35	NA	NA	0.35	0.35	0.35	NA	NA	NA	NA	NA

CPUE = catch-per-unit-effort (fish/100 s)
n = sample size
SE = standard error of the mean
SD = standard deviation of the mean
CI - confidence interval (95%)
NA = not applicable

7.3.3 Lakes

Three of the seven sampled lakes were fish bearing (Table 7.3-5). No fish were captured Brucejack Lake or in the three lakes located in the Wildfire Creek watershed (Unnamed Lake 1, Unnamed Lake 2, and Unnamed Lake 4). Gillnetting and minnow trapping locations, effort, and catch data are provided in Appendix 7.3-3. Fewer fish species were captured in lakes than in streams. Todedada Lake and Unnamed Lake 3 had simple fish communities with only one or two fish species present. A total of four fish species were identified in Bowser Lake. Of the three confirmed fish-bearing lakes, only Dolly Varden/bull trout were captured in all three, with rainbow trout, mountain whitefish, sockeye salmon, and longnose sucker captured in only one of the lakes.

Table 7.3-5. Fish Species Presence in Lake Sites in the Fish and Fish Habitat Study Area

Species	Bowser	Brucejack	Todedada	UL 1	UL 2	UL 3	UL 4
Dolly Varden/Bull Trout	X	-	X	-	-	X	-
Rainbow Trout/Steelhead	-[1]	-	X	-	-	-	-
Mountain Whitefish	X	-	-	-	-	-	-
Sockeye Salmon	X	-	-	-	-	-	-
Longnose Sucker	X	-	-	-	-	-	-
Coho salmon	-[1]	-	-	-	-	-	-

UL = Unnamed Lake
- = not captured
[1] *not captured, presence indicated by historical data*

The diversity of species captured in minnow traps was low (Table 7.3-6). Dolly Varden/bull trout and longnose sucker were the only species captured in minnow traps. CPUE in minnow traps in fish-bearing lakes was lowest in Bowser Lake and highest in Unnamed Lake 3. Minnow trapping the shallows of Bowser Lake was unproductive. Young-of-the-year mountain whitefish were observed schooling in the shallows and inlets of the lake and juvenile sockeye salmon and Dolly Varden/bull trout and mountain whitefish were captured by electrofishing the lake inlets (Table 7.3-7).

Table 7.3-6. Minnow Trap Standard CPUE Summary Statistics, Fish-bearing Lake Sites in the Fish and Fish Habitat Study Area

			Standard CPUE (fish/trap/24 h)						
Lake	Species	Year	n	Mean	SD	SE	Median	Lower CI	Upper CI
Bowser Lake	Longnose Sucker	2010	18	0.08	0.14	0.05	0.01	0.00	0.36
Todedada Lake	Dolly Varden/Bull Trout	2010	20	0.18	0.48	0.11	0.00	0.00	1.40
Unnamed Lake 3	Dolly Varden/Bull Trout	2010	20	1.27	1.48	0.33	1.07	0.00	4.57

CPUE = catch-per-unit-effort (fish/trap/24 h)
n = sample size
SE = standard error of the mean
SD = standard deviation of the mean
CI - confidence interval (95%)

Gillnet catch rates for Dolly Varden/bull trout were high in Unnamed Lake 3 and Todedada Lake (Table 7.3-8) compared to Bowser Lake. In Bowser Lake, longnose sucker and sockeye salmon were captured more frequently than Dolly Varden/bull trout.

Gillnets set in Bowser Lake captured small kokanee salmon with nearly mature gonads (Plate 7.3-1). Kokanee salmon are a small, landlocked form of sockeye salmon and may spawn and rear in Bowser Lake.

Plate 7.3-1. Mature kokanee salmon captured in Bowser Lake.

Dolly Varden/bull trout captured in Todedada Lake and Unnamed Lake 3 appeared to be nearing spawning condition. Many had developed spawning colouration and their gonads had begun to mature (Plate 7.3-2). In both lakes areas of possible spawning were identified along the shoreline. Areas of disturbed gravel and coarse sand suggested possible spawning areas, although Dolly Varden/bull trout are not generally considered to be shoreline spawning species.

Plate 7.3-2. Dolly Varden/bull trout with spawning colours captured in Todedada Lake.

7.3.4 Wetlands

Rearing Dolly Varden/bull trout fry and parr were the only fish captured in WL1, although historical sampling in WL1 captured adult Dolly Varden/bull trout and coho fry and parr (Rescan 2010). WL1 is valuable rearing habitat; the CPUE for the electrofishing carried out there was higher than any sampled stream site (Table 7.3-9).

Table 7.3-7. Single Pass Electrofishing Standard and Bootstrap CPUE Summary Statistics, Lake Sites in the Fish and Fish Habitat Study Area

			Standard CPUE (fish/100 s)							Bootstrapped CPUE (fish/100 s)				
Lake	Species	Year	n	Mean	SD	SE	Median	Lower CI	Upper CI	Mean	SD	Median	Lower CI	Upper CI
Bowser Lake	Dolly Varden/Bull Trout	2010	4	0.20	0.25	0.12	0.16	0.00	0.49	0.20	0.11	0.20	0.00	0.41
Bowser Lake	Mountain Whitefish	2010	4	2.60	2.74	1.37	2.59	0.04	5.20	2.63	1.19	2.60	0.25	4.96
Bowser Lake	Sockeye	2010	4	0.49	0.58	0.29	0.31	0.02	1.25	0.49	0.25	0.49	0.08	1.07

CPUE = catch-per-unit-effort (fish/100 s)
n = sample size
SE = standard error of the mean
SD = standard deviation of the mean
CI - confidence interval (95%)

Table 7.3-8. Gillnet Standard and Bootstrapped CPUE Summary Statistics, Fish-Bearing Lake Sites in the Fish and Fish Habitat Study Area

			Standard CPUE (fish/100 m^2 of gillnet/h)							Bootstrapped CPUE (fish/100 m^2 of gillnet/h)				
Lake	Species	Year	n	Mean	SD	SE	Median	Lower CI	Upper CI	Mean	SD	Median	Lower CI	Upper CI
Bowser Lake	Dolly Varden	2010	8	0.50	0.97	0.34	0.00	0.00	2.35	0.50	0.32	0.50	0.00	1.17
	Longnose Sucker	2010	8	1.88	3.40	1.20	0.26	0.00	8.61	1.89	1.15	1.82	0.26	4.42
	Mountain Whitefish	2010	8	0.23	0.64	0.23	0.00	0.00	1.49	0.22	0.21	0.23	0.00	0.68
	Sockeye Salmon	2010	8	1.09	2.06	0.73	0.00	0.00	5.15	1.09	0.68	1.03	0.06	2.51
Todedada Lake	Dolly Varden	2010	8	2.72	4.58	1.62	0.30	0.00	11.00	2.72	1.51	2.64	0.15	6.00
	Rainbow Trout	2010	8	0.52	1.46	0.52	0.00	0.00	3.40	0.51	0.48	0.52	0.00	1.55
Unnamed Lake	Dolly Varden	2010	8	5.14	5.58	1.97	3.90	0.16	15.87	5.16	1.87	4.97	2.21	9.34

CPUE = catch-per-unit-effort (fish/100 m^2/h)
n = sample size
SE = standard error of the mean
SD = standard deviation of the mean
CI - confidence interval (95%)

Table 7.3-9. Single Pass Electrofishing Standard and Bootstrapped CPUE Summary Statistics, Wetland Sites in the Fish and Fish Habitat Study Area

			Standard CPUE (fish/100 s)							Bootstrapped CPUE (fish/100 s)				
Site	Species	Year	n	Mean	SD	SE	Median	Lower CI	Upper CI	Mean	SD	Median	Lower CI	Upper CI
WL-1	Dolly Varden/Bull Trout	2010	1	23.46	NA	NA	23.46	23.46	23.46	NA	NA	NA	NA	NA

CPUE = catch-per-unit-effort (fish/100 s)
n = sample size
SE = standard error of the mean
SD = standard deviation of the mean
CI - confidence interval (95%)
NA = not available

7.3.5 Spawning Surveys

Spawning surveys were conducted in the Bowser River, Todedada Creek, Scott Creek, and their immediate tributaries to locate spawning areas for coho and sockeye salmon. Spawning surveys were carried out on September 22 and 23, 2010, and from October 19 to 22, 2010, and were scheduled to coincide with the anticipated spawning periods of sockeye and coho salmon, respectively (RTEC 2005, Rescan 2010). Appendices 7.3-4 and 7.3-5 show the detailed results of the sockeye and coho salmon surveys, respectively.

Adult sockeye salmon were observed in a branch of Todedada Creek (Plate 7.3-3), in a small tributary of the Bowser River, and in two groundwater-fed channels near the outlets of the Bowser River and Scott Creek to Bowser Lake (Figure 7.3-2). They were observed engaging in courtship behaviour and holding over redds, indicating that the locations in which they were observed are spawning grounds.

Plate 7.3-3. Sockeye salmon spawning in a groundwater-fed inlet to Bowser Lake.

Approximately 46 spawning sockeye salmon were observed in the study area in September and October. Fifteen sockeye salmon were observed in Todedada Creek. Sixteen spawning sockeye salmon were observed in inlets to Bowser Lake (this assumes that the salmon observed in that location in September were the same individuals observed in October). Fifteen spawning sockeye salmon were observed in a tributary to the Bowser River.

Additional sockeye salmon spawning may occur along the shoreline of Bowser Lake. Sockeye salmon often spawn in the shallow littoral zones of lakes and the remains of sockeye salmon carcasses were found along the lake shore during the October coho spawning surveys. Although a few adult sockeye salmon were observed in the lake where clear water from inflows allowed for an aerial observation, the lake itself was too turbid to determine if sockeye salmon spawn along the shore or if the observed spawners were travelling further upstream.

PROJECT #0194150-0009 GIS # BJP-06-013 May 14, 2013

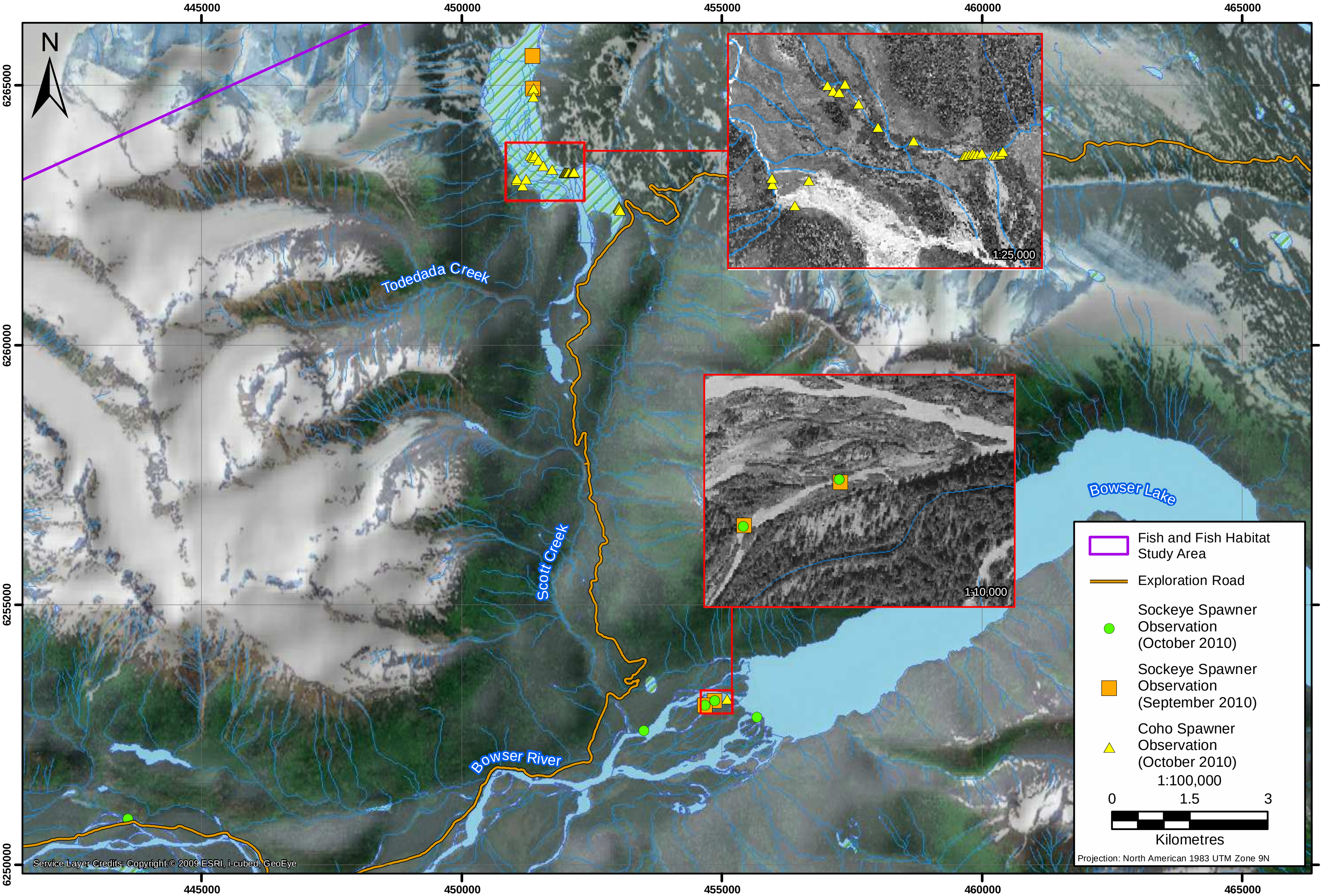


Figure 7.3-2

PRETIVM

Locations of Salmon Spawner Observations

Rescan Engineers & Scientists

Figure 7.3-2

Ninety nine coho salmon spawners and approximately twenty redds were found in a tributary to Todedada Creek near the wetland reach of the stream (Plate 7.3-4). Six coho spawners were also found in the mainstem of Todedada Creek nearby. The adult coho observed in the Todedada Creek watershed were displaying active spawning behaviour. Many were paired up and holding near redds. Only a single female coho was observed in the Bowser River system in a groundwater channel near the Scott Creek outlet to Bowser Lake.

Plate 7.3-4. Coho salmon spawning in Todedada Creek.

The sockeye salmon observed in September in the Bowser Lake watershed appeared to be in better condition than those in Todedada Creek. During the coho spawning survey, it was noted that sockeye salmon spawners were still present and in good condition in the Bowser Lake watershed while none were seen in the Todedada Creek watershed. The single coho salmon observed in the Bowser Lake watershed appeared to have very recently arrived at the site while those in Todedada Creek showed signs of a longer period of residence at the spawning grounds, such as the establishment of redds and damage to the tail and fins from spawning activity. These disparities suggest a difference in spawning timing in the two watersheds. Spawning in the Todedada Creek watershed may occur earlier than spawning in the Bowser Lake watershed for both species.

7.4 BIOLOGY

7.4.1 Streams

Biological data from captured fish is presented in Appendix 7.4-1. Summaries of fish length, weight, and condition are presented in Table 7.4-1.

Additional analyses of length, weight, and age were conducted where sample size permitted (Table 7.4-2). In many cases, only a small number of fish were captured in a given watershed in a given year, and additional analyses were not conducted or are presented with cautions regarding inference where sample sizes are small.

Table 7.4-1. Biological Summary Statistics for Fish Captured by Electrofishing at Stream Sites in the Brucejack Fish and Fish Habitat Study Area

			Fork Length (mm)							Weight (g)							Condition (K)						
Species	**Watershed**	**Year**	**n**	**Mean**	**SD**	**SE**	**Median**	**Lower CI**	**Upper CI**	**n**	**Mean**	**SD**	**SE**	**Median**	**Lower CI**	**Upper CI**	**n**	**Mean**	**SD**	**SE**	**Median**	**Lower CI**	**Upper CI**
Chinook salmon	Bell Irving	2011	1	67	NA	NA	67	67	67	1	4.5	NA	NA	4.5	4.5	4.5	1	1.50	NA	NA	1.50	1.50	1.50
	Unuk	2010	2	55	2.1	1.5	55	53	56	2	2.0	0.2	0.2	2.0	1.8	2.1	2	1.20	0.01	0.01	1.20	1.20	1.21
	Wildfire	2011	4	72	4.4	2.2	71	67	77	4	NA	NA	NA	NA	3.8	4.9	3	1.29	0.04	0.03	1.26	1.26	1.34
Coho salmon	Bell Irving	2012	3	53	5.8	3.3	56	47	56	3	2.4	0.6	0.3	2.2	1.9	3.0	3	1.80	1.11	0.64	1.26	1.07	2.99
	Bowser	2010	4	37	5.5	2.7	37	31	44	4	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	NA
	Unuk	2010	15	50	12.1	3.1	49	31	70	15	1.7	1.2	0.3	1.2	0.4	4.2	15	1.18	0.23	0.06	1.15	0.92	1.62
Dolly Varden/bull trout	Bell Irving	2011	1	40	NA	NA	40	40	40	1	0.7	NA	NA	0.7	0.7	0.7	1	1.09	NA	NA	1.09	1.09	1.09
		2012	8	87	8.1	2.9	87	75	100	8	6.5	1.7	0.6	6.3	4.2	9.5	8	0.97	0.05	0.02	0.95	0.90	1.03
	Bowser	2010	26	71	29.9	5.9	76	24	117	26	NA	NA	NA	NA	4.1	15.5	8	0.94	0.13	0.05	0.96	0.76	1.11
	Scott Creek	2010	8	84	33.3	11.8	84	46	124	8	NA	NA	NA	NA	1.2	18.8	7	0.98	0.33	0.12	0.95	0.50	1.41
	Todd	2010	6	160	24.8	10.1	157	132	197	6	52.3	22.8	9.3	47.1	27.7	88.6	6	1.22	0.11	0.05	1.18	1.13	1.41
	Todedada	2010	42	86	35.1	5.4	72	43	150	42	10.7	12.3	1.9	3.5	0.9	35.0	42	1.10	0.18	0.03	1.15	0.85	1.36
	Unuk	2010	38	78	22.5	3.7	81	39	125	35	7.5	5.4	0.9	6.3	0.3	21.8	35	1.20	0.34	0.06	1.18	0.62	1.87
		2011	16	84	21.8	5.5	72	60	120	16	7.8	6.1	1.5	4.0	2.5	19.5	16	1.09	0.10	0.03	1.09	0.93	1.25
	Wildfire	2011	14	95	25.7	6.9	100	53	131	14	11.3	8.5	2.3	10.4	1.6	27.9	16	1.07	0.11	0.03	1.07	0.88	1.22
		2012	6	124	50.2	20.5	119	69	191	6	26.4	28.2	11.5	17.3	3.5	72.1	6	0.98	0.15	0.06	0.99	0.78	1.15
Mountain whitefish	Bowser	2010	9	141	44.1	14.7	125	92	204	9	NA	NA	NA	NA	9.2	101.1	7	0.87	0.35	0.13	0.90	0.33	1.27
	Scott Creek	2010	2	181	6.4	4.5	181	176	185	2	76.0	2.1	1.5	76.0	74.6	77.3	2	1.29	0.10	0.07	1.29	1.23	1.36
	Todd	2010	6	150	104.7	42.8	168	23	265	6	NA	NA	NA	NA	53.0	60.8	2	1.20	0.06	0.04	1.20	1.16	1.24
	Todedada	2010	1	151	NA	NA	151	151	151	1	37.2	NA	NA	37.2	37.2	37.2	1	1.08	NA	NA	1.08	1.08	1.08
Rainbow trout	Bell Irving	2011	9	46	23.9	8.0	39	31	95	9	2.7	6.2	2.1	0.7	0.3	15.6	9	1.13	0.22	0.07	1.07	0.86	1.50
		2012	30	79	25.3	4.6	78	38	133	30	7.2	7.7	1.4	5.1	0.6	26.1	30	1.13	0.22	0.04	1.11	0.86	1.63
	Bowser	2010	4	118	22.5	11.2	123	90	136	4	18.3	8.2	4.1	19.4	8.2	26.5	4	1.07	0.16	0.08	1.08	0.89	1.25
	Todedada	2010	6	112	13.1	5.3	115	91	126	6	17.0	6.1	2.5	18.0	7.7	23.8	6	1.15	0.12	0.05	1.18	1.00	1.27
	Unuk	2010	1	230	NA	NA	230	230	230	1	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	NA
	Wildfire	2011	14	83	28.9	7.7	79	39	129	9	12.4	8.2	2.7	10.4	3.2	25.0	9	1.2	0.1	0.0	1.2	1.1	1.4
Sockeye salmon	Bowser	2010	2	90	14.8	10.5	90	80	99	0	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	NA

NA = not available
n = sample size
SE = standard error of the mean
SD = standard deviation of the mean
CI = 95% confidence interval

Table 7.4-2. Summary of Statistical Analyses Performed on Data from Fish Captured in Streams

		Chinook Salmon		Coho Salmon		Dolly Varden/Bull Trout		Mountain Whitefish		Rainbow Trout		Sockeye Salmon	
Watershed	Year	Regression	Length Freq.	Regression	Length Freq.	Regression	Length Freq.	Regression	Length Freq.	Regression	Length Freq.	Regression	Length Freq.
Bell-Irving	2010	-	-	-	-	-	-	-	-	-	-	-	-
	2011	-	-	-	-	-	-	-	-	X*	-	-	-
	2012	-	-	-	-	-	-	-	-	X	X	-	-
Bowser	2010	-	-	-	-	X*	X	X*	-	-	-	-	-
Scott	2010	-	-	-	-	X*	-	-	-	-	-	-	-
Todd	2010	-	-	-	-	X*	-	-	-	-	-	-	-
Todedada	2010	-	-	-	-	X	X	-	-	X*	-	-	-
Unuk	2010	-	-	X	-	X	X	-	-	-	-	-	-
	2011	-	-	-	-	X*	-	-	-	-	-	-	-
Wildfire	2010	-	-	-	-	X*	-	-	-	-	-	-	-
	2011	-	-	-	-	X*	-	-	-	X*	-	-	-
	2012	-	-	-	-	-	-	-	-	-	-	-	-
Minimum Sample Size		**15**	**25**	**15**	**25**	**15**	**25**	**15**	**25**	**15**	**25**	**15**	**25**

** = sample size was large enough to examine the significance of the relationship, but not sufficient to accurately describe specifics*

Regression = length-weight regression analysis

Length Freq. = length frequency distribution analysis

X = analysis was performed

- = analysis was not performed

Dolly Varden/bull trout lengths and weights were significantly related in all watersheds and years in which sample sizes permitted analysis. Significant relationships between length and weight were found for Dolly Varden/bull trout captured in 2010 in Bowser River (GLM, $F_{1,7}$=100.9, P<0.001), Scott Creek (GLM, $F_{1,6}$=40.9, P=0.001), Todd Creek (GLM, $F_{1,5}$=113.9, P<0.001), Todedada Creek (GLM, $F_{1,41}$=1927.4, P<0.001), Unuk River (GLM, $F_{1,31}$= 530.8, P=0.001), and Wildfire Creek watersheds (GLM, $F_{1,8}$=703.4, P<0.001; Figure 7.4-1), and for those captured in 2011 in Unuk River (GLM, $F_{1,15}$=919.8, P=0.001) and Wildfire Creek watersheds (GLM, $F_{1,4}$=1206.8, P=0.001; Figure 7.4-2). With the exception of Todedada Creek watershed and Unuk River watershed in 2010, in all cases the sample size was below the number necessary to ensure an accurate calculation of intercept or slope. While the relationship between length and weight was statistically valid, specifics of the model may not be valid and the models could not be compared between years to examine annual variability.

Sample sizes were large enough to examine Dolly Varden/bull trout population structure through length-frequency distributions for fish captured in 2010 in the Bowser River, Todedada Creek, and Unuk River watersheds (Figure 7.4-3). In all three groups the majority of fish captured were small. In the Bowser River watershed the distribution mode was at a fork length of 75 - 80 mm, and 80% of the captured fish were less than 90 mm in fork length. In the Todedada Creek watershed the mode of the fork length distribution was the 35 - 40 mm interval. Fish captured in the Unuk River watershed had a mode length of 80 - 85mm. The small mode fork lengths suggest the populations contain many young fish. The mean fork lengths were 71 mm in the Bowser River watershed, 86 mm in the Todedada Creek watershed, and 78 mm in the Unuk River watershed.

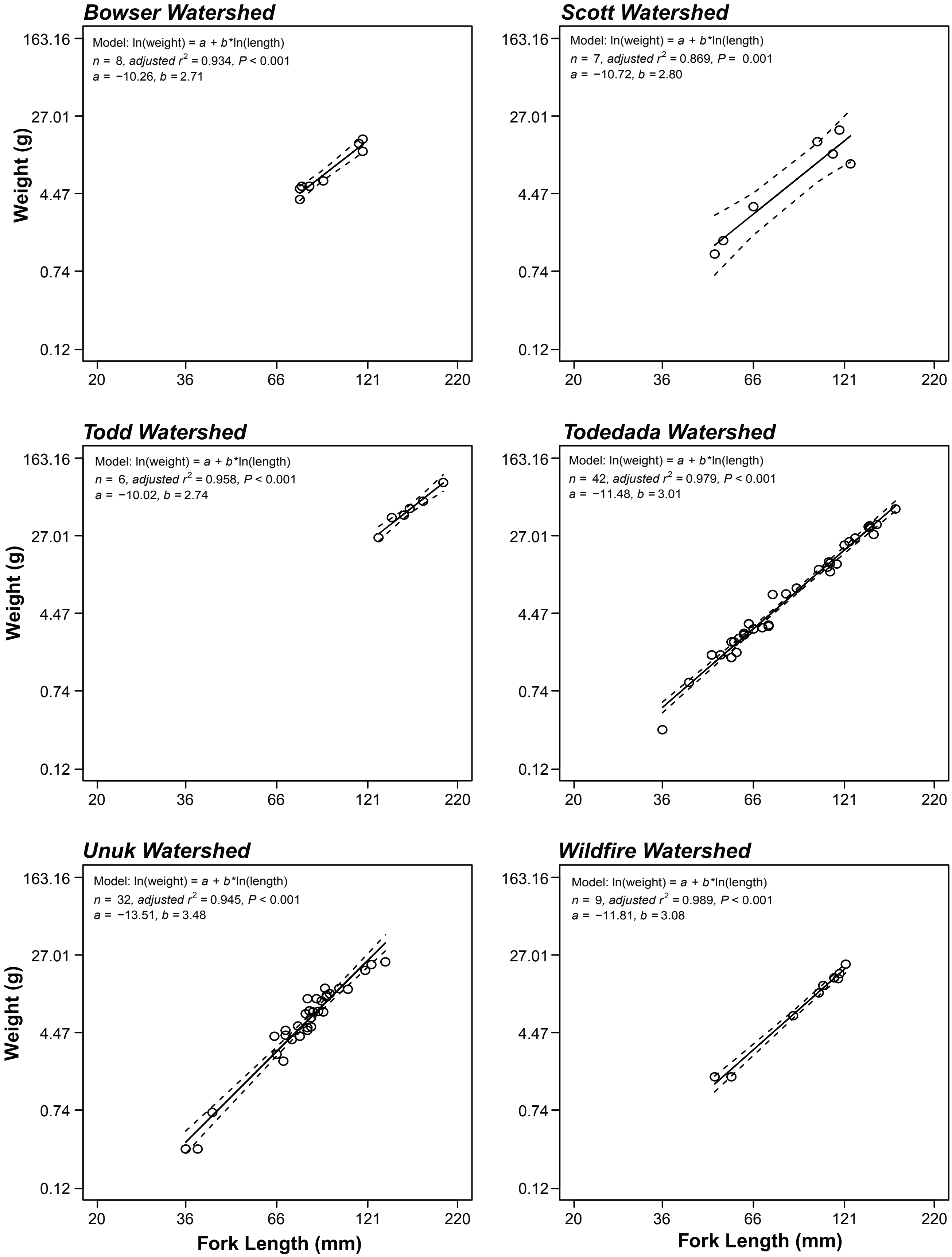
Rainbow trout lengths and weights were significantly related in all watersheds and years in which sample sizes permitted analysis. Significant relationships between length and weight were found for rainbow trout captured in 2011 in the Bell Irving River watershed (GLM, $F_{1,6}$=527.9, P<0.001), in 2012 in the Bell-Irving River watershed (GLM, $F_{1,27}$=1819.5, P<0.001), in 2010 in the Todedada Creek watershed (GLM, $F_{1,4}$=150.9, P<0.001), and in 2011 in the Wildfire Creek watershed (GLM, $F_{1,5}$=477.6, P<0.001; Figure 7.4-4). Length and weight data from Bell-Irving River watershed fish in 2011, Todedada Creek watershed fish in 2010 and Wildfire Creek watershed fish in 2011 were only available for small numbers of fish and as a result the calculated intercept and slope may not be accurate.

A length-frequency distribution created from the fork lengths of rainbow trout from the Bell-Irving watershed in 2012 showed two length modes at 70 - 75 mm and 80 - 85 mm (Figure 7.4-5). The majority of the fish captured were of similar length: 60% were 60-85 mm in length. The numbers of fish captured in other watersheds and years were not sufficient to create meaningful length-frequency distributions.

Mountain whitefish were not captured in sufficient numbers to analyze statistically. While a significant weight-length relationship was found with data from fish in the Bowser River watershed in 2010, the intercept and slope of the line may not accurately represent the population due to the sample size (GLM, $F_{1,5}$=10.9, P=0.02; Figure 7.4-6). Length-frequency distributions also could not be calculated.

Coho salmon were the only salmon species captured in numbers sufficient to analyze the relationship between fork length and weight. A significant weight-length relationship was found for coho salmon captured in the Unuk River watershed in 2010 (GLM, $F_{1,14}$=230.7, P<0.001; Figure 7.4-7). A length-frequency distribution could not be created given the small sample size.

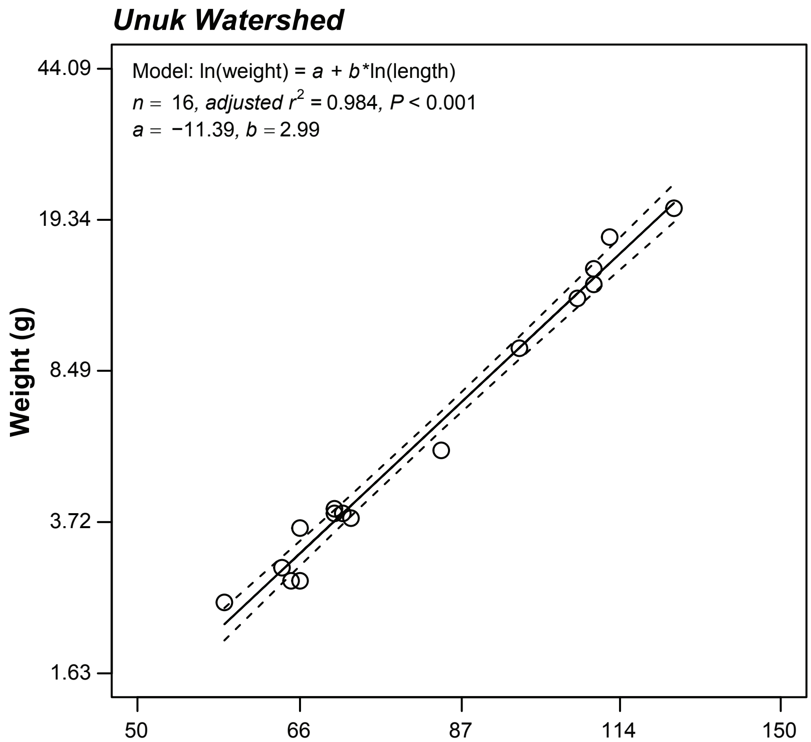
Chinook salmon and sockeye salmon were not caught in sufficient numbers to perform regression analyses or to draw conclusions from their length frequencies.

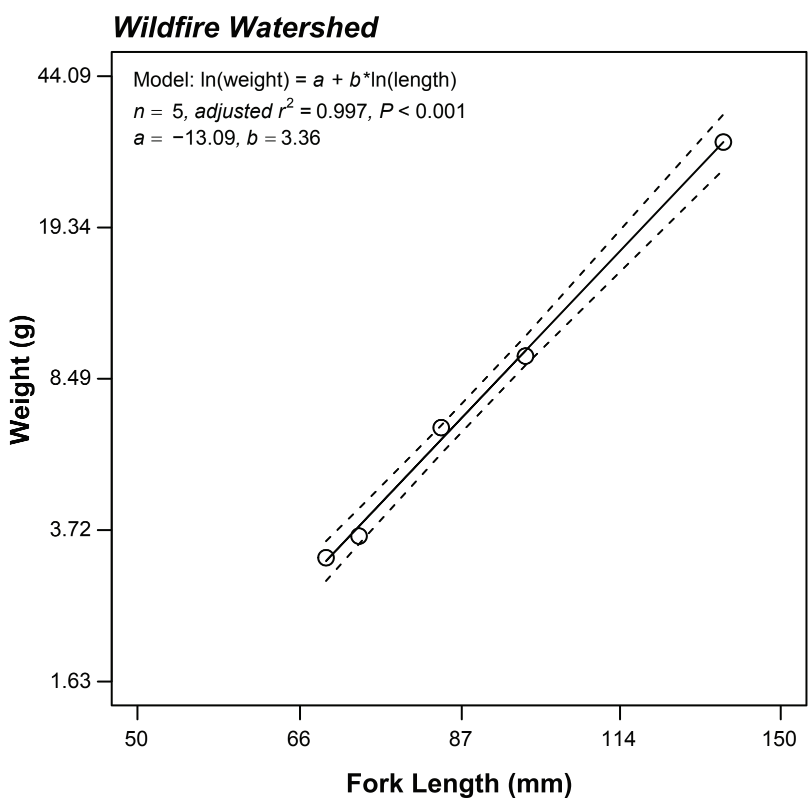


Note: Axis values have been backtransformed from the natural log (Ln).

Figure 7.4-1

Weight-Length Regressions for Dolly Varden/Bull Trout Captured by Electrofishing in Streams, 2010





Note: Axis values have been backtransformed from the natural log (Ln).

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Weight-Length Regressions for Dolly Varden/Bull Trout Captured by Electrofishing in Streams, 2011

Figure 7.4-2

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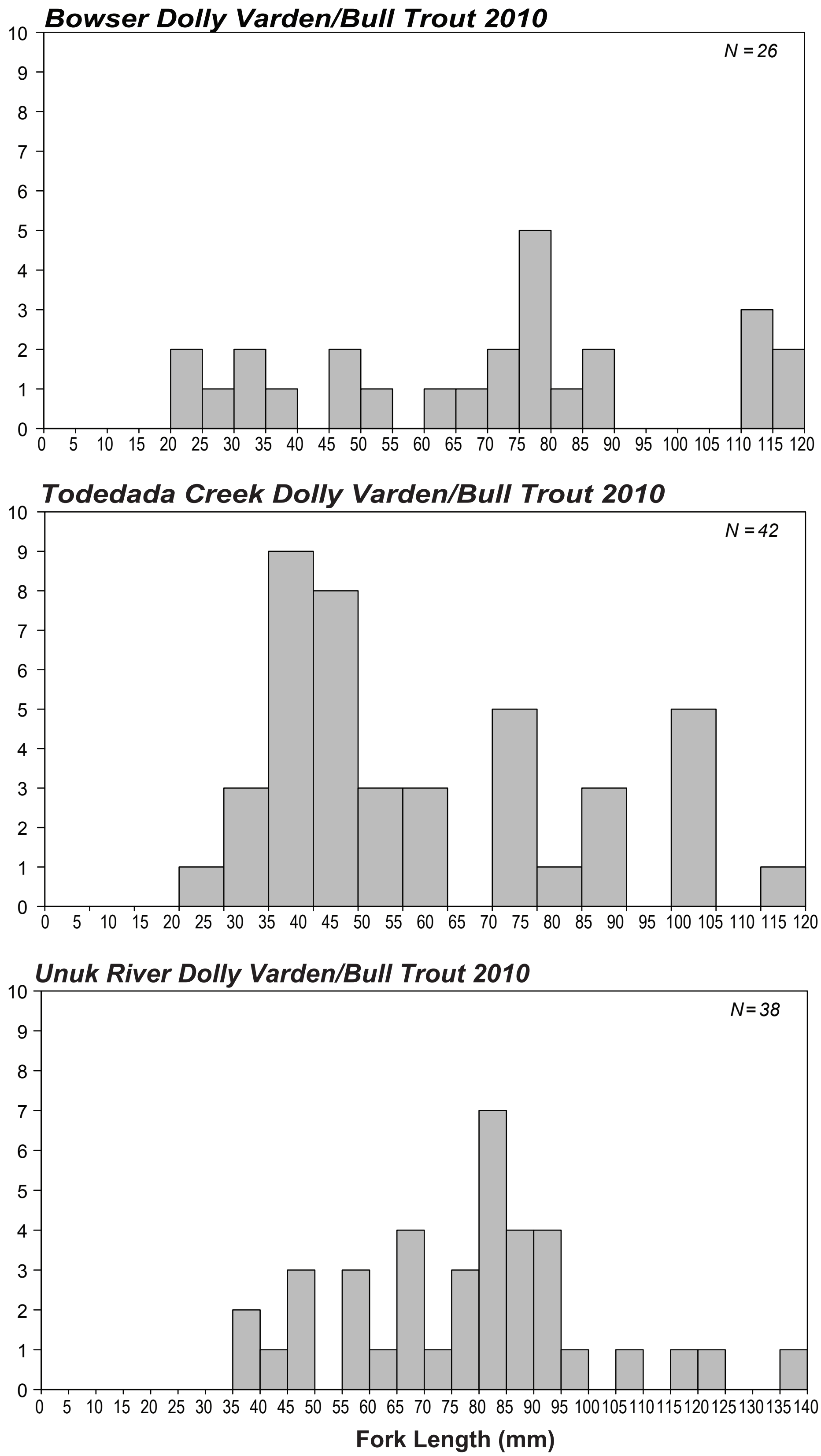

Figure 7.4-3

Length-Frequency Distributions for Dolly Varden/Bull Trout Captured by Electrofishing in Streams

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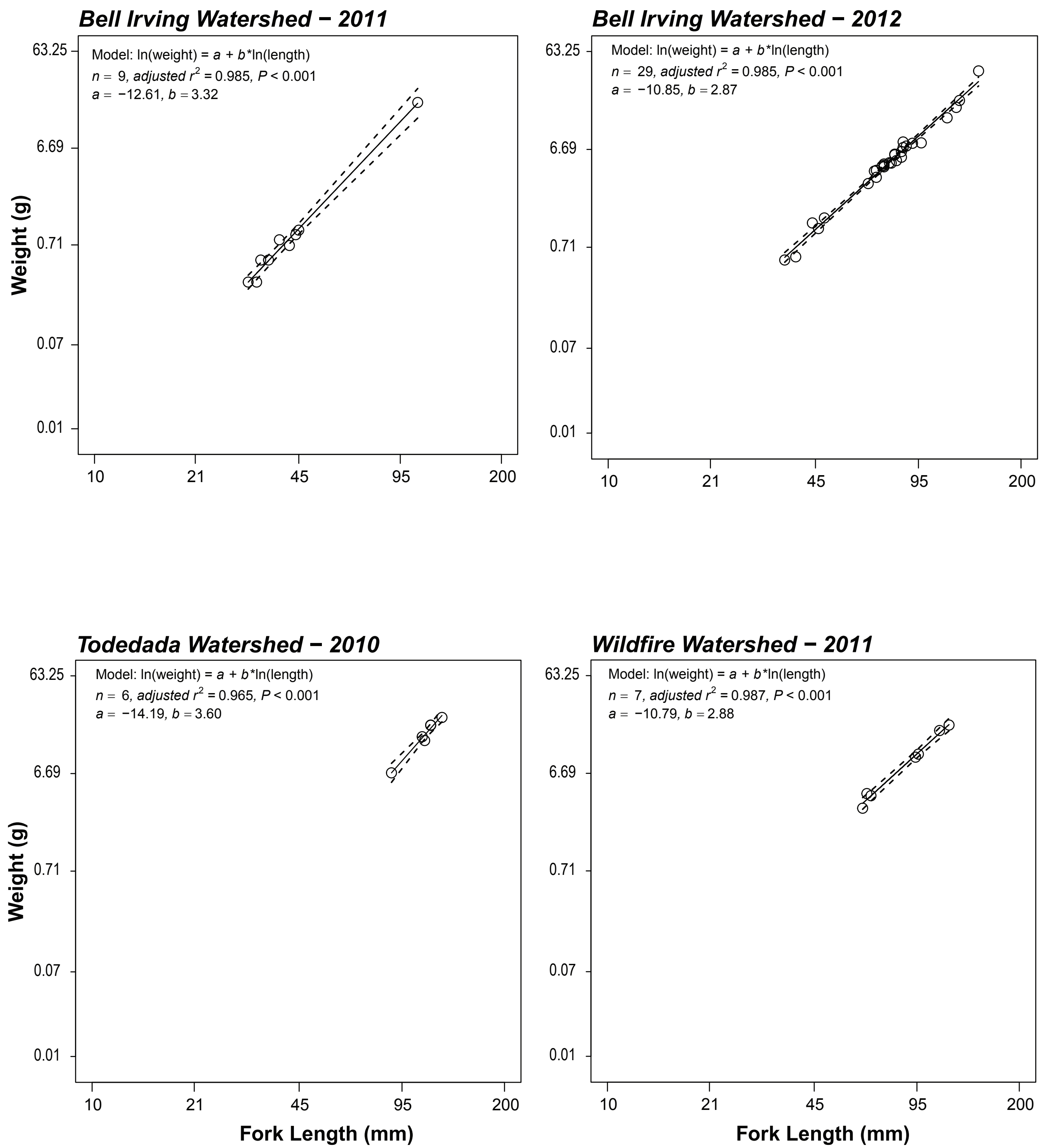

Note: Axis values have been backtransformed from the natural log (Ln).

Figure 7.4-4

Weight-Length Regressions for Rainbow Trout Captured by Electrofishing in Streams

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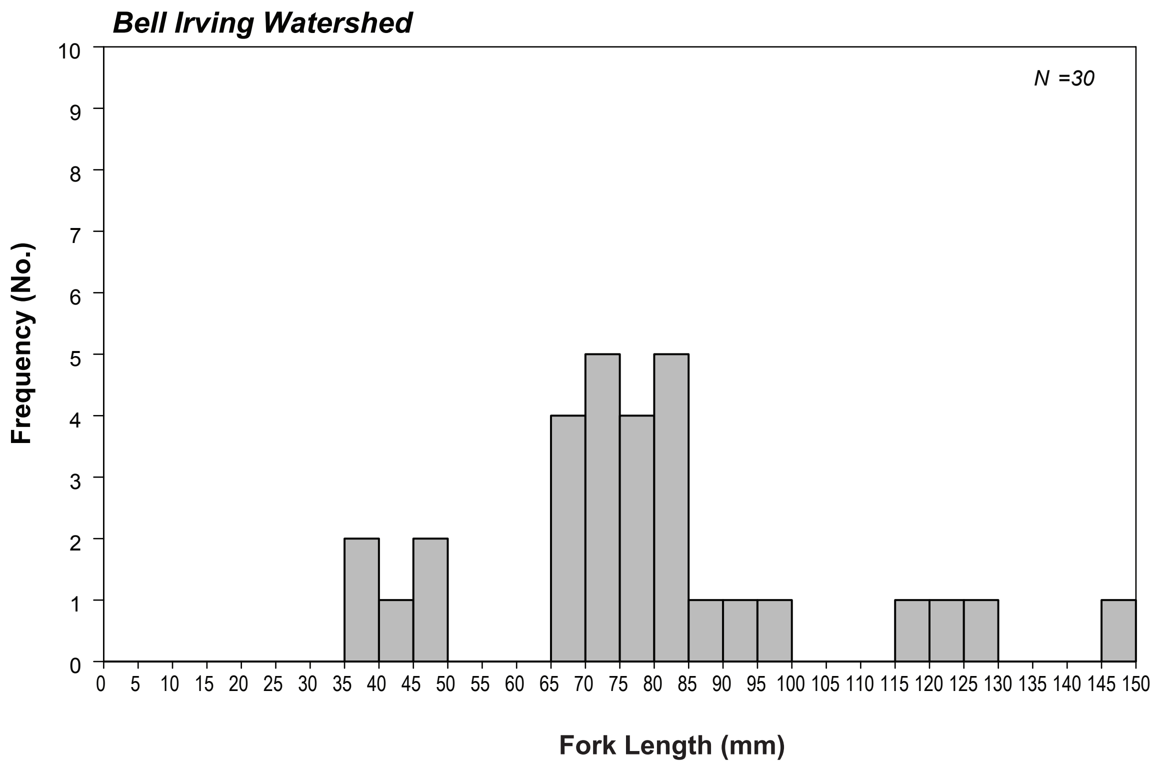

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Length-Frequency Distribution for Rainbow Trout Captured by Electrofishing in Streams

Figure 7.4-5

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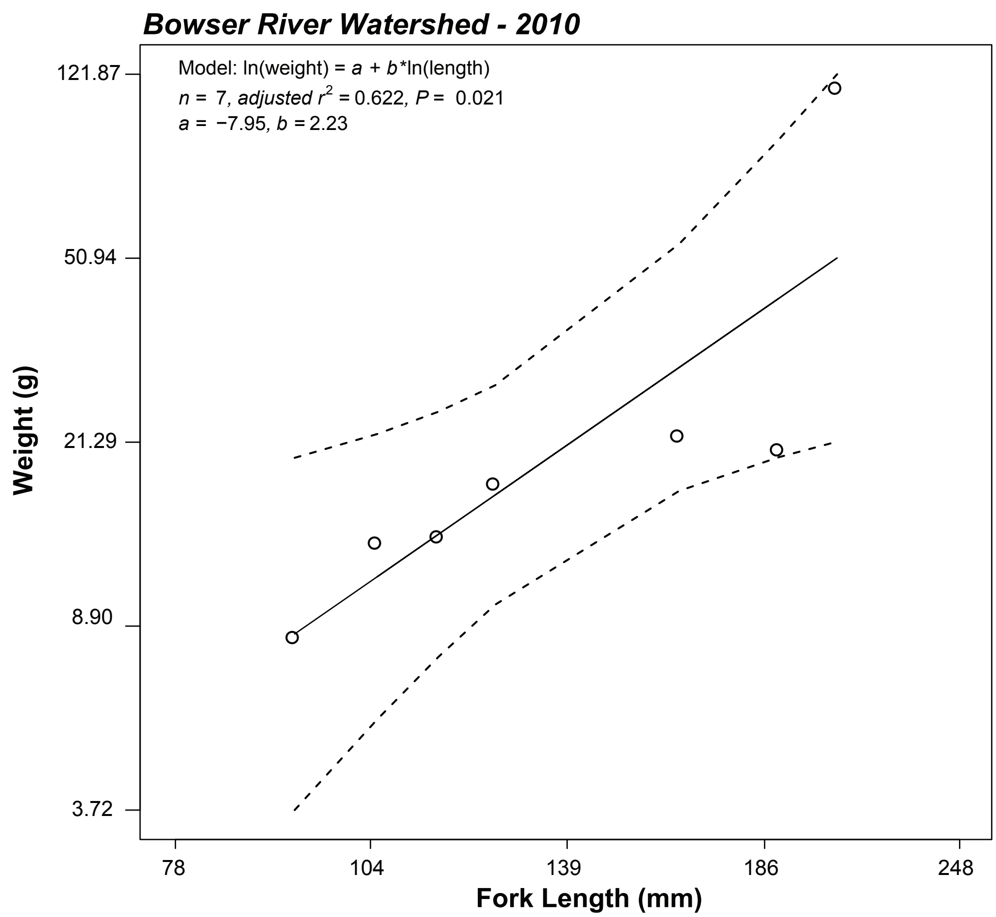

Note: Axis values have been backtransformed from the natural log (Ln).

Figure 7.4-6

Weight-Length Regressions for Mountain Whitefish Captured by Electrofishing in Streams

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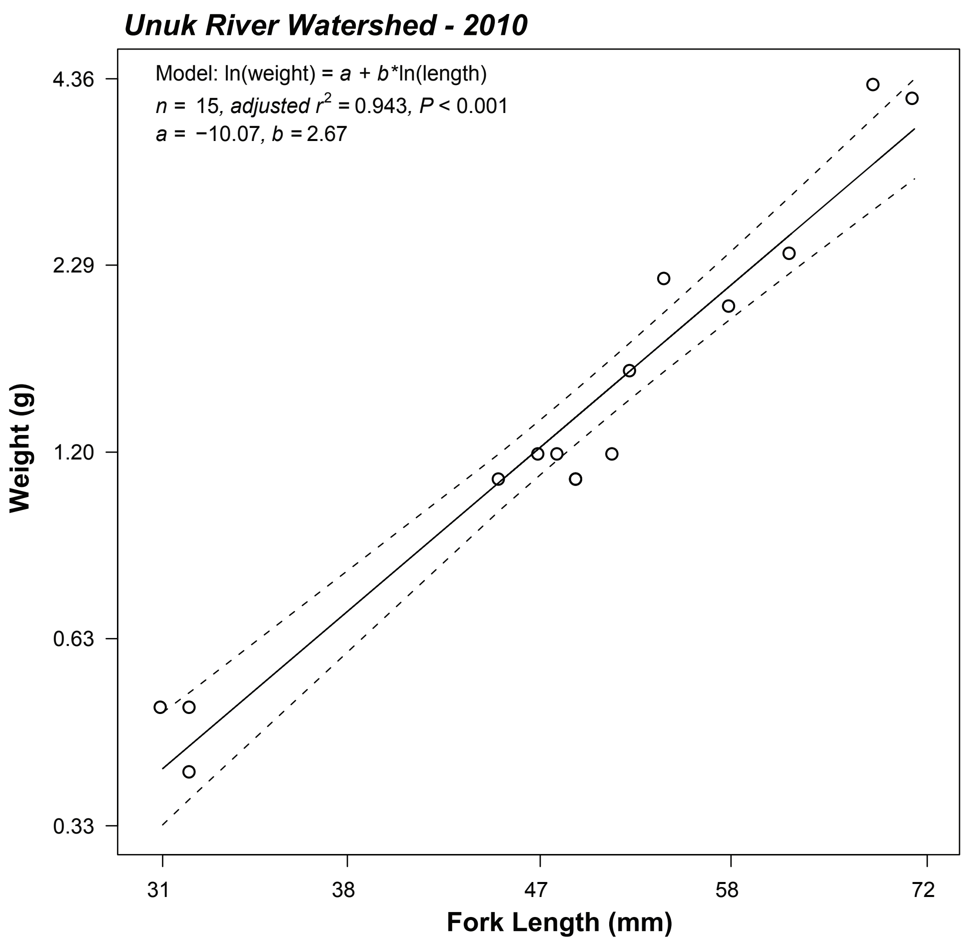

Note: Axis values have been backtransformed from the natural log (Ln).

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Weight-Length Regressions for Coho Salmon Captured by Electrofishing in Streams

Figure 7.4-7

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7.4.2 Lakes

Fish in lake habitats were sampled by a combination of gillnets, minnow traps, and electrofishing. Each type of sampling gear has different size selectivity, so biological data were summarized separately for fish captured by each gear type. Summary statistics for fish captured by minnow trapping in lakes is presented in Table 7.4-3. Summary statistics for fish captured in lakes are presented in Table 7.4-4. Electrofishing was only conducted in Bowser Lake. The summary statistics for fish captured by electrofishing in Bowser Lake are presented in Table 7.4-5. As all fish captured in lakes were sampled in 2010, there were no inter-annual comparisons to determine annual variability. Where minimum sample size requirements were not met, no statistical analyses could be performed (Table 7.4-6).

Of fish captured by gillnet, Dolly Varden/bull trout from Unnamed Lake 3 were the only group captured in sufficient numbers to calculate an accurate weight-length regression (Figure 7.4-8). Weight and fork length were significantly related (GLM, $F_{1,14}$=230.7, P<0.001). Significant weight-length regressions were calculated for kokanee and longnose sucker captured in Bowser Lake (kokanee: GLM, $F_{1,5}$=38.7, P=0.002; longnose sucker: GLM, $F_{1,6}$=2201.3, P<0.001), although as a result of the small sample size the estimates of slope and intercept may be inaccurate.

Length-frequency distributions were analyzed for Dolly Varden/bull trout captured in Unnamed Lake 3 and Todedada Lake (Figure 7.4-9). The length distribution of fish from Todedada Lake showed a mode at 340 - 380 mm. The length distribution of fish from Unnamed Lake 3 showed a mode at 360 - 380 mm. Fish captured in Unnamed Lake 3 showed a greater range of fork lengths than Todedada Lake (200 - 420 mm and 300 - 420 mm, respectively), but the greater range may be a result of the larger sample size (22 in Todedada Lake, 62 in Unnamed Lake 3).

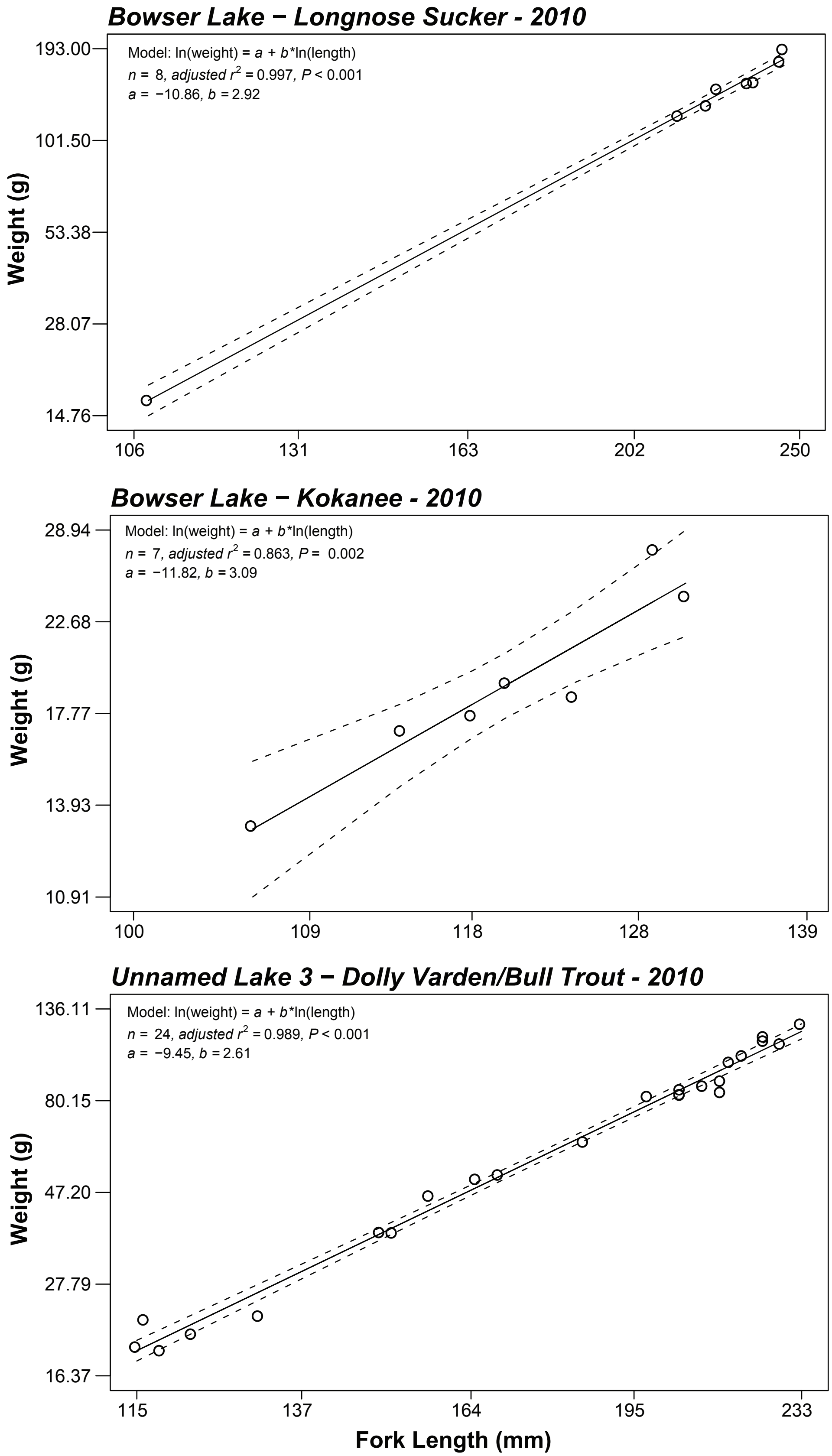
Dolly Varden/bull trout were the only species captured in minnow traps in numbers that allowed for analysis, and only in Unnamed Lake 3. A significant relationship was found between fork length and weight (GLM, $F_{1,25}$=2059.0, P<0.001; Figure 7.4-10). The length frequency distribution showed a mode at 120 - 130 mm fork length (Figure 7.4-11). The range of lengths of Dolly Varden captured in the minnow traps was wide (41 - 224 mm).

Electrofishing in Bowser Lake captured a sufficient number of mountain whitefish to calculate a significant weight-length model (GLM, $F_{1,32}$=2785.9, P<0.001), while numbers of Dolly Varden/bull trout and sockeye salmon were sufficient to determine the existence of a significant weight-length relationship, but not accurate slopes or intercepts (Dolly Varden/bull trout: GLM, $F_{1,3}$=841.9, P<0.001; sockeye salmon: GLM, $F_{1,3}$=38.2, P<0.001; Figure 7.4-12).

The length frequency distribution of Bowser Lake mountain whitefish captured by electrofishing showed a mode at 80 - 90 mm fork length and a range of 41 - 186 mm.

7.4.3 Wetlands

The biological summary statistics of the fish captured in WL1 in 2010 are presented in Table 7.4-7. Weight and fork length were significantly related for the Dolly Varden/bull trout captured in the wetland (GLM, $F_{1,36}$=4618.3, P<0.001; Figure 7.4-13). The length-frequency distribution showed a mode at 30 - 40 mm fork length (Figure 7.4-14). The distribution of length-frequencies was skewed, with the mode at the minimum fork length, while the maximum fork length was 150 mm.



Note: Axis values have been backtransformed from the natural log (Ln).

Figure 7.4-8

Weight-Length Regressions for Fish Captured by Gillnet in Lakes

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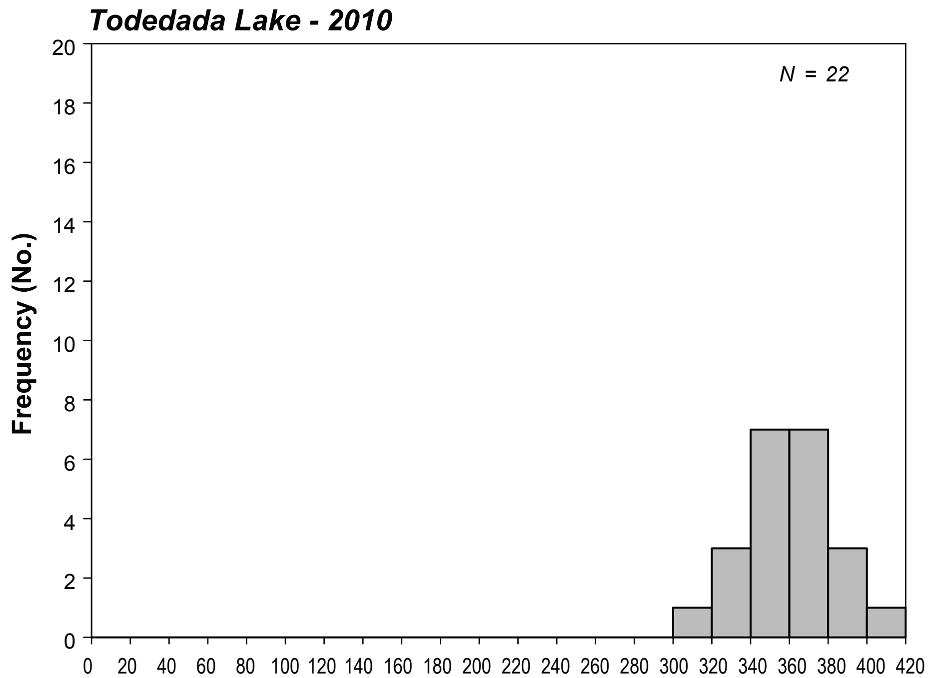

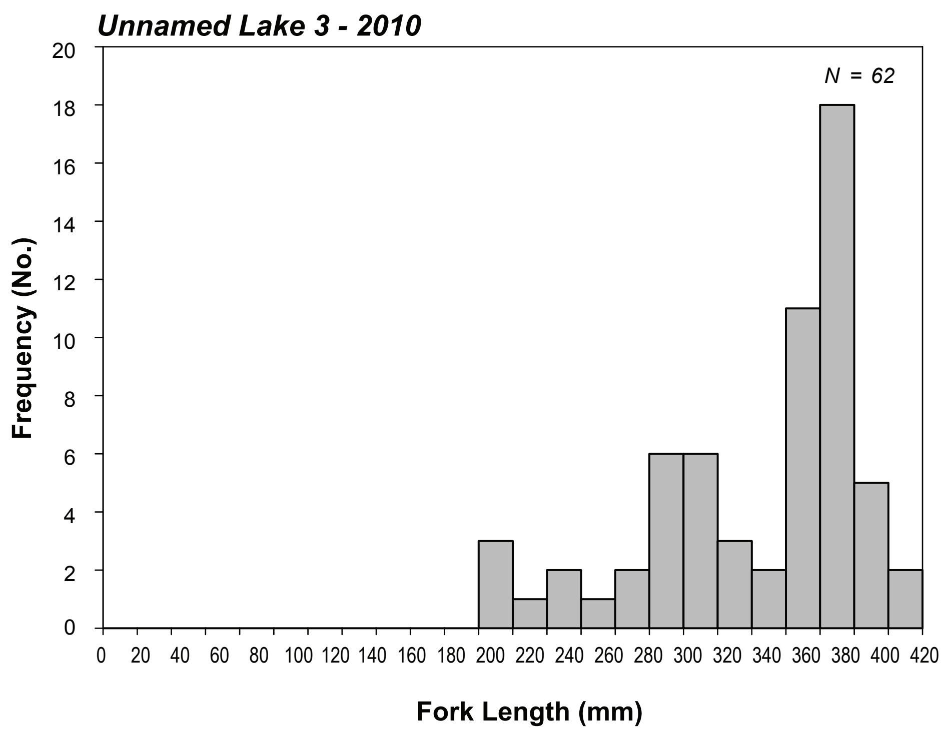

Figure 7.4-9

Length-Frequency Distributions for Dolly Varden/Bull Trout Captured by Gillnet in Lakes

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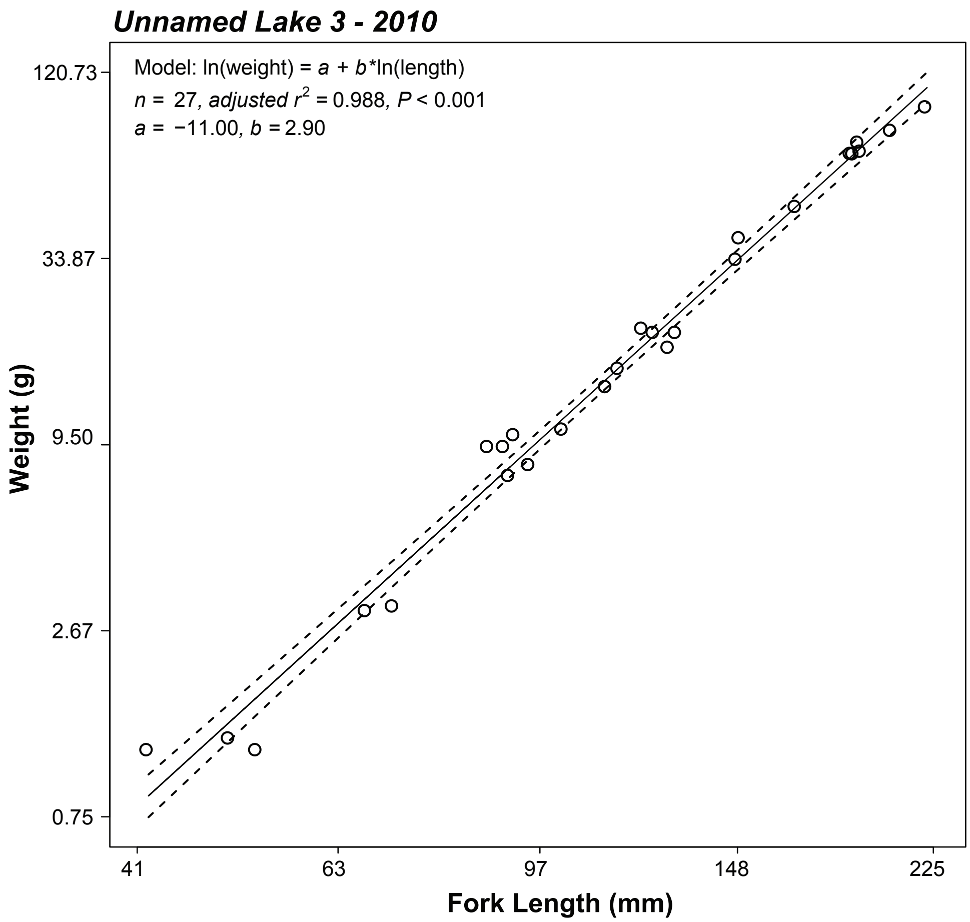

Note: Axis values have been backtransformed from the natural log (Ln).

Weight-Length Regression for Dolly Varden/Bull Trout Captured by Minnow Trap in Lakes

Figure 7.4-10

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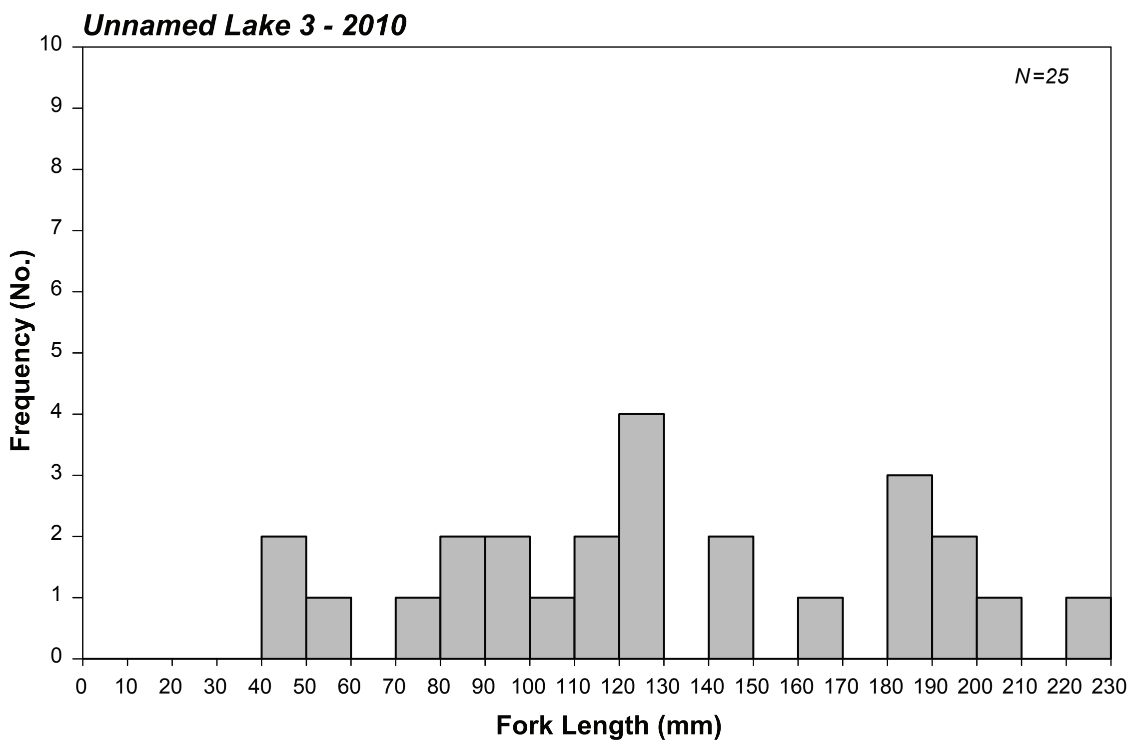

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Length-Frequency Distribution for Dolly Varden/Bull Trout Captured by Minnow Trap in Lakes

Figure 7.4-11

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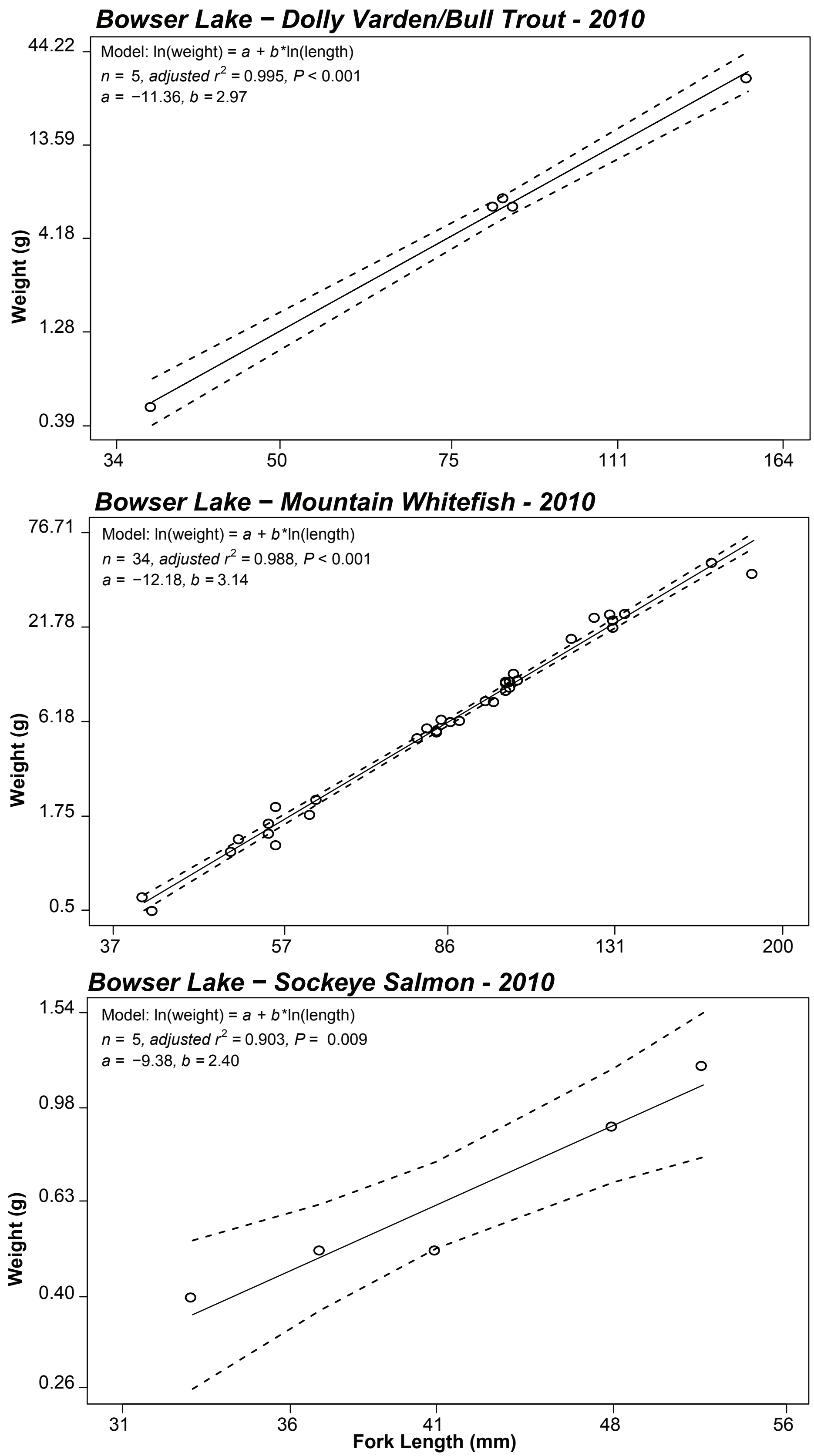

Note: Axis values have been backtransformed from the natural log (Ln).

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Weight-Length Regression for Fish Captured by Electrofishing in Lakes

Figure 7.4-12

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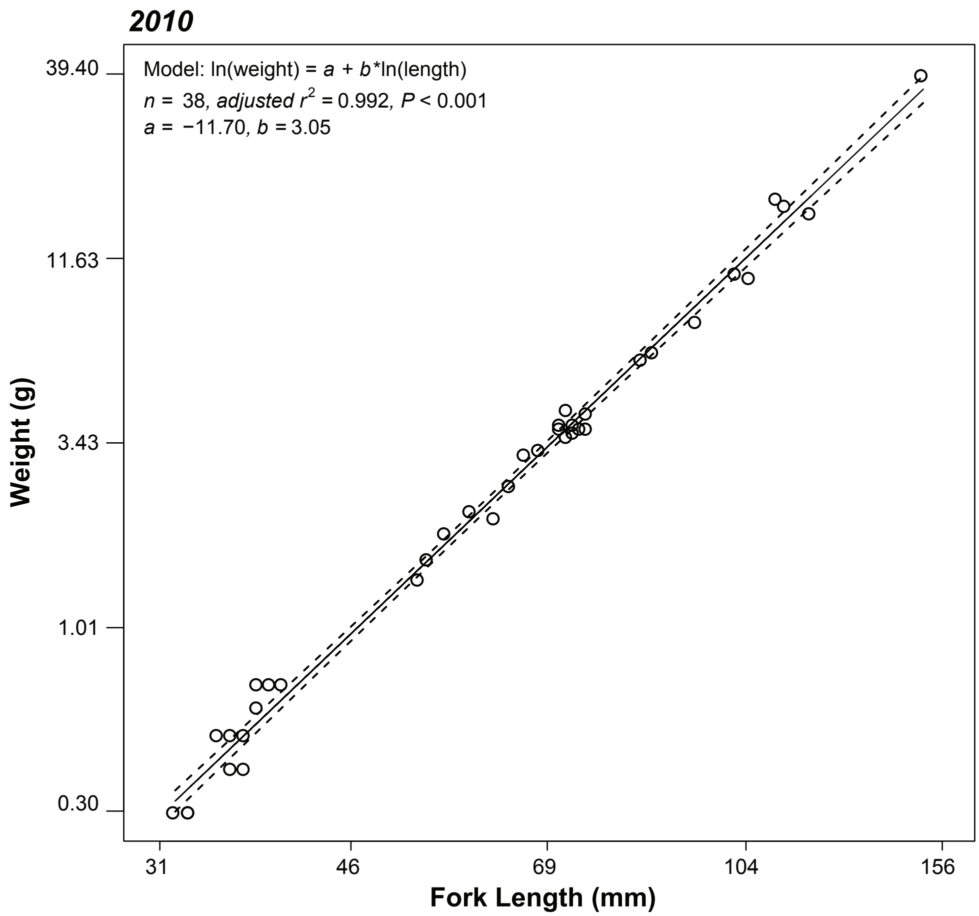


Note: Axis values have been backtransformed from the natural log (Ln).

Table 7.4-3. Biological Summary Statistics for Fish Captured by Minnow Trapping in Lakes

			Fork Length (mm)							Weight (g)							Condition (K)						
Species	Watershed	Year	n	Mean	SD	SE	Median	Lower CI	Upper CI	n	Mean	SD	SE	Median	Lower CI	Upper CI	n	Mean	SD	SE	Median	Lower CI	Upper CI
Dolly Varden/bull trout	Todedada Lake	2010	2	79	17.0	12.0	79	68	90	2	5	3.3	2.4	5	3	8							
	Unnamed Lake 3	2010	25	130	52.4	10.5	124	47	212	25	33	30.3	6.1	21	1	88	25	1	0.2	0.0	1	1	2
Longnose sucker	Bowser Lake	2010	1	67	NA	NA	67	67	67	1	3.6	NA	NA	3.6	3.6	3.6	1	1	NA	NA	1	1	1
Rainbow trout	Todedada Lake	2010	1	77	NA	NA	77	77	77	1	6	NA	NA	6	6	6	1	1	NA	NA	1	1	1

Table 7.4-4. Biological Summary Statistics for Fish Captured by Gillnetting in Lakes

			Fork Length (mm)							Weight (g)							Condition (K)						
Species	Watershed	Year	n	Mean	SD	SE	Median	Lower CI	Upper CI	n	Mean	SD	SE	Median	Lower CI	Upper CI	n	Mean	SD	SE	Median	Lower CI	Upper CI
Dolly Varden/bull trout	Bowser Lake	2010	3	378	120.5	69.6	380	263	492	1	145	NA	NA	145	145	145	1	0.85	NA	NA	0.85	0.85	0.85
	Todedada Lake	2010	22	361	22.6	4.8	363	317	395	0	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	NA
	Unnamed Lake 3	2010	62	192	31.5	4.0	206	117	230	24	76	41.1	8.4	83	20	153	24	1.49	2.15	0.44	1.02	0.89	5.75
Longnose sucker	Bowser Lake	2010	32	242	48.7	8.6	245	108	310	16	136	51.8	12.9	149	17	193	16	1.24	0.06	0.01	1.23	1.16	1.31
Mountain whitefish	Bowser Lake	2010	2	248	53.7	38.0	248	212	284	1	101	NA	NA	101	101	101	1	1.09	NA	NA	1.09	1.09	1.09
Rainbow trout	Todedada Lake	2010	8	344	49.6	17.5	352	264	405	0	NA	NA	NA	NA	NA	NA	0	NA	NA	NA	NA	NA	NA
Sockeye salmon	Bowser Lake	2010	7	120	8.7	3.3	120	107	131	7	20	4.8	1.8	19	14	27	7	1.11	0.09	0.03	1.11	0.99	1.26

Table 7.4-5. Biological Summary Statistics for Fish Captured by Electrofishing in Lakes

			Fork Length (mm)							Weight (g)							Condition (K)						
Species	Watershed	Year	n	Mean	SD	SE	Median	Lower CI	Upper CI	n	Mean	SD	SE	Median	Lower CI	Upper CI	n	Mean	SD	SE	Median	Lower CI	Upper CI
Dolly Varden/bull trout	Bowser Lake	2010	5	89	40.6	18.2	85	42	145	5	10	12.3	5.5	6	1	29	5	1	0.1	0.0	1	1	1
Mountain whitefish	Bowser Lake	2010	34	92	34.7	5.9	92	41	171	34	11	12.2	2.1	7	1	46	34	1	0.1	0.0	1	1	1
Sockeye salmon	Bowser Lake	2010	5	42	7.8	3.5	41	33	52	5	1	0.3	0.2	1	0	1	5	1	0.2	0.1	1	1	1

Table 7.4-6. Summary of Statistical Analyses Performed on Data from Fish Captured in Lakes

		Dolly Varden/Bull Trout		Longnose Sucker		Mountain Whitefish		Kokanee Salmon	
Lake	Gear	Regression	Length Freq.	Regression	Length Freq.	Regression	Length Freq.	Regression	Length Freq.
Bowser	GN	-	-	X*	-	-	-	X*	-
	EF	-	-	X*	-	X	X	X*	-
Todedada	GN	-	X	-	-	-	-	-	-
Unnamed Lake 3	GN	X	X	-	-	-	-	-	-
	MT	X	X	-	-	-	-	-	-
Minimum Sample Size		**15**	**25**	**15**	**25**	**15**	**25**	**15**	**25**

** = sample size was large enough to examine the significance of the relationship, but not sufficient to accurately describe specifics*

Regression = length-weight regression analysis

Length Freq. = length frequency distribution analysis

X = analysis was performed

- = analysis was not performed

GN = gillnet

EF = electrofishing

MT = minnow trap

Table 7.4-7. Biological Summary Statistics for Fish Captured by Electrofishing in WL-1

			Fork Length (mm)							Weight (g)							Condition (K)						
Species	Watershed	Year	n	Mean	SD	SE	Median	Lower CI	Upper CI	n	Mean	SD	SE	Median	Lower CI	Upper CI	n	Mean	SD	SE	Median	Lower CI	Upper CI
Dolly Varden/bull trout	Todedada Creek	2010	38	67	28.5	4.6	67	33	121	38	5	7.3	1.2	3	0	19	38	1	0.1	0.0	1	1	1

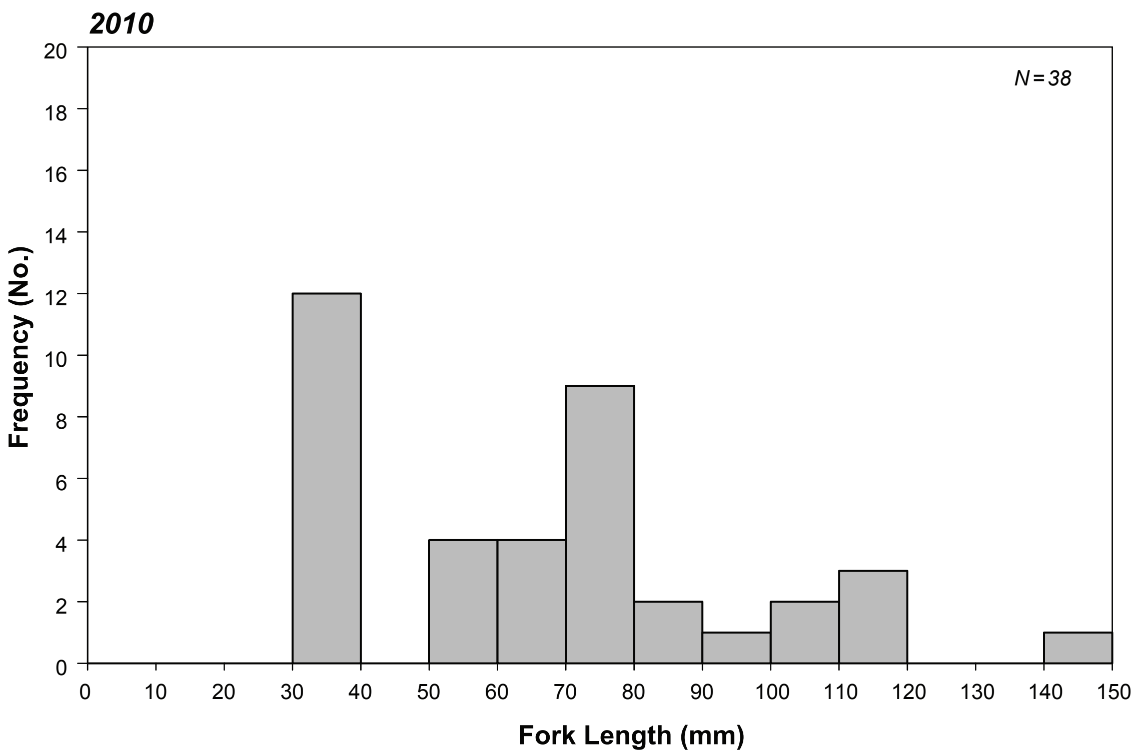
NA = not available

n = sample size

SE = standard error of the mean

SD = standard deviation of the mean

CI = 95% confidence interval



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Length-Frequency Distribution for Fish Captured by Electrofishing in WL1

Figure 7.4-14

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7.5 MINING METAL EFFLUENT REGULATIONS

7.5.1 Effect Endpoints

Data included in this baseline report was collected with the intention of contributing to future environmental effects monitoring for the Brucejack Gold Mine Project. The collected data are suitable for analysing the three principle biological endpoint responses and four effect indicators listed in Table 7.5-1 and specified by Environment Canada (2012). Each response has at least one endpoint addressed in this report.

Table 7.5-1. Summary of Three Principle Endpoint Responses for Environmental Effects Monitoring

Type of Response	Effect Indicator	Lethal Effect and Support Endpoint	Non-Lethal Effect and Support Endpoint
Energy Use	Growth	Size-at-age (body weight-at-age)	Length of YOY (age 0) at end of growth period
		*Length-at-age	Weight of YOY (age 0) at end of growth period Size of the 1+ fish Size-at-age
	Reproduction	Gonad weight vs body weight	*Relative abundance of young of year
Energy Storage	Condition	*Body weight at length	*Body weight at length
		*Liver size at body weight	
Survival	Survival	*Age	Length-frequency distribution
		Age-frequency distribution	Age-frequency distribution
		Length-frequency distribution	

Adapted from Environment Canada (2012)
**Fish survey effect endpoints used for determining effects as designated by statistically significant differences between exposure and reference streams. Other supporting endpoints can be used to support analyses.*

Dolly Varden/bull trout were chosen as the likely sentinel species for future environmental effects monitoring as they were the only species present throughout the study area. Dolly Varden/bull trout have an expected longevity of 8 to 9 years (Mcphail, 2007). Their length and age at maturation is relatively short (3 to 5 years and 130 to 162 mm, respectively). Their primary food source is benthic invertebrates.

The sites UR1, WC1 and MC1 were identified as potential receiving environment and reference monitoring sites. UR1, in the Unuk River directly downstream of the Sulphurets Creek confluence, was designated as the receiving environment site as this is the point closest to potential Project discharges to Brucejack Lake with a substantive fish population. Abundance of Dolly Varden in Sulphurets Creek is relatively low. Low abundance could impede the ability to obtain adequate numbers of fish to ensure an appropriate level of statistical power; and if the low catch rate is indicative of a small population, regular lethal sampling could have a negative effect on the population. WC1 (at the mouth of Wildfire Creek) and MC1 (at the mouth of McIness Creek) were initially sampled as potential receiving environment sites. Although no longer associated with planned Project discharge, the collected data is presented here as their similarity to other waterbodies in the study area provides information on general regional conditions.

Non-lethal biological information including length and weight was gathered from captured Dolly Varden/bull trout. This data was included in the effect endpoint summaries to provide additional information regarding annual variation. Additionally, a site less than 100 m distance from UR1, Site 514, was sampled in 2010. As the two sites were in close proximity, contained similar habitat, and there were no tributaries or barriers to fish migration between the two sites, fish sampled from Site 514 were included in the UR1 biological summaries.

All collected data following environmental effects monitoring methodology are reported in Appendix 7.5-1.

7.5.2 Energy Use

Fish growth (expressed as an increase in body length or weight over time) and reproduction are two primary uses of energy for fish, and energy allocation to those two uses was explored as due to their potential as future effect indicators.

Fish growth was explored through the use of models examining the relationship between length and age. Creating growth models requires age data from individuals from a large range of body lengths and ages. Length and age data was available for Dolly Varden/bull trout captured at UR1 in 2010 and 2011, and WC1 in 2010, 2011 and 2012. Determination of age and weight does not require lethal sampling, so data from non-lethally sampled fish captured at UR1 and WC1 for study area description sampling were included in age- and length- related analyses.

Von Bertalanffy growth curves with three parameters (L_∞: asymptotic fork length; K: yearly growth coefficient; t_0= length at age 0) and two parameters (where t_0 is fixed at 0) and size-at-age linear regression were created with data from Dolly Varden/bull trout captured at UR1 and WC1. Akaike weights (AIC_w) show the magnitude of support for each model. A higher weight indicates a better fit.

The linear regression model best explained the relationship between length and age for fish captured in UR1 (GLM, $F_{1,16}$=14.1, p<0.001; Figure 7.5-1). The predicted size at age 0 was 58 mm and the predicted slope was 23. The sample size was small (n = 18) and the age range of captured fish was small (0 - 2 years), which may have caused the poor fit of all three models. Von Bertalanffy models are sensitive to small age ranges, as older individuals are required to predict the asymptotic fork length. Von Bertalanffy models and linear regression analyses are sensitive to small sample sizes. Therefore, caution should be used in interpretations of the model.

The relationship between length and age for fish captured in WC1 was also best described by the linear regression model (GLM, $F_{1,11}$=20.6, p<0.001; Figure 7.5-2). The model predicted a length of 65 mm at age 0 and the predicted slope of the relationship was 23. The sample size for the WC1 size-at-age regressions was also small (n = 13) and the captured fish represented a small age range (0 - 3 years), therefore interpretations of the model should be made with caution, and the models are not suitable for statistical comparisons between sites.

Only four maturing or mature adult Dolly Varden/bull trout were captured following environmental effects monitoring sampling methods. All four were male and captured in WC1 in 2011 or 2012. The sampling was conducted in early fall, timed to take place approximately four to six weeks prior to the start of spawning season as recommended for reproductive effects indicator monitoring (Environment Canada 2012). The low representation of mature fish in the sample was more likely a result of the age range of the fish captured (0 - 3 years), as maturation generally occurs at 3 - 5 years of age and most captured fish were too young to spawn.

Analyses of gonad weight vs. body weight and the GSI require the capture of mature fish (Environment Canada 2012). The number of mature fish captured was insufficient to allow for either analysis. No mature females were captured, preventing analysis of fecundity. The relative abundance of young-of-year (0+, fish less than one year old) fish was used as an alternate expression of reproduction.

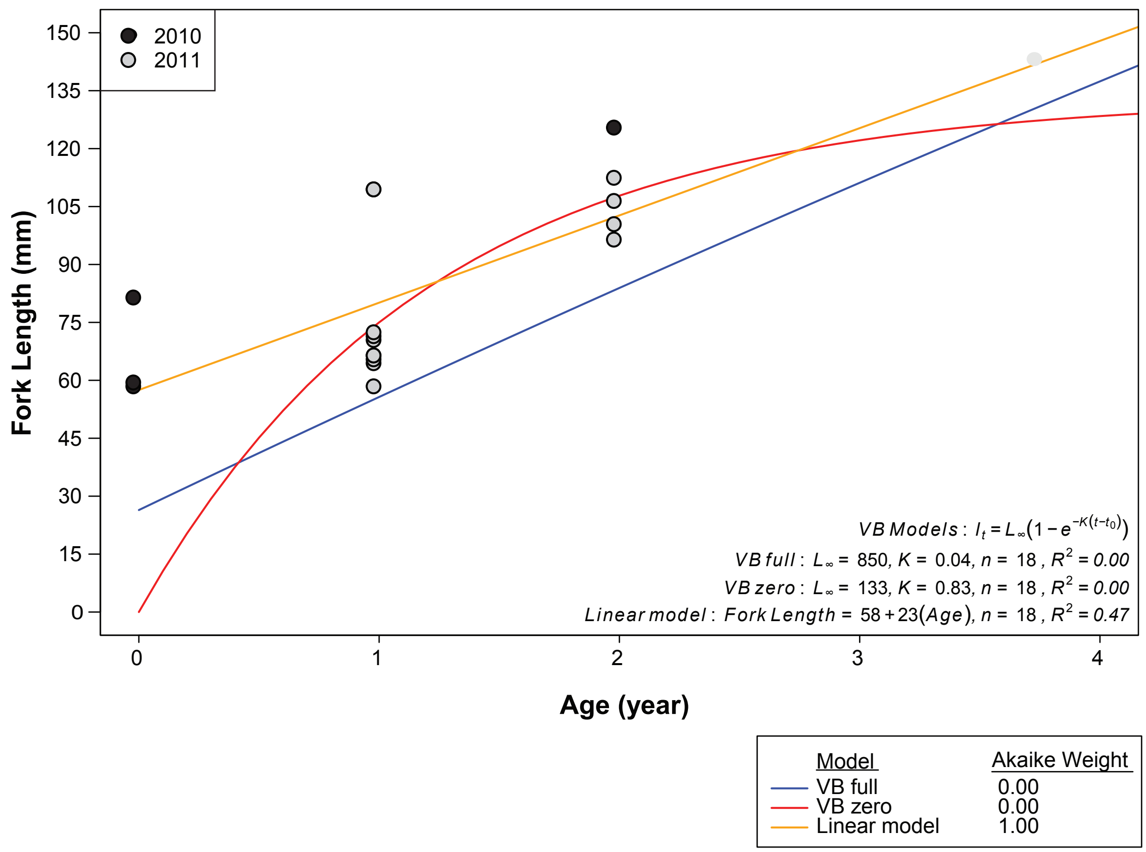


Figure 7.5-1

Growth Models Relating Age and Fork Length in Dolly Varden/Bull Trout, UR1

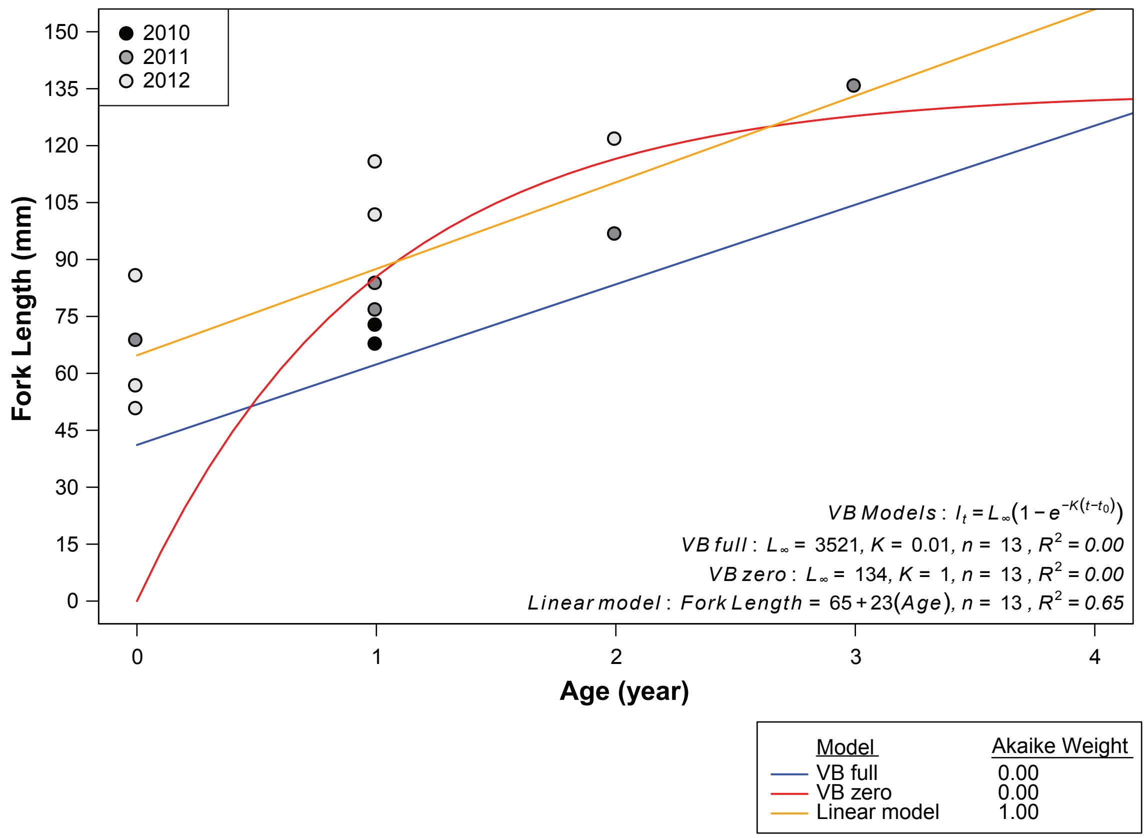


Figure 7.5-2

Growth Models Relating Age and Fork Length in Dolly Varden/Bull Trout, WC1

The proportion of 0+ Dolly Varden/bull trout in McInnes Creek was 100% in 2011 (Table 7.5-2). Age data was available for only a single fish, so the calculated proportion is not an accurate descriptor of the population.

Table 7.5-2. Proportion of Young-of-Year Dolly Varden/Bull Trout at Selected Sites, 2010 to 2012

			Proportion	
Site	**Year**	**N**	**0+**	**> 0+ years**
MC1	2011	1	100	0
UR1	2010	4	75	25
	2011	13	0	100
WC1	2010	6	50	50
	2011	5	20	80
	2012	2	0	100

N = number of fish
0+ = young-of-year fish

The proportion of 0+ Dolly Varden/bull trout in UR1 ranged from 75% in 2010 to 0% in 2011. The sample size in 2010 was small and may not accurately reflect the population composition. The sampling in 2011 provided a larger sample and suggested few 0+ fish at UR1, potentially as a result of low allocation of energy for reproductive purposes.

Age data from WC1 was available for 2010, 2011, and 2012. The proportion of young of year fish ranged from 0% in 2012 to 50% in 2010. The 2012 analyses were conducted with age data from only two fish and may not be an accurate representation of the population composition. Data from 2010 and 2011 suggested that young of year comprise a large part of the population.

7.5.3 Energy Storage

Dolly Varden/bull trout lengths and weights were significantly related in UR1 in 2011 (GLM, $F_{1,32}$=277.3, p<0.001; Figure 7.5-3), MC1 in 2012 (GLM, $F_{1,7}$=2044.6, p<0.001; Figure 7.5-4), and WC1 in 2011 (GLM, $F_{1,3}$=1206.8, p<0.001; Figure 7.5-5) and 2012 (GLM, $F_{1,4}$=126.9, p<0.001).

Condition (K) is a measure of energy storage that compares body weight to body length (Table 7.5-3). For salmonids, including Dolly Varden and bull trout, a condition of 1 is normal in a healthy fish. The average condition was not significantly different from 1 in WC1 (one sample t-test, 2010: t_8=2.2, *p*=0.06; 2011: t_4=1.1, p=0.35; 2012: t_5=-0.3, p=0.77) and MC1 (one sample t-test, t_7=-1.9, *p*=0.09), but fish captured at UR1 had a condition of greater than 1 in both 2010 (one sample t-test, t_{17}=5.4, *p*<0.001) and 2011 (one sample t-test, t_{15}=3.7, *p*<0.01), suggesting high energy storage. Fish captured in UR1 in 2010 had an average condition of 1.4, which was higher than the average condition of 1.1 calculated for fish captured in UR1 in 2011 (two sample t-test, t_{21}=3.9, *p*<0.01). The condition of fish captured at WC1 showed no change among years (ANOVA, $F_{1,18}$=2.3, *p*=0.15).

Liver size at body weight is a supporting endpoint for energy storage and condition. Liver weight and body weight were significantly related in WC1 in 2012, MC1 in 2012 and UR1 in 2011 (Figure 7.5-6). WC1 in 2012 (GLM, $F_{1,4}$=43.3, *p*<0.01) had the widest range of body weights and liver weights of any of the monitoring sites and years and showed the highest level of relationship significance. In comparison, while the narrow weight ranges exhibited by fish captured in UR1 in 2011 (GLM, $F_{1,4}$=8.9, *p*=0.04) and MC1 (GLM, $F_{1,6}$=6.3, p=0.05) were sufficient to show a significant relationship between body and liver weights, the relationships were not as strong as in WC1 in 2012. There was no significant relationship between body weight and liver weight in WC1 in 2011 (GLM, $F_{1,3}$=7.0, *p*=0.08). The sample size was small for all sites and years and all relationships should be interpreted with caution as they may not accurately reflect the population.

Table 7.5-3. Summary Statistics of Dolly Varden/Bull Trout Energy Storage Indicators from Selected Sites

		Condition (K)							Liver Weight (g)						
Site	Year	n	Mean	SD	SE	Median	Lower CI	Upper CI	n	Mean	SD	SE	Median	Lower CI	Upper CI
MC1	2011	1	1.09	NA	NA	1.09	1.09	1.09	0	NA	NA	NA	NA	NA	NA
	2012	8	0.97	0.05	0.02	0.95	0.90	1.03	8	0.08	0.03	0.01	0.07	0.04	0.13
UR1	2010	18	1.40	0.31	0.07	1.33	0.87	1.93	0	NA	NA	NA	NA	NA	NA
	2011	16	1.09	0.10	0.03	1.09	0.93	1.25	6	0.16	0.06	0.03	0.17	0.07	0.24
WC1	2010	9	1.1	0.1	0.0	1.1	0.9	1.2	6	0.67	0.82	0.33	0.50	0.00	1.88
	2011	5	1.05	0.12	0.05	1.05	0.93	1.21	5	1.40	1.14	0.51	1.00	0.10	2.90
	2012	6	0.98	0.15	0.06	0.99	0.78	1.15	2	1.00	0.00	0.00	1.00	1.00	1.00

		HSI						
Site	Year	n	Mean	SD	SE	Median	Lower CI	Upper CI
MC1	2011	0	NA	NA	NA	NA	NA	NA
	2012	8	0.08	0.03	0.01	0.07	0.04	0.13
UR1	2010	0	NA	NA	NA	NA	NA	NA
	2011	6	0.16	0.06	0.03	0.17	0.07	0.24
WC1	2010	0	NA	NA	NA	NA	NA	NA
	2011	5	0.10	0.09	0.04	0.05	0.01	0.24
	2012	6	0.23	0.31	0.13	0.14	0.01	0.77

HSI = Hepatosomatic Index

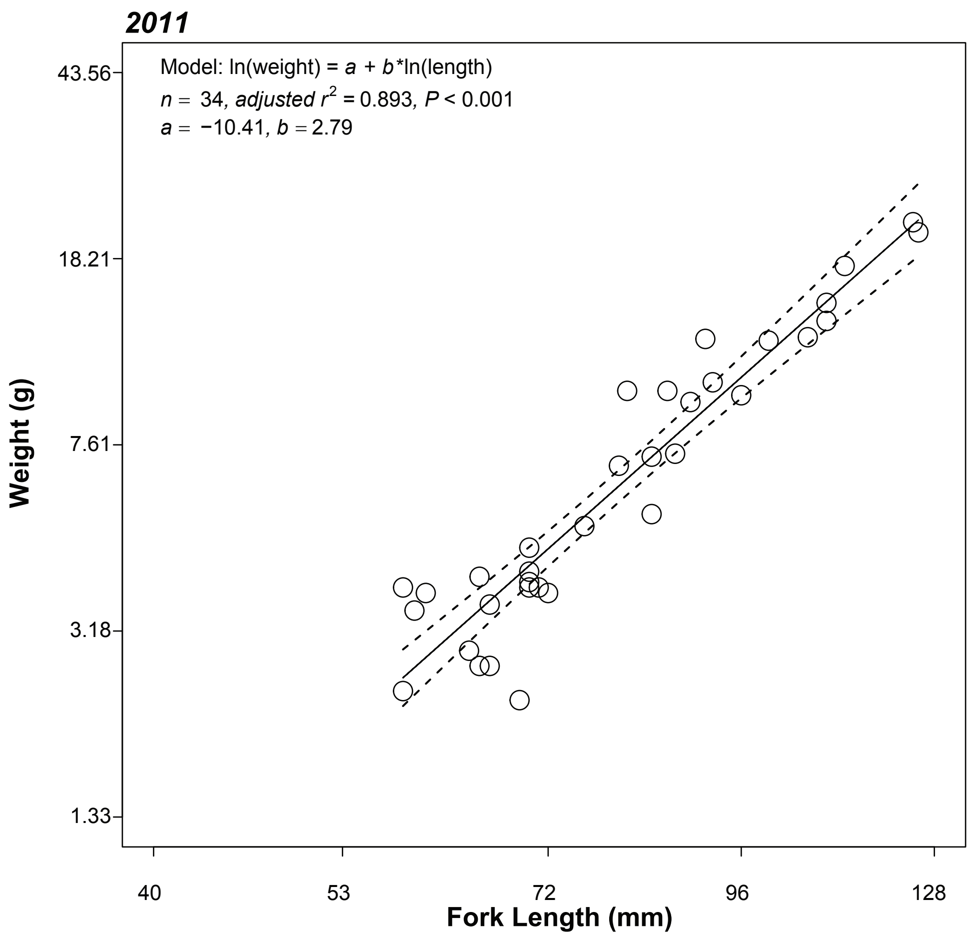
NA = not available

n = sample size

SE = standard error of the mean

SD = standard deviation of the mean

CI = 95% confidence interval



Note: Axis values have been backtransformed from the natural log (Ln).

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Weight-Length Regression for Dolly Varden/Bull Trout, UR1

Figure 7.5-3

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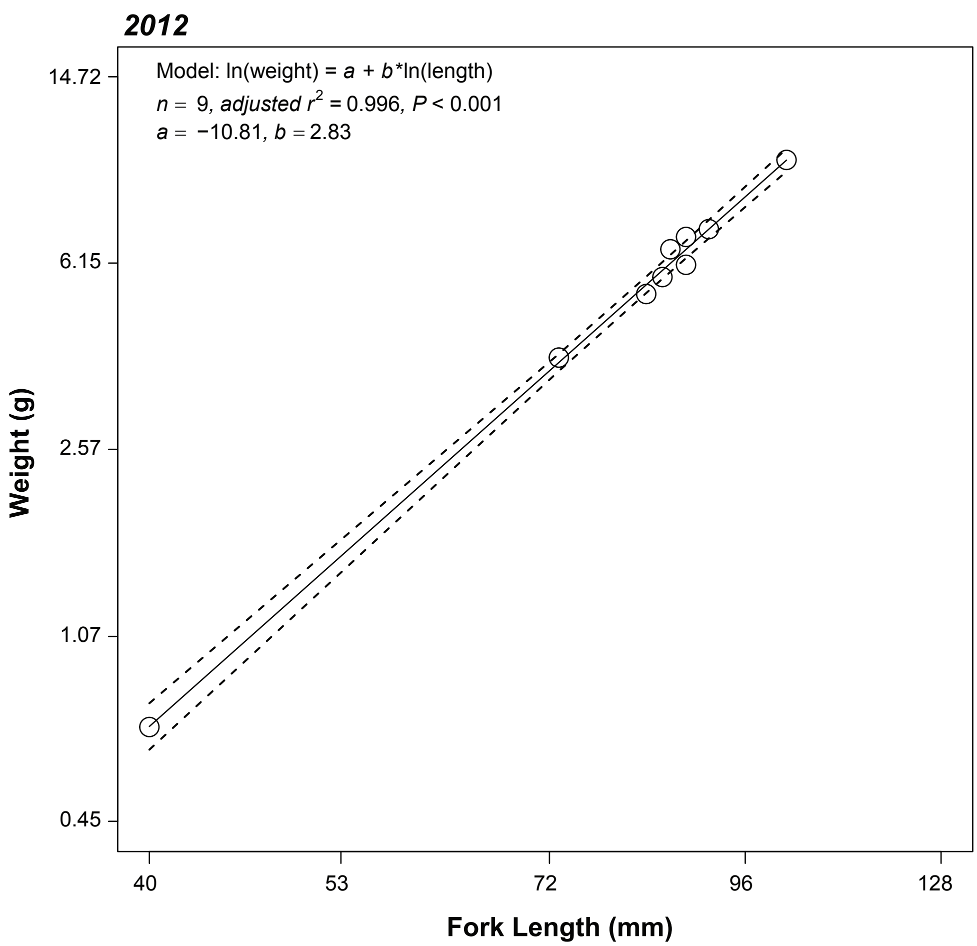

Note: Axis values have been backtransformed from the natural log (Ln).

Figure 7.5-4

Weight-Length Regression for Dolly Varden/Bull Trout, MC1

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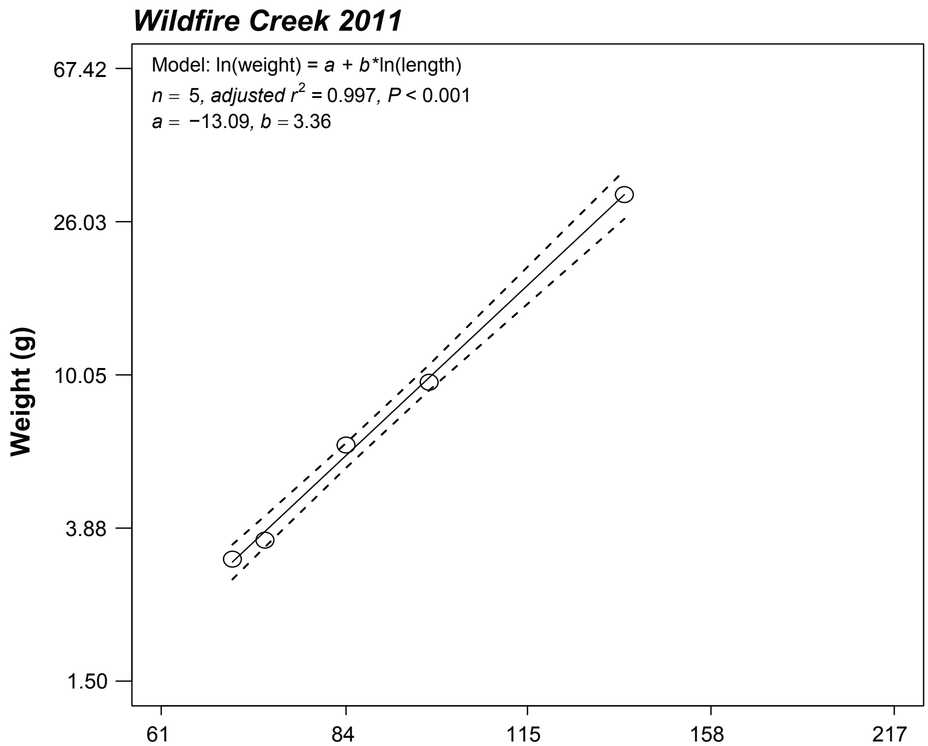

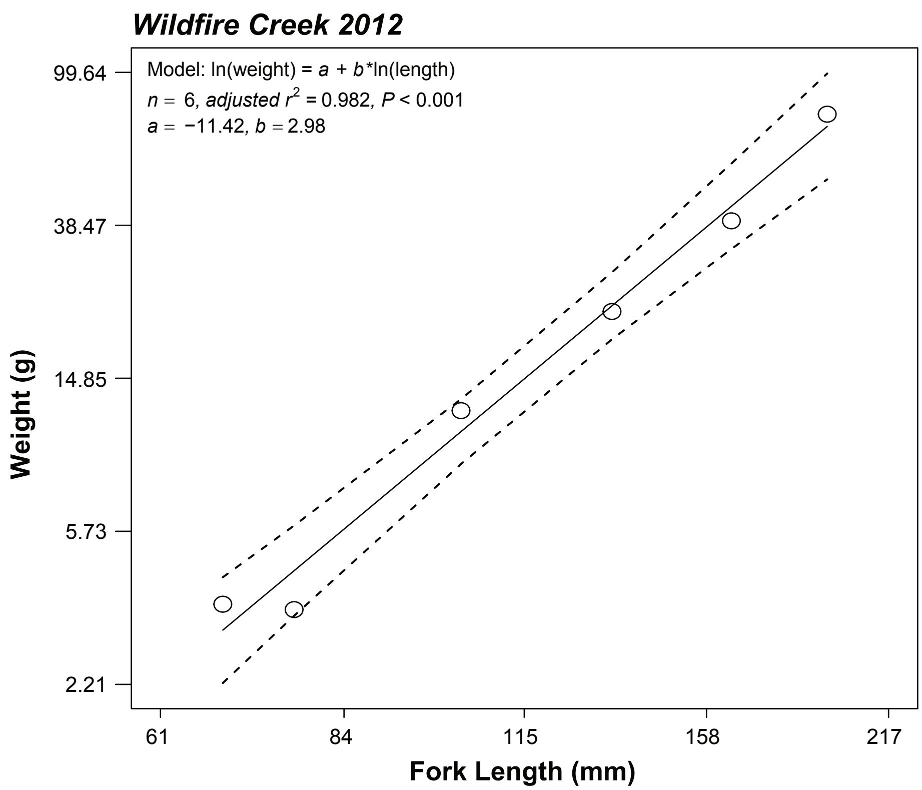

Note: Axis values have been backtransformed from the natural log (Ln).

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Weight-Length Regression for Dolly Varden/Bull Trout, WC1

Figure 7.5-5

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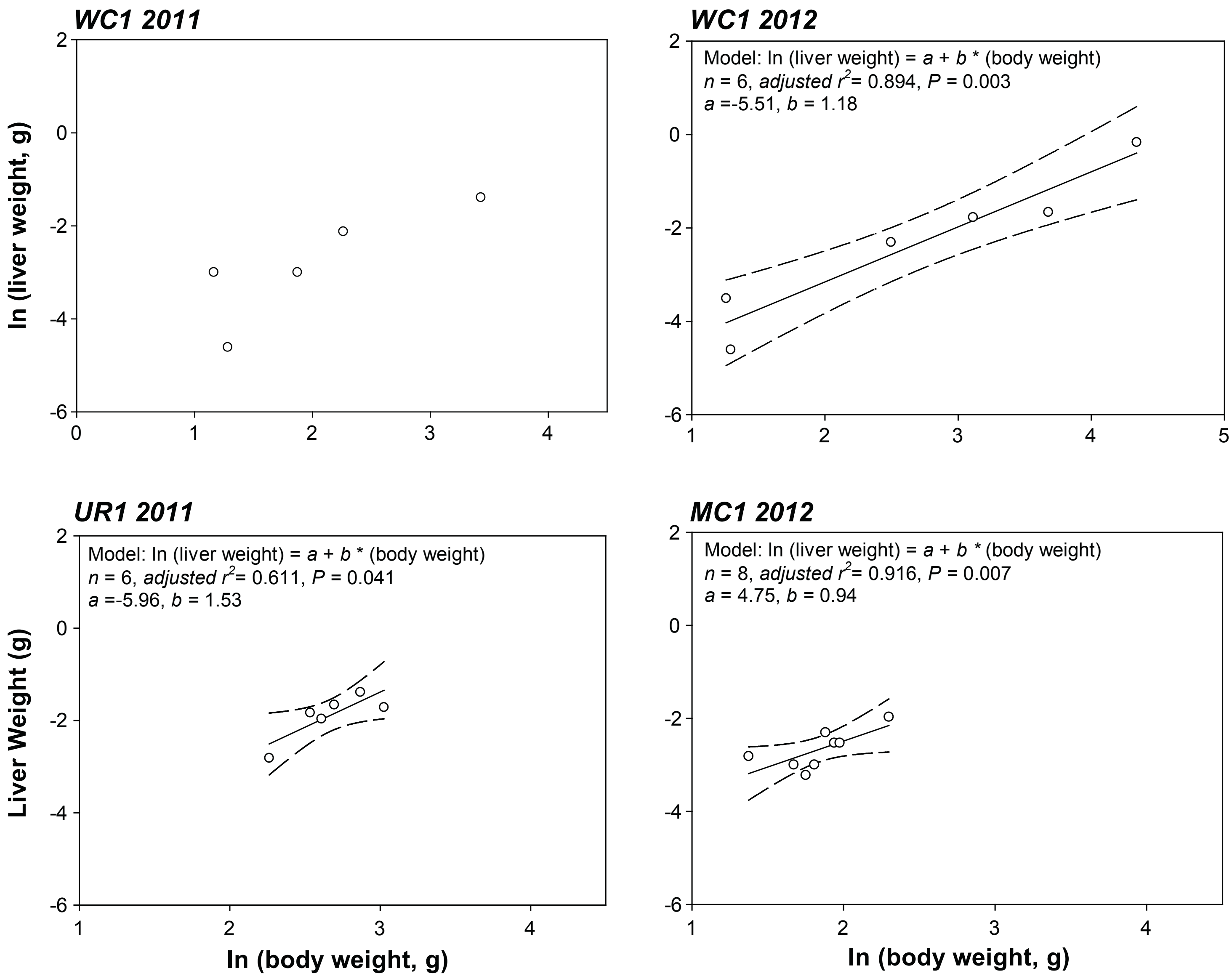

Figure 7.5-6

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Liver Weight-Body Weight Regression for Dolly Varden/Bull Trout at Selected Sites

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HSI provides a second comparison of body weight and liver size. There was no significant differences in HSI among any of sites and years (ANOVA, $F_{2,22}$=2.4, p=0.15).

7.5.4 Survival

The data necessary for measuring survival (age and length) can be gathered non-lethally, so length and age data from Dolly Varden/bull trout non-lethally sampled from the potential monitoring sites were included in the analyses. There was insufficient length and age data to develop meaningful age- and length-frequency distributions. Statistical summaries of age and length data are presented in Table 7.5-4.

There was no difference in length (two sample t-test, t_{28}=-0.58, p=0.57) or age (two sample t-test, t_4=-1.5, p=0.21) between Dolly Varden/bull trout captured at site UR1 in 2010 and in 2011. Fish captured in WC1 also showed no yearly variation in age (ANOVA, $F_{1,11}$=0.7, p=0.42) or length (ANOVA, $F_{1,18}$=1.9, p=0.19). The number of Dolly Varden/bull trout captured in MC1 in 2011 was insufficient to allow for interannual comparisons of fish from McInnes Creek.

7.5.5 Tissue Metals

Body length may influence tissue metal concentrations, but as there was no difference in mean length among the sites and years (ANOVA, $F_{2,21}$=0.8, p=0.45), direct comparisons between mean metal concentrations can be made.

Antimony, beryllium, bismuth, lithium, silver, and uranium were found below the detection limit in 90% or more of sites and were not included in further analysis.

Table 7.5-5 presents a summary of the mean concentrations of the remaining metals in fish tissue in the three monitoring sites. Observed concentrations are shown in Appendix 7.5-2.

The concentration of mercury in fish tissues was only significantly related to fork length in MC1 in 2011 (GLM, $F_{2,6}$=16.2, p=0.007). Contrary to expectation, the relationship between concentration of mercury and fork length at this site was negative, with larger fish having less mercury in their tissues (Figure 7.5-7). Mercury bioconcentrates in organisms, a trend that generally results in high mercury concentrations in larger, older animals. The sample size for this analysis was low, and the majority of the mercury concentrations observed in MC1 were very similar. As a result, two dissimilar observations have a strong influence on the analysis and may have biased results. Alternately, this unusual relationship may be due to a currently unknown life history trait or environmental event that resulted in smaller, younger fish experiencing greater mercury exposure than larger fish.

Fish captured in WC1 and UR1 showed no significant relationship between mercury concentration and body length (WC1, 2011: GLM, $F_{1,3}$=1.8, p=0.27; WC1, 2012: GLM, $F_{1,4}$=2.4, p=0.20; UR1, 2011: $F_{1,3}$=0.00, p=0.97).

All observed mercury concentrations were below the maximum allowable concentration of total mercury in fish muscle tissue as specified by Health Canada (2001).

Table 7.5-4. Summary Statistics of Dolly Varden/Bull Trout Energy Use Indicators from Selected Sites

		Fork Length (mm)							Weight (g)						
Site	Year	n	Mean	SD	SE	Median	Lower CI	Upper CI	n	Mean	SD	SE	Median	Lower CI	Upper CI
MC1	**2011**	1.0	40.0	NA	NA	40.0	40.0	40.0	1	0.7	NA	NA	0.7	0.7	0.7
	2012	8.0	87.0	8.1	2.9	87.0	74.8	100.1	8	6.5	1.7	0.6	6.3	4.2	9.5
UR1	**2010**	18.0	80.1	16.6	3.9	80.5	58.4	113.8	18	7.7	4.7	1.1	7.1	2.8	17.7
	2011	16.0	83.9	21.8	5.5	71.5	60.3	120.1	16	7.8	6.1	1.5	4.0	2.5	19.5
WC1	**2010**	9.0	96.6	26.4	8.8	105.0	52.2	121.0	9	11.7	7.1	2.4	13.3	1.6	20.9
	2011	5.0	91.8	27.0	12.1	84.0	69.4	132.1	5	10.7	11.5	5.1	6.5	3.2	28.7
	2012	6.0	123.7	50.2	20.5	118.5	69.1	191.3	6	26.4	28.2	11.5	17.3	3.5	72.1

		Age (years)						
Site	Year	n	Mean	SD	SE	Median	Lower CI	Upper CI
MC1	**2011**	1	0	NA	NA	0	0	0
	2012	0	NA	NA	NA	NA	NA	NA
UR1	**2010**	4	1	1	1	0	0	2
	2011	14	1	0	0	1	1	2
WC1	**2010**	6	1	1	0	1	0	2
	2011	5	1	1	1	1	0	3
	2012	2	1	0	0	1	1	1

NA = not available

n = sample size

SE = standard error of the mean

SD = standard deviation of the mean

CI = 95% confidence interval

Table 7.5-5. Summary of Mean Tissue Metal Concentration

			UR1				MC1				WC1							
			2011 (*n* = 5)				2012 (n = *8*)				2011 (*n* = 5)				2012 (n = 6)			
	Units	Detection Limit	Mean	SE	Min	Max	Mean	SE	Min	Max	Mean	SE	Min	Max	Mean	SE	Min	Max
Moisture	%	0.10	76.30	0.69	73.90	77.60	77.60	79.29	0.49	77.50	81.50	77.18	0.51	76.00	78.90	79.50	0.82	77.30
Aluminum (Al)	mg/kg WWT	2.0	47.2	15.0	19.3	99	99.0	24.1	10.8	5.3	90.7	21.4	15.0	1.0	79.9	4.0	1.0	1.0
Arsenic (As)	mg/kg WWT	0.010	0.157	0.039	0.077	0.287	0.287	0.023	0.006	0.011	0.050	0.027	0.006	0.012	0.045	0.026	0.005	0.013
Barium (Ba)	mg/kg WWT	0.010	0.999	0.364	0.422	2.26	2.260	0.408	0.150	0.107	1.390	0.501	0.259	0.030	1.330	0.088	0.018	0.011
Calcium (Ca)	mg/kg WWT	2.0	189.6	21.8	129.0	246.0	246.0	389.4	63.0	154.0	645.0	354.0	106.2	120.0	637.0	192.2	51.6	95.2
Cadmium (Cd)	mg/kg WWT	0.0050	0.0094	0.0015	0.0058	0.0149	0.0149	0.0042	0.0017	0.0025	0.0163	0.0048	0.0010	0.0025	0.0072	0.0033	0.0008	0.0025
Cobalt (Co)	mg/kg WWT	0.020	0.073	0.010	0.047	0.097	0.097	0.084	0.019	0.010	0.202	0.065	0.008	0.047	0.089	0.076	0.011	0.034
Chromium (Cr)	mg/kg WWT	0.10	0.12	0.03	0.05	0.23	0.23	0.14	0.05	0.05	0.37	0.20	0.11	0.05	0.59	0.12	0.07	0.05
Copper (Cu)	mg/kg WWT	0.010	0.927	0.353	0.459	2.33	2.330	0.507	0.034	0.365	0.654	0.440	0.056	0.321	0.604	0.699	0.166	0.322
Mercury (Hg)	mg/kg WWT	0.0010	0.0242	0.0034	0.0130	0.0330	0.033*	0.0232*	0.0013*	0.0156*	0.0292	0.0200	0.0021	0.0156	0.0281	0.0277	0.0039	0.0125
Magnesium (Mg)	mg/kg WWT	1.0	319.2	11.8	293.0	355.0	355.0	341.1	7.3	317.0	376.0	296.2	8.8	281.0	330.0	289.5	10.7	247.0
Manganese (Mn)	mg/kg WWT	0.010	1.730	0.483	0.835	3.35	3.350	0.872	0.269	0.389	2.410	0.575	0.161	0.253	1.150	0.338	0.041	0.154
Molybdinum (Mo)	mg/kg WWT	0.010	0.009	0.003	0.005	0.018	0.018	0.007	0.002	0.005	0.022	0.005	0.000	0.005	0.005	0.005	0.000	0.005
Nickel (Ni)	mg/kg WWT	0.10	0.07	0.02	0.05	0.14	0.14	0.10	0.03	0.05	0.28	0.07	0.02	0.05	0.14	0.07	0.02	0.05
Lead (Pb)	mg/kg WWT	0.020	0.032	0.009	0.010	0.064	0.064	0.012	0.002	0.010	0.026	0.010	0.000	0.010	0.010	0.010	0.000	0.010
Selenium (Se)	mg/kg WWT	0.20	0.79	0.04	0.67	0.89	0.89	0.46	0.02	0.39	0.58	0.85	0.05	0.74	0.98	0.82	0.08	0.52
Tin (Sn)	mg/kg WWT	0.050	0.025	0.000	0.025	0.025	0.025	0.040	0.011	0.025	0.110	0.025	0.000	0.025	0.025	0.046	0.014	0.025
Strontium (Sr)	mg/kg WWT	0.010	0.352	0.078	0.193	0.612	0.612	0.734	0.151	0.231	1.380	0.576	0.214	0.085	1.140	0.288	0.107	0.078
Thallium (Tl)	mg/kg WWT	0.010	0.011	0.002	0.005	0.017	0.017	0.005	0.000	0.005	0.005	0.009	0.004	0.005	0.024	0.010	0.003	0.005
Vanadium (V)	mg/kg WWT	0.10	0.25	0.08	0.11	0.54	0.54	0.10	0.03	0.05	0.30	0.09	0.04	0.05	0.27	0.05	0.00	0.05
Zinc (Zn)	mg/kg WWT	0.10	7.67	0.48	6.68	9.15	9.15	5.63	0.35	3.77	6.50	6.40	0.23	5.83	7.02	8.06	0.94	5.06

WWT = wet weight

n = number of samples

SE = standard error

Min = minumum

Max = maximum

** Samples showed significant relationship between concentration and fork length, mean may not accurately reflect population*

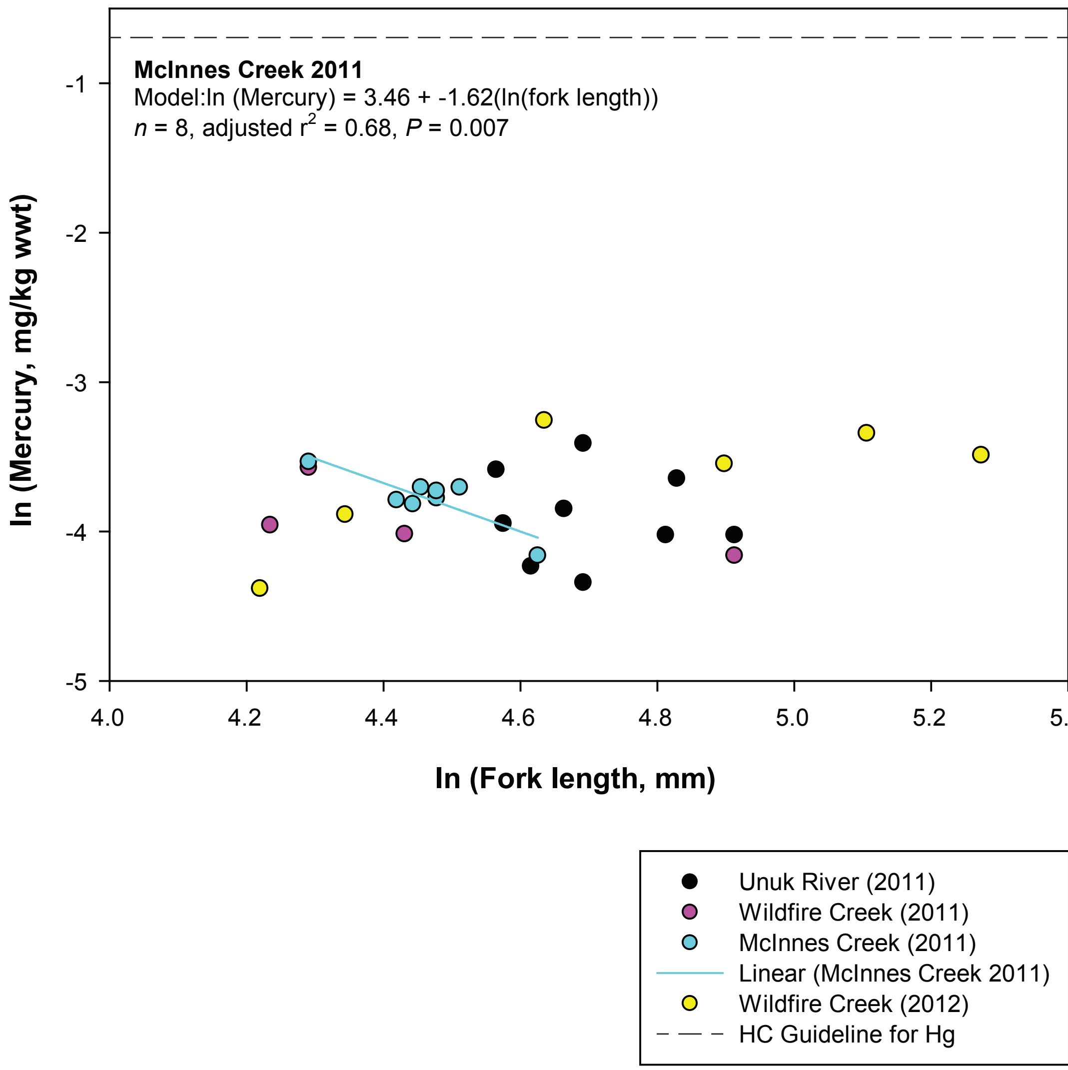

Figure 7.5-7

Mercury Concentrations on Fork Length of Dolly Varden/Bull Trout Sampled for Metals

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7.6 DIET

A description and enumeration of stomach contents from all lethally sampled fish from UR1, MC1 and WC1 is presented in Appendix 7.6-1. Percent stomach fullness ranged from 1% (in MC1) to 100% (all sites). Stomach weight was only significantly related to body weight in WC1 in 2011 and 2012 (GLM, $F_{1,5}$=10.2, p=0.02; and $F_{1,4}$=11.6, p=0.03, respectively; Figure 7.6-1). There was no significant relationship between stomach weight and body weight in MC1 in 2012 (GLM, $F_{1,6}$=0.3, p=0.59) or in UR1 in 2011 (GLM, $F_{1,4}$=0.3, p=0.61). Stomach size is generally related to body size, but stomach weight is affected by other factors, including stomach fullness and digestion. Given the low sample size in UR1 and MC1, the lack of a significant relationship may not accurately reflect the relationship between stomach weight and body weight in the population.

Plecoptera nymphs (stoneflies), Trichoptera larvae (caddisflies), and Ephemeroptera nymphs (mayflies) were the most abundant groups identified in fish stomachs by number and by weight (Figures 7.6-2 through 7.6-4). In UR1 in 2011 Trichoptera and Plecoptera comprise a total of 72% of the stomach contents by weight, while Ephemeroptera are comparatively underrepresented and comprise 14% of the stomach contents by number and 5% by weight. In contrast, stomach contents of fish captured in MC1 in 2012 were 39% Ephemeroptera by number and 40% by weight. The difference may be related to an annual difference in abundance of prey items, as the 2011 and 2012 stomach content samples from fish captured in WC1 range between 33% Ephemeroptera by weight in 2011 and 63% Ephemeroptera by weight in 2012. In WC1 in 2011, Plecoptera were the primary diet component instead, comprising 46% of the diet by weight.

Benthic/epibenthic (located at or near the substrate) food items comprised the majority of the diet in each site and year. Almost all major food types were benthic in origin, with Lepidoptera, Hymenoptera, and Coleoptera as the primary non-benthic food sources. Non-benthic food sources comprised approximately 6% of the total stomach content by weight. All non-benthic food sources were classified as drift food sources.

Non-food items, such as plants or pebbles, were found in the stomachs of every fish captured in UR1, and eight of the fish from WC1, but only in a single fish from MC1. Only one dissected stomach contained fish. The single fish comprised almost half of the stomach contents of that individual by weight, and was found in the stomach of a fish from UR1.

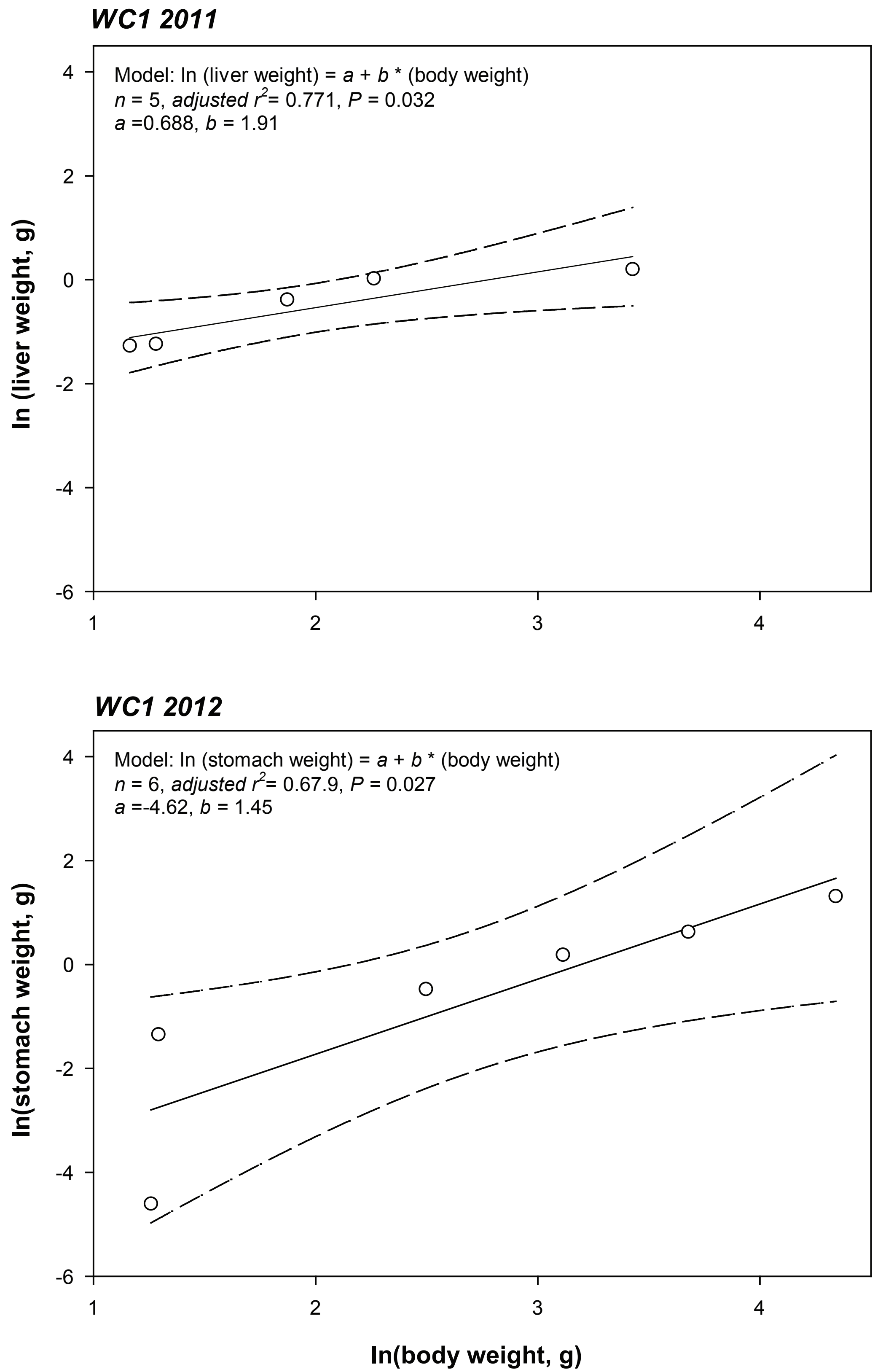


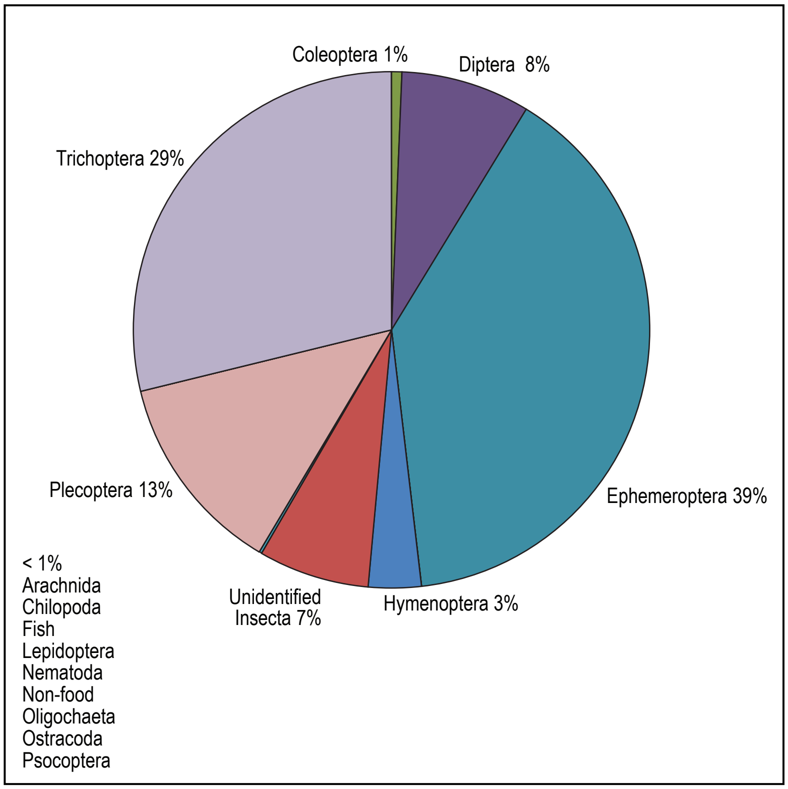
Figure 7.6-1

Stomach Weight-Body Weight Regression for Dolly Varden/Bull Trout in WC1

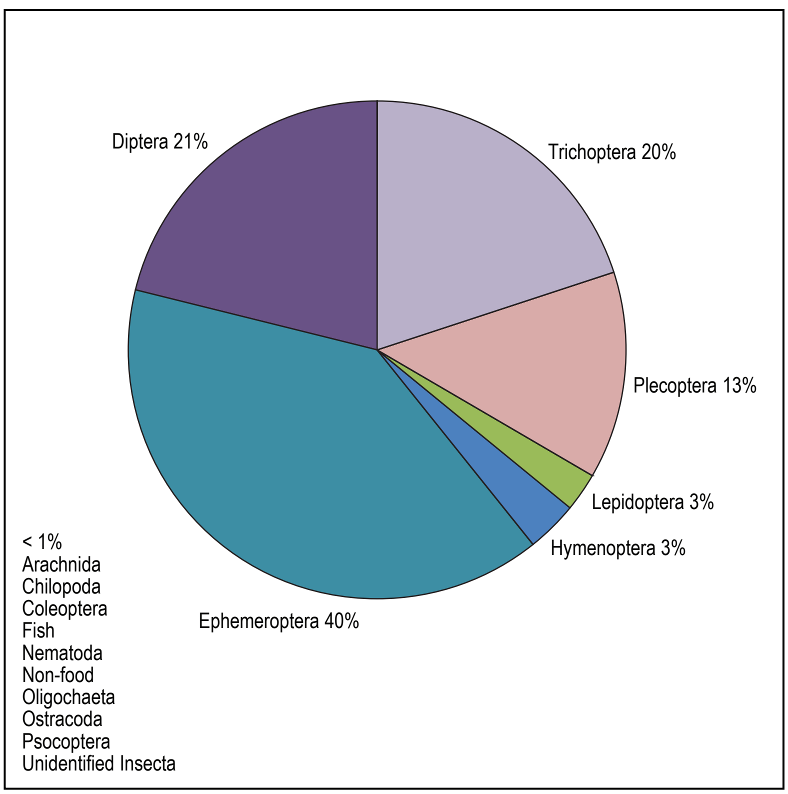
PRETIVM

Rescan Engineers & Scientists

By Weight



By Number



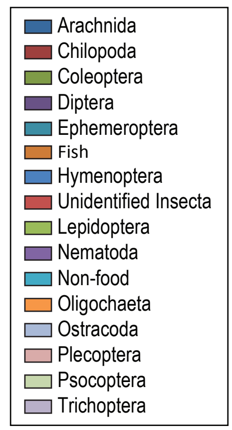


Figure 7.6-2

Mean Percent Composition of the Stomach Contents of Dolly Varden/Bull Trout, MC1, 2012

PRETIVM

Rescan Engineers & Scientists

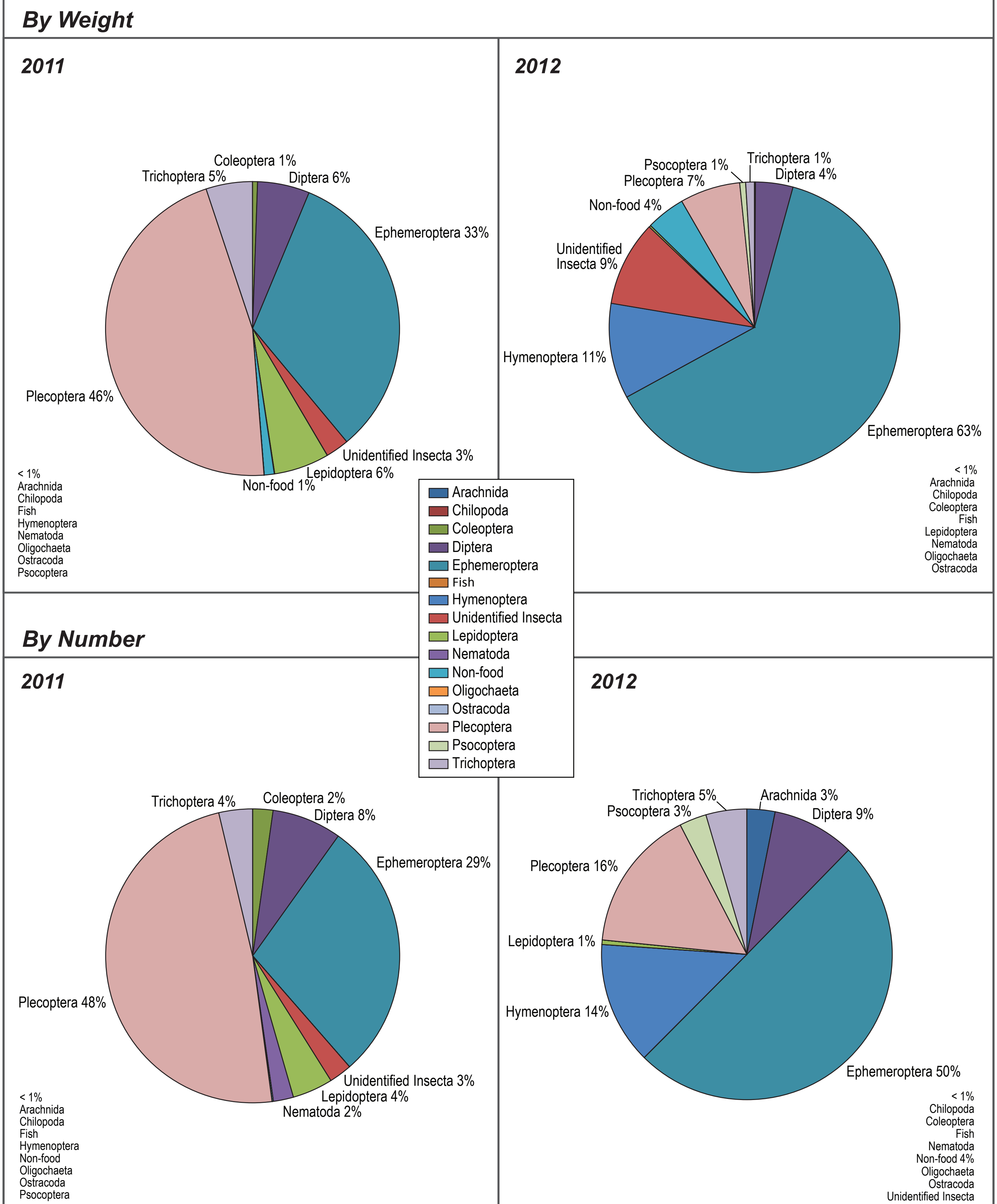


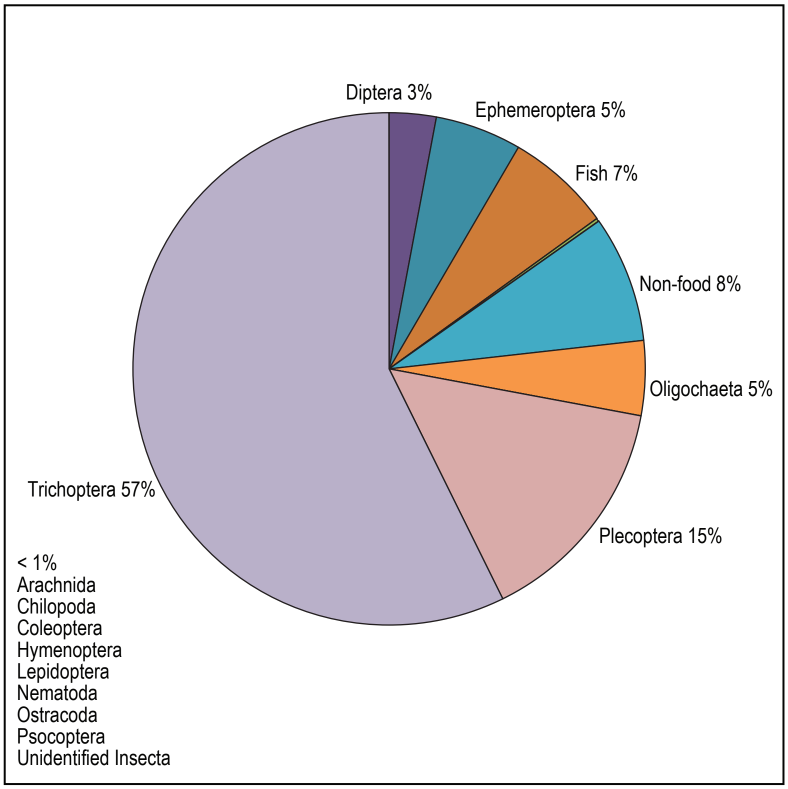
Figure 7.6-3

Mean Percent Composition of the Stomach Contents of Dolly Varden/Bull Trout, WC1

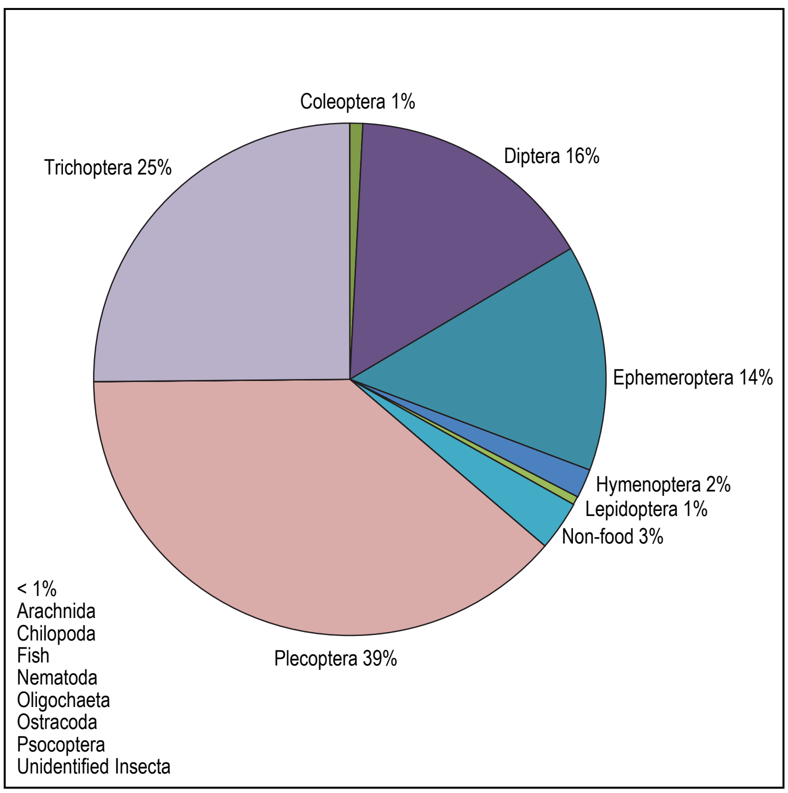
PRETIVM

Rescan Engineers & Scientists

By Weight



By Number



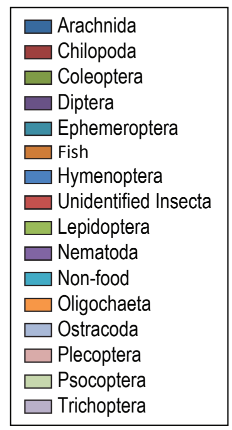


Figure 7.6-4

Mean Percent Composition of the Stomach Contents of Dolly Varden/Bull Trout, UR1, 2011

PRETIVM

Rescan Engineers & Scientists

8. Summary

8. Summary

The purpose of the Brucejack Gold Mine Project Fish and Fish Habitat Baseline Study was to provide baseline information on fish and fish habitat that may be impacted by the proposed mine and infrastructure development. This report described sampling procedures and results of study conducted in 2010, 2011, and 2012.

Brucejack Lake and immediate downstream environments including Brucejack Creek and the majority of Sulphurets Creek are non-fish bearing. However, the fish and fish habitat study area supports populations of several resident and migrant fish species. Fish communities were found in creeks, rivers, lakes and wetlands in the study area. Observed fish species were found in multiple life history stages, including spawning and rearing. Table 8-1 provides a summary of the fish habitat available in the region, summarized by species.

All surveyed watersheds had fish habitat. There was a range of types and qualities of habitat in the study area. Fish barriers were located on Sulphurets Creek, Wildfire Creek, Scott Creek, and McInnes Creek, and on numerous tributaries to the Upper Bowser River. It has been determined that there are no fish populations upstream of the Sulphurets Creek barrier and the Wildfire Creek barrier. Only one stream crossing along the proposed transmission line route – south option was designated fish-bearing.

Both Dolly Varden and bull trout were genetically confirmed to be present in the study area, and together comprised the most commonly caught fish species as well as the most widely dispersed. The Unuk River system appears to only support Dolly Varden, with no bull trout captured in this study or in historical surveys. Species distribution in the Bell-Irving River system is more complicated. In the Bowser River and Todedada Creek systems, the two species occur sympatrically, while only bull trout were identified in Todd Creek and Scott Creek, and only Dolly Varden identified in Wildfire Creek.

Rainbow trout, Chinook salmon, coho salmon, sockeye salmon, kokanee salmon, mountain whitefish, and longnose sucker were also captured in the study area.

Baseline data suitable for an environmental effect monitoring program was collected from the Unuk River, Wildfire Creek, and McInnes Creek. The associated analyses describe aspects of energy use, energy storage, survival, tissue metal content and diet.

Table 8-1. Species Life History Timing, Habitat Preference and Distribution within the Brucejack Gold Mine Project Region

Species	Specific Life History											
	Adult Migration	Spawning			Fry Emergence	Fry and Parr Rearing		Adult Rearing		Overwintering		Smolt Migration
	Timing	Timing	Habitat Preference	Distribution	Timing	Habitat Preference	Distribution	Habitat Preference	Distribution	Habitat Preference	Distribution	Timing
Chinook	Oct-Sept	Sept-Nov	Glides and pools, gravel substrate, large streams	Unuk River, Bell-Irving River	Apr-May	Small to medium streams, large stream margins	Unuk River, Bell-Irving River, and tributaries	N/A	N/A	Large channels	Unuk River, Bell-Irving River	May-June
Coho	Sept-Nov	Sept-Dec	Glides and pools tailouts, gravel substrate, small to large streams	Unuk River, Bell-Irving River, Todedada River, Bowser River, and tributaries	Apr-May	Small to medium streams, beaver ponds, off-channel areas and fisheries sensitive zones	Unuk River, Bell-Irving River, Todedada River, Bowser River, and tributaries	N/A	N/A	Large channels, deep slow pools, beaver ponds	Unuk River, Bell-Irving River, Todedada River, Bowser River, and tributaries	May-June
Dolly Varden/ bull trout	Sept - Oct	Sept - Oct	Small streams	Throughout region	Apr - May	Small streams, sidechannels, Stream margins, wetlands	Throughout region	All stream types, sidechannels, wetlands	Throughout region	Deep, slow pools	Throughout region	N/A
Longnose sucker	Apr - June	June	Riffles in tributaries of large waterbodies	Bowser River/Lake	June	Shallow, weedy lake shorelines	Bowser Lake/River and tributaries	Cold, deep lakes	Bowser Lake	Deep lakes	Bowser Lake, Bowser River	N/A
Mountain whitefish	N/A	Oct-Nov	Shallow water near riffles, coarse substrate	Bowser River/Lake, Todedada Creek	May-June	Sidechannels and river margins	Bowser River/Lake and tributaries, Todedada Creek and tributaries	Slow moving areas next to fast riffles in large streams, lakes	Bowser River/Lake, Todedada Creek	Large rivers and lakes	Bowser Lake, Bowser Rive	N/A
Rainbow trout	N/A	Apr - May	Fine gravel, riffle areas	Bowser, Bell-Irving, Todedada, Wildfire streams and tributaries	May-June	Clear, low velocity, small to moderate sized streams and tributaries, lakes	Bowser, Bell-Irving, Todedada, Wildfire watersheds	Small to moderate streams and tributaries, lakes	Bowser, Bell-Irving, Todedada, Wildfire watersheds	Deep pools and slow areas of large channels, lakes	Bowser, Bell Irving, Todedada and Wildfire Creek, lakes	N/A
Steelhead*	May-Aug, Nov-Dec	July-Aug, Nov-Dec	Coarse gravel, large streams	Bell-Irving, Bowser River, Todedada, Wildfire watersheds	Apr-May	Clear, low velocity, small to moderate size streams and tributaries	Bowser, Bell-Irving, Todedada, Wildfire watersheds	N/A	N/A	Deep pools and slow areas of large channels	Bowser, Bell Irving, Todedada and Wildfire Creek, lakes	Apr-May
Sockeye salmon	Aug-Oct	Sept-Oct	Slow moving small to moderate sized channels, lake shores	Bell-Irving, Bowser River/Lake, Todedada, Unuk watersheds	Apr-May	Large ponds, large streams, lakes	Bowser Lake, Bowser River, Unuk River, Bell-Irving River	N/A	N/A	Deep pools and slow areas of large channels	Bowser Lake, Bowser River, Unuk River, Bell-Irving River	May-June

**Steelhead occur historically in the region. As juvenile steelhead are indistinguishable from juvenile rainbow trout, distribution is assumed based on habitat preferences.*

N/A - does not generally occur in freshwater systems

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Rescan
Engineers and Scientists

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Appendix 7.2-1

Stream Habitat Site Cards, Brucejack Gold Mine Project, 2010 to 2012

Engineers and Scientists

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-00000-00000-0000-0000-000-000-000-000-000-000	1.1			1

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: BOWSER RIVER   Local Name:
Watershed Code: 560-208600-00000-00000-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 1.1   Site #: 1
Field UTM (Z.E.N): ..   Method: Site Lg: 150   Method: RF   Access: H
GIS UTM (Z.E.N): 9.451088.6251772   Ref. Name: BR1/201
Date: 2010/08/27   Time: 09:30   Agency: C660   Crew: KM/LT/KW   Fish Crd?: ☑   Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	RF	120.00	122.00	90.00	112.00							111.00
Wetted Width (m):	RF	75.00	61.00	70.00	99.00							76.25
Pool Depth (m):	MS	0.60										0.60

	Gadient %		Mtd	Avg
Method I:	0.5		C	0.50
Method II:			C	

No Vis.Ch.: ☐   Intermittent: ☐
Dw: ☐   Tribs.: ☐

Wb Depth:	1.2	3.6	

Avg: 2.40   Method: MS   Stage: L ☐ M ☑ H ☐

COVER   Total: M

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	T	T	S	T	D	S	N
Loc: P/S/O:	☐☑☐	☐☑☐	☐☑☐	☐☑☐	☐☑☐	☐☑☐	☐☑☐

CROWN CLOSURE
1   1-20%
INSTREAM VEG: N ☑ A ☐ M ☐ V ☐

LWD: F   DIST: E

LB SHP: S
Texture: F ☐ G ☑ C ☑ B ☐ R ☐ A ☐
RIP: D
STG: YF

RB SHP: S
Texture: F ☐ G ☑ C ☑ B ☐ R ☐ A ☐
RIP: S
STG: PS

WATER

EMS: Req #:
Temp: 5   Method: T3   Cond.: 60   Method: S3
pH: 8.1   Method: P2   Turb.: T ☑ M ☐ L ☐ C ☐   Method: GE
Flood Signs: Method: GE

MORPHOLOGY

Bed Material: Dominant: C   Subdom: G
D95: 27.0   D (cm): 20.00   Morph: RPG
Pattern: ME
Islands: F
Coupling: PC
Confinement: FC
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☑	☐	☐	☑	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☑	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☑ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Rearing Habitat	GOOD - LOTS OF COVER AND BANK VEGETATION, LOWER VELOCITY AREAS, GOOD CONNECTION TO DOWNSTREAM HABITATS
OverWinter Habitat	GOOD - DEEP POOL HABITAT DOMINATES

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	DIG	F:	4264	STD	U	VIEW OF 0M TO 50M (0M IS UPSTREAM EXTENT)
R:	DIG	F:	4265	STD	U	VIEW AT 92M ALONG SIDECHANNEL SHOWING GLIDE HABITAT AND OV
R:	DIG	F:	4266	STD	D	SAME AS 4265

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-00000-00000-0000-0000-000-000-000-000-000-000	1.1			1

P H O T O S

Photo				Foc Lg	Dir	Comments
R:	DIG	F:	4267	STD	U	VIEW NEAR BOTTOM AT 140M
R:	DIG	F:	4268	STD	D	140M
R:	DIG	F:	4269	STD	D	PAN FROM 4268
R:	DIG	F:	4270	STD	D	PAN FROM 4269
R:	DIG	F:	4271	STD	X	RB OF MAINSTEM SHOWING EROSION
R:	DIG	F:	4272	STD	X	AERIAL VIEW OF SITE
R:	DIG	F:	4273	STD	X	AERIAL VIEW OF SITE

Site # 1 Photo: IMGP4272
Site 1 - An aerial view of the site.

Site # 1 Photo: IMGP4264
Site 1 - An upstream view of the site.

Site # 1 Photo: IMGP4268
Site 1 - A downstream view of the site.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-00000-00000-0000-0000-000-000-000-000-000-000	2.1			2

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER — Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: BOWSER RIVER — Local Name:
Watershed Code: 560-208600-00000-00000-0000-0000-000-000-000-000-000-000
ILP Map#: — ILP #: — NID Map #: — NID #: — Reach #: 2.1 — Site #: 2

Field UTM (Z.E.N): .. — Method: — Site Lg: 200 — Method: GE — Access: H
GIS UTM (Z.E.N): 9.453896.6252998 — Ref. Name: 202

Date: 2010/08/26 — Time: 12:30 — Agency: C660 — Crew: KM/LT/KW — Fish Crd?: ☑ — Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	RF	31.00	34.50	24.00	16.00	30.00						27.10
Wetted Width (m):	RF	30.00	23.50	24.00	13.00	29.50						24.00
Pool Depth (m):	MS	0.15	0.30									0.23

	Gadient %		Mtd	Avg
Method I:	1.0	0.5	C	0.75
Method II:			C	

No Vis.Ch.: ☐ Intermittent: ☐
Dw: ☐ Tribs.: ☐

Wb Depth:	.8	.5	

Avg: 0.65 — Method: MS — Stage: L ☑ M ☐ H ☐

COVER — Total: M

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	T	T	S	T	D	S	T
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
1 1-20%
INSTREAM VEG: N ☐ A ☐ M ☐ V ☐

LWD: F — DIST: E

LB SHP: S
Texture: F ☑ G ☑ C ☐ B ☐ R ☐ A ☐
RIP: D
STG: YF

RB SHP: S
Texture: F ☑ G ☑ C ☐ B ☐ R ☐ A ☐
RIP: S
STG: SHR

WATER

EMS: — Req #:
Temp: 7 — Method: T3 — Cond.: 110 — Method: S3
pH: 7.4 — Method: P2 — Turb.: T ☐ M ☐ L ☐ C ☑ — Method: GE
Flood Signs: — Method: GE

MORPHOLOGY

Bed Material: — Dominant: G — Subdom: C
D95: 18.0 — D (cm): 18.00 — Morph: RPG

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☑	☐	☐	☑	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☑	☐	☐	☐	☐

Pattern: SI
Islands: F
Coupling: DC
Confinement: FC
FSZ: ☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☑ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Spawning Habitat	GOOD - GRAVEL SUBSTRATE AND HOLDING AREAS FOR ADULTS
Rearing Habitat	GOOD - COVER FROM TURBIDITY, POOLS AND OVERHEAD COVER. SMALL DV IN SHALLOW RIFFLES, LARGER DV AND WHITEFISH IN DEEPER AREAS
OverWinter Habitat	GOOD - DEEP SCOUR POOLS ALONG CHANNEL EDGE, DECENT FLOW
Off Channel	SHALLOW OPEN SLOUGH AT 120M. POOR FISH HABITAT BUT SIGNS OF USE BY WILDLIFE (MOOSE AND BEAVER)

Site # 2 Photo: IMGP4252
Site 2 - An upstream view of the site.

Site# 2 Photo: IMGP4253
Site 2 - A downstream view of the site.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-00000-00000-0000-0000-000-000-000-000-000-000	1.0			100

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: BOWSER RIVER   Local Name:
Watershed Code: 560-208600-00000-00000-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 1.0   Site #: 100
Field UTM (Z.E.N): ..   Method: Site Lg: 150   Method: HC   Access: H
GIS UTM (Z.E.N): 9.453917.6252990   Ref. Name: Bowser Creek
Date: 2010/06/23   Time: 12:06   Agency: C660   Crew: KM/LT/KW   Fish Crd?: ☑   Incomplete: ☑

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	MS	30.40	30.40	30.40	23.00	17.60	22.90					25.78
Wetted Width (m):	MS	30.20	29.20	29.20	22.90	17.40	21.00					24.98
Pool Depth (m):	MS	0.29										0.29

	Gadient %		Mtd	Avg
Method I:	1.5	1.8	C	1.65
Method II:			C	

Wb Depth: .3   Avg: 0.30   Method: MS   Stage: L ☐ M ☐ H ☑
No Vis.Ch.: ☐   Intermittent: ☐   Dw: ☐   Tribs.: ☐

COVER   Total: T

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	T	T	N	T	T	D	T
Loc: P/S/O:	☑☑☐	☑☑☐	☑☑☑	☐☑☐	☑☑☐	☑☑☐	☑☐☐

CROWN CLOSURE
1   1-20%
INSTREAM VEG: N ☐ A ☑ M ☐ V ☐

LWD: F   DIST: E

LB SHP: S
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: S
STG: SHR

RB SHP: S
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: S
STG: SHR

WATER

EMS: Req #:
Temp: 6   Method: T3   Cond.: 100   Method: S3
pH: 8.6   Method: P2   Turb.: T ☑ M ☐ L ☐ C ☐   Method: GE
Flood Signs: Method: GE

MORPHOLOGY

Bed Material: Dominant: F   Subdom: G
D95: 9.90   D (cm): 9.90   Morph: RPG
Pattern: SI
Islands: F
Coupling: DC
Confinement: OC
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☑	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☑	☐	☐	☐	☑	☐	☐	☐	☐

Bars: N ☐ SIDE ☐ DIAG ☐ MID ☑ SPAN ☐ BR ☐

FEATURES

NID Map	NID	Type	Hgt	Method	Lg	Method	Photo		AirPhoto		UTM (Z/E/N)	Method
		SD	.0	GE	80	GE	R:	F:	L:	#:	9.453855.6252942	GP3

Comments: PHOTO US

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	1	F:	6433	STD	D	VIEW OF MAINSTEM GLIDE DOWNSTREAM OF SIDECHANNEL
R:	1	F:	6435	STD	U	VIEW FROM B0OTTOM OF THE SIDE CHANNEL
R:	1	F:	6436	STD	U	VIEW FROM TOP OF SIDE CHANNEL

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-00000-00000-0000-0000-000-000-000-000-000-000	1.0			100

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	1	F:	6464	STD	U	VIEW OF SIDE CHANNEL AND MAIN CHANNEL

COMMENTS

Section	Comments
SITE CARD	SIDE CHANNEL IS ESPECIALLY PRODUCTIVE, MOST FISH CAUGHT HERE
COVER	CHANNEL BANKS PROVIDE MOST OV FOR FISH. MAIN COVER PROVIDED BY TURBID WATER, NEXT IS OV AND DP IN SIDECHANNEL.
SITE CARD	HABITAT ALONG M/S MAINLY GLIDE - MUDDY ALONG BANKS AND GRAVEL EMBEDDED IN FINES IN DEEPER, HIGHER CURRENT AREA. FREQUENT SIDE CHANNELS - 2 LOCATED WITHIN 100M OF CHANNEL ALONG RB. ISLANDS VEGETATED

Site # 100 Photo: IMGP6435
Site 100 - An upstream view of the side channel habitat.

Site # 100 Photo: IMGP6433
Site 100 - A downstream view of the mainstem.

FDIS Site Card

Watershed Code	Reach #	ILP Map #	ILP #	Site
560-208600-00000-00000-0000-0000-000-000-000-000-000-000	2.0			101

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER — Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: BOWSER RIVER — Local Name:
Watershed Code: 560-208600-00000-00000-0000-0000-000-000-000-000-000-000
ILP Map#: — ILP #: — NID Map #: — NID #: — Reach #: 2.0 — Site #: 101
Field UTM (Z.E.N): .. — Method: — Site Lg: 95 — Method: RF — Access: H
GIS UTM (Z.E.N): 9.451616.6251657 — Ref. Name:
Date: 2010/06/23 — Time: 14:17 — Agency: C660 — Crew: KM/LT/KW — Fish Crd?: ☑ — Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	RF	101.50	90.50	88.70								93.57
Wetted Width (m):	RF	92.35	81.38	79.55								84.43
Pool Depth (m):												0.00

	Gadient %	Mtd	Avg
Method I:	1.0	C	1.00
Method II:		C	

No Vis.Ch.: ☐ Intermittent: ☐ Dw: ☐ Tribs.: ☐

Wb Depth: .4 — Avg: 0.40 — Method: MS — Stage: L ☐ M ☑ H ☐

COVER — Total: T

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	T	N	D	T	N	S	N
Loc: P/S/O:	☑☑☐	☑☑☐	☑☑☐	☑☑☐	☑☑☐	☑☑☐	☑☑☐

CROWN CLOSURE: 1 1-20%
INSTREAM VEG: N ☑ A ☐ M ☐ V ☐

LWD: N — DIST: E

LB SHP: S
Texture: F ☐ G ☐ C ☑ B ☐ R ☐ A ☐
RIP: D
STG: MF

RB SHP: S
Texture: F ☐ G ☐ C ☑ B ☐ R ☐ A ☐
RIP: S
STG: SHR

WATER

EMS: — Req #:
Temp: 6 — Method: T3 — Cond.: 100 — Method: S3
pH: 8.3 — Method: P2 — Turb.: T ☑ M ☐ L ☐ C ☐ — Method: GE
Flood Signs: — Method: GE

MORPHOLOGY

Bed Material: — Dominant: C — Subdom: G
D95: 14.0 — D (cm): 12.00 — Morph: RP
Pattern: SI
Islands: F
Coupling: DC
Confinement: OC
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☑	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☑ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Rearing Habitat	FAIR - SWIIFT WATER BUT THE EDGES OF THE ISLAND AND THE RIFFLE AT THE TOP OF THE ISLAND PROVIDE SOME LOWER VELOCITY REFUGE

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	1	F:	6439	STD	U	R TO L OF TOP OF ISLAND TAKEN NEAR RL
R:	1	F:	6440	STD	U	PAN FROM 6439
R:	1	F:	6441	STD	D	PAN FROM L TO R OF BOTTOM OF THE ISLAND
R:	1	F:	6442	STD	D	PAN FROM 6441

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-00000-00000-0000-0000-000-000-000-000-000-000	2.0			101

PHOTOS						
Photo				Foc Lg	Dir	Comments
R:	1	F:	6443	STD	U	RIFFLE HABITAT NEAR TOP OF ISLAND
R:	1	F:	6444	STD	D	EDGE HABITAT, SK CAUGHT HERE ALONG R SIDE OF ISLAND

COMMENTS	
Section	Comments
SITE CARD	ONLY 1 SK CAPTURED WITH EF METHODS, BUT 2 OTHER MISSED. ALL FISH CAUGHT ALONG RB OF ISLAND

Site # 101 Photo: IMGP6439
Site 101 - The upstream view from island.

Site # 101 Photo: IMGP6441
Site 101 - The downstream view from island showing edge habitat.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-00000-00000-0000-0000-000-000-000-000-000-000	3.0			102

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER — Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: BOWSER RIVER — Local Name:
Watershed Code: 560-208600-00000-00000-0000-0000-000-000-000-000-000-000
ILP Map#: — ILP #: — NID Map #: — NID #: — Reach #: 3.0 — Site #: 102
Field UTM (Z.E.N): .. — Method: — Site Lg: 233 — Method: HC — Access: H
GIS UTM (Z.E.N): 9.451275.6251714 — Ref. Name:
Date: 2010/06/23 — Time: 15:30 — Agency: C660 — Crew: KM/LT/KW — Fish Crd?: ☑ — Incomplete: ☑

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	T	8.40	12.60	16.30	13.50	17.80	26.70					15.88
Wetted Width (m):	T	7.30	9.10	13.70	11.00	15.50	25.60					13.70
Pool Depth (m):												0.00

	Gadient %		Mtd	Avg
Method I:	1.0	0.5	C	1.67
Method II:	3.5		C	

No Vis.Ch.: ☐ — Intermittent: ☐
Dw: ☐ — Tribs.: ☐

Wb Depth: | | | — Avg: 0.00 — Method: — Stage: L ☐ M ☑ H ☐

COVER — Total:

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	T	T	T	N	D	S	T
Loc: P/S/O:	☐☐☐	☐☐☐	☐☐☐	☐☐☐	☐☐☐	☐☐☐	☐☐☐

CROWN CLOSURE
1 — 1-20%
INSTREAM VEG: N ☐ A ☐ M ☑ V ☐

LWD: F — DIST: C

LB SHP: S
Texture: F ☑ G ☐ C ☑ B ☐ R ☐ A ☐
RIP: S
STG: SHR

RB SHP: S
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: S
STG: SHR

WATER

EMS: — Req #:
Temp: 6 — Method: T3 — Cond.: 100 — Method: S3
pH: 8.3 — Method: P2 — Turb.: T ☑ M ☐ L ☐ C ☐ — Method: GE
Flood Signs: — Method: GE

MORPHOLOGY

Bed Material: — Dominant: F — Subdom: C
D95: 0.18 — D (cm): 0.15 — Morph: RPG
Pattern: SI
Islands: O
Coupling: DC
Confinement: OC
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☑	☐	☐	☐	☐

Bars: N ☑ SIDE ☐ DIAG ☐ MID ☐ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Rearing Habitat	GOOD - SLOW MOVING POOLS, SOME RIFFLES, IV, SHRUBS, AND OV EXTENSIVE ALONG LB. DIVERSE HABITAT LOWER DOWN WHERE IT BRANCHES

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	1	F:	6445	STD	U	View Habitat unit 1
R:	1	F:	6449	STD	U	VIEW HABITAT UNIT 2
R:	1	F:	6450	STD	D	VIEW HABITAT UNIT 2
R:	1	F:	6451	STD	U	VIEW HABITAT UNIT 3

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-00000-00000-0000-0000-000-000-000-000-000-000	3.0			102

PHOTOS							
Photo				Foc Lg	Dir	Comments
R:	1	F:	6452	STD	D	VIEW HABITAT UNIT 3
R:	1	F:	6453	STD	U	VIEW HABITAT UNIT 4
R:	1	F:	6454	STD	D	VIEW HABITAT UNIT 4
R:	1	F:	6646	STD	D	VIEW HABITAT UNIT 1

Site # 102 Photo: IMGP6445
Site 102 - The upstream view of Habitat Unit 1.

Site # 102 Photo: IMGP6449
Site 102 - The upstream view of Habitat Unit 2.

Site # 102 Photo: IMGP6451
Site 102 - The upstream view of Habitat Unit 3.

Site # 102 Photo: IMGP6454
Site 102 - The downstream view of Habitat Unit 4.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-39300-00000-0000-0000-000-000-000-000-000-000	1.0			103

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: SCOTT CREEK   Local Name:
Watershed Code: 560-208600-39300-00000-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 1.0   Site #: 103
Field UTM (Z.E.N): ..   Method: Site Lg: 65   Method: HC   Access: H
GIS UTM (Z.E.N): 9.452949.6253051   Ref. Name:
Date: 2010/06/24   Time: 09:30   Agency: C660   Crew: KM/LT/KW   Fish Crd?: ☑   Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	T	27.30	28.50	25.70	31.60	17.90						26.20
Wetted Width (m):	T	14.00	14.50	18.40	15.10	17.30						15.86
Pool Depth (m):	MS	0.13										0.13

	Gadient %		Mtd	Avg
Method I:	0.5	2.5	C	1.50
Method II:			C	

No Vis.Ch.: ☐   Intermittent: ☐
Dw: ☐   Tribs.: ☐

Wb Depth:	1.3	.7	

Avg: 1.00   Method: MS   Stage: L ☐ M ☑ H ☐

COVER   Total: M

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	S	D	T	S	T	S	T
Loc: P/S/O:	☑☑☐	☑☑☐	☑☑☐	☑☑☐	☑☑☐	☑☑☐	☑☑☐

CROWN CLOSURE
1   1-20%
INSTREAM VEG: N ☐ A ☐ M ☐ V ☑

LWD: A   DIST: C

LB SHP: S
Texture: F ☑ G ☐ C ☑ B ☐ R ☐ A ☐
RIP: D
STG: MF

RB SHP: S
Texture: F ☑ G ☐ C ☑ B ☐ R ☐ A ☐
RIP: D
STG: MF

WATER

EMS: Req #:
Temp: 5   Method: T3   Cond.: 100   Method: S3
pH: 8.1   Method: P2   Turb.: T ☑ M ☐ L ☐ C ☐   Method: GE
Flood Signs: Method: GE

MORPHOLOGY

Bed Material: Dominant: G   Subdom: C
D95: 28.0   D (cm): 26.00   Morph: RPG
Pattern: SI
Islands: F
Coupling: PC
Confinement: OC
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☑	☐	☐	☑	☑	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☑ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Spawning Habitat	GOOD IN RIFFLES AT US AND DS ENDS OF THE ISLAND
Rearing Habitat	MARGINAL IN MAINSTEM DUE TO HIGH VELOCITY BUT GOOD IN SIDE CHANNEL WHERE THERE IS ABUNDANT OVERHEAD COVER, UNDERCUT BANKS, SLOW BACKWATER CHANNELS, SHALLOW HABITAT, AND WOODY DEBRIS

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	1	F:	3909	STD	U	VIEW FROM L TO R, SECONDARY CHANNEL
R:	1	F:	3910	STD	U	PAN FROM 3909
R:	1	F:	3911	STD	D	VIEW FROM R TO L OF SECONDARY CHANNEL

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-39300-00000-0000-0000-000-000-000-000-000-000	1.0			103

P H O T O S

Photo				Foc Lg	Dir	Comments
R:	1	F:	3912	STD	D	PAN FROM 3911
R:	1	F:	3913	STD	U	VIEW US FROM TOP OF VEGETATED ISLAND

Site # 103 Photo: IMGP3913
Site 103 - An upstream view of the site, showing mainstem and side channel diverging.

Site # 103 Photo: IMGP3911
Site 103 - A downstream view of the side channel.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-39300-00000-0000-0000-000-000-000-000-000-000	2.0			104

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: SCOTT CREEK   Local Name:
Watershed Code: 560-208600-39300-00000-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 2.0   Site #: 104
Field UTM (Z.E.N): ..   Method: Site Lg: 65   Method: T   Access: H
GIS UTM (Z.E.N): 9.452364.6256689   Ref. Name:
Date: 2010/06/24   Time: 11:54   Agency: C660   Crew: KM/LT/KW   Fish Crd?: ☑   Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	RF	17.00	16.20	22.80	22.10	14.30	15.90					18.05
Wetted Width (m):	RF	15.50	10.80	11.30	21.80	14.30	15.90					14.93
Pool Depth (m):	MS	0.15										0.15

	Gadient %		Mtd	Avg
Method I:		4.0	C	4.00
Method II:			C	

No Vis.Ch.: ☐   Intermittent: ☐
Dw: ☐   Tribs.: ☐

Wb Depth:	.7		

Avg: 0.70   Method: MS   Stage: L ☐ M ☑ H ☐

COVER   Total: M

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	S	S	D	N	T	T	N
Loc: P/S/O:	☑☑☐	☑☑☐	☑☐☐	☑☑☐	☑☑☐	☑☑☐	☑☑☐

CROWN CLOSURE
1   1-20%
INSTREAM VEG: N ☑ A ☐ M ☐ V ☐

LWD: A   DIST: C

LB SHP: V
Texture: F ☑ G ☐ C ☑ B ☐ R ☐ A ☐
RIP: M
STG: MF

RB SHP: S
Texture: F ☐ G ☐ C ☑ B ☑ R ☐ A ☐
RIP: D
STG: MF

WATER

EMS: Req #:
Temp: 6   Method: T3   Cond.: 90   Method: S3
pH: 8.0   Method: P2   Turb.: T ☑ M ☐ L ☐ C ☐   Method: GE
Flood Signs: Method: GE

MORPHOLOGY

Bed Material: Dominant: B   Subdom: C
D95: 0.30   D (cm): 0.30   Morph: RP
Pattern: TM
Islands: F
Coupling: PC
Confinement: FC
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☑	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☑	☐	☐	☐	☐	☐	☐	☐	☑

Bars: N ☐ SIDE ☐ DIAG ☑ MID ☑ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Rearing Habitat	LIMITED TO LOW VELOCITY AREAS BEHIND BOULDERS AND ALONG EDGES. ABUNDANT LWD AND ISLANDS CREATED SIDECHANNEL HABITAT WHICH WAS SHALLOW WITH SMALL POOLS

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	1	F:	3914	STD	D	VIEW OF GLIDE (HABITAT UNIT 2) ON LEFT SIDE OF PIC
R:	1	F:	3915	STD	U	VIEW OF TOP OF SITE AND PLUNGE POOL CREATED BY LWD
R:	1	F:	3916	STD	D	SHALLOW RIFFLE ALONG SECONDARY CHANNEL ON R SIDE OF ISLAND

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-39300-00000-0000-0000-000-000-000-000-000-000	2.0			104

P H O T O S

Photo				Foc Lg	Dir	Comments
R:	1	F:	3917	STD	D	BOTTOM OF SITE, LOWER END OF SECONDARY CHANNEL, SLOW MAINSTEM EDGE HABITAT
R:	1	F:	3918	STD	U	VIEW FROM DS END OF SITE, MAINSTEM TO LEFT, SECONDARY CHANNEL TO RIGHT, ISLAND MID
R:	1	F:	3920	STD	U	VIEW FROM AIR OF CASCADE DOWNSTREAM OF SITE 104
R:	1	F:	3921	STD	D	VIEW OF ANOTHER CASCADE DOWNSTREAM FROM ABOVE CASCADE
R:	1	F:	3922	STD	U	VIEW OF SITE 104

Site # 104 Photo: IMGP3922
Site 104 - An aerial view of the site.

Site # 104 Photo: IMGP3918
Site 104 - An upstream view of the secondary channel entering the mainstem.

Site # 104 Photo: IMGP3915
Site 104 - A view of the mainstem habitat from the top of the site.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-39300-00000-0000-0000-000-000-000-000-000-000	3.0			105

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: SCOTT CREEK   Local Name:
Watershed Code: 560-208600-39300-00000-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 3.0   Site #: 105

Field UTM (Z.E.N): ..   Method: Site Lg: 82   Method: HC   Access: H
GIS UTM (Z.E.N): 9.452252.6257225   Ref. Name:

Date: 2010/06/24   Time: 14:30   Agency: C660   Crew: KM/LT/KW   Fish Crd?: ☑   Incomplete: ☑

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	T	21.00	20.00	24.10	37.70							25.70
Wetted Width (m):	T	16.40	17.30	23.00	15.40							18.02
Pool Depth (m):	MS	0.10										0.10

	Gadient %		Mtd	Avg
Method I:	5.5		C	5.50
Method II:			C	

No Vis.Ch.: ☐   Intermittent: ☐
Dw: ☐   Tribs.: ☐

Wb Depth:	1.1		

Avg: 1.10   Method: MS   Stage: L ☐ M ☑ H ☐

COVER   Total: T

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	S	S	D	N	N	T	N
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
0   0%
INSTREAM VEG: N ☐ A ☐ M ☑ V ☐

LWD: F   DIST: C

LB SHP: S
Texture: F ☐ G ☐ C ☑ B ☑ R ☐ A ☐
RIP: M
STG: MF

RB SHP: S
Texture: F ☐ G ☐ C ☑ B ☑ R ☐ A ☐
RIP: M
STG: MF

WATER

EMS: Req #:
Temp: 5   Method: T3   Cond.: 120   Method: S3
pH: 8.1   Method: P2   Turb.: T ☑ M ☐ L ☐ C ☐   Method: GE
Flood Signs: Method: GE

MORPHOLOGY

Bed Material: Dominant: C   Subdom: B
D95:   D (cm): 0.22   Morph: RP
Pattern: TM
Islands: F
Coupling: PC
Confinement: OC
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☑	☑	☑	☑	☑	☑	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☑ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Rearing Habitat	MARGINAL - TOO SWIFT

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	1	F:	3926	STD	U	VIEW US MS FROM TRIB. LOW VELOCITY HABITAT AMONGST B ON RIGHT SIDE OF PIC
R:	1	F:	3932	STD	U	U/S END OF SITE. EDGE HABITAT. EF'ED HERE
R:	1	F:	3933	STD	D	VIEW OF SITE SHOWING LOW VELOCITY. SECONDARY CHANNELS ON LEFT SIDE OF PIC
R:	1	F:	3934	STD	U	VIEW OF LOW VELOCITY SECONDARY CHANNEL ON LB
R:	1	F:	3935	STD	U	SAME AS 3934

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-39300-00000-0000-0000-000-000-000-000-000-000	3.0			105

COMMENTS	
Section	Comments
SITE CARD	SITE IS LOCATED 100M US OF A LARGE TRIBUTARY. HABITAT IS VERY MARGINAL.

Site # 105 Photo: IMGP3932
Site 105 - A view of the top of the site.

Site # 105 Photo: IMGP3933
Site 105 - A downstream view of the site, showing low velocity secondary channels.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-39300-00000-0000-0000-000-000-000-000-000-000	4.0			106

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER — Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: SCOTT CREEK — Local Name:
Watershed Code: 560-208600-39300-00000-0000-0000-000-000-000-000-000-000
ILP Map#: — ILP #: — NID Map #: — NID #: — Reach #: 4.0 — Site #: 106

Field UTM (Z.E.N): .. — Method: — Site Lg: 145 — Method: HC — Access: H
GIS UTM (Z.E.N): 9.453763.6261089 — Ref. Name:

Date: 2010/06/25 — Time: 09:00 — Agency: C660 — Crew: KM/LT/KW — Fish Crd?: ☑ — Incomplete: ☑

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	T	7.70	5.00	4.20	6.80	3.30						5.40
Wetted Width (m):	T	7.70	3.55	3.50	6.00	8.10						5.77
Pool Depth (m):												0.00

	Gadient %		Mtd	Avg
Method I:	1.0	3.5	C	2.13
Method II:	2.0	2.0	C	

No Vis.Ch.: ☐ — Intermittent: ☐
Dw: ☐ — Tribs.: ☐

Wb Depth: | | | — Avg: 0.00 — Method: — Stage: L ☐ M ☑ H ☐

COVER — Total: M

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	S	S	N	T	S	D	T
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
3 — 41-70%
INSTREAM VEG: N ☐ A ☐ M ☐ V ☑

LWD: F — DIST: E

LB SHP: S
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: C
STG: MF

RB SHP: S
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: C
STG: MF

WATER

EMS: — Req #:
Temp: 8 — Method: T3 — Cond.: 90 — Method: S3
pH: 7.9 — Method: P2 — Turb.: T ☐ M ☐ L ☐ C ☑ — Method: GE
Flood Signs: yes — Method: GE

MORPHOLOGY

Bed Material: — Dominant: G — Subdom: F
D95: 0.15 — D (cm): 0.13 — Morph: RPG

Pattern: SI
Islands: O
Coupling: DC
Confinement: OC
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☑	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☑	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☐ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
OverWinter Habitat	GOOD - DEEP PLUNGE POOL
Spawning Habitat	GOOD - GRAVEL, HOLDING POOLS
Rearing Habitat	GOOD - AREAS OF HIGH COVER, LWD, POOLS

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	1	F:	3949	STD	U	VIEW FROM 30M
R:	1	F:	3951	STD	D	SAME AS 3949
R:	1	F:	3952	STD	U	VIEW FROM 0M SHOWING LWD AND PLUNGE POOL

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-39300-00000-0000-0000-000-000-000-000-000-000	4.0			106

PHOTOS						
Photo				Foc Lg	Dir	Comments
R:	1	F:	3953	STD	D	OPEN SECTION OF STREAM
R:	1	F:	3954	STD	U	SAME AS 3953

WILDLIFE	
Group	Observations
MAM	BEAVER TRACKS AND DAM

Site # 106 Photo: IMGP3952
Site 106 - The upstream view from the bottom of the site.

Site # 106 Photo: IMGP3949
Site 106 - An upstream view of the site.

Site # 106 Photo: IMGP3954
Site 106 - A view of the top of the site.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-409900-38400-00000-0000-0000-000-000-000-000-000-000	3.0			107

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER — Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: TODEDADA CREEK — Local Name:
Watershed Code: 560-409900-38400-00000-0000-0000-000-000-000-000-000-000
ILP Map#: — ILP #: — NID Map #: — NID #: — Reach #: 3.0 — Site #: 107
Field UTM (Z.E.N): .. — Method: — Site Lg: 100 — Method: GE — Access: H
GIS UTM (Z.E.N): 9.452159.6267218 — Ref. Name:
Date: 2010/06/25 — Time: 12:00 — Agency: C660 — Crew: KM/LT/KW — Fish Crd?: ☑ — Incomplete: ☑

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	T	15.20	14.00	20.00	13.30	15.00	17.00					15.75
Wetted Width (m):	T	14.00	12.00	18.00	13.00	12.00	11.00					13.33
Pool Depth (m):	MS	0.10										0.10

	Gadient %		Mtd	Avg
Method I:	1.0		C	1.00
Method II:			C	

No Vis.Ch.: ☐ — Intermittent: ☐ — Dw: ☐ — Tribs.: ☐

Wb Depth:	.6		

Avg: 0.60 — Method: MS — Stage: L ☐ M ☑ H ☐

COVER — Total: T

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	D	S	S	T	S	T	T
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
1 — 1-20%
INSTREAM VEG: N ☐ A ☐ M ☐ V ☑

LWD: F — DIST: C

LB SHP: V
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: S
STG: SHR

RB SHP: S
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: S
STG: SHR

WATER

EMS: — Req #:
Temp: 7 — Method: T3 — Cond.: 110 — Method: S3
pH: — Method: P2 — Turb.: T ☑ M ☐ L ☐ C ☐ — Method: GE
Flood Signs: — Method: GE

MORPHOLOGY

Bed Material: — Dominant: G — Subdom: F
D95: 0.24 — D (cm): 0.23 — Morph: RP
Pattern: TM
Islands: O
Coupling: DC
Confinement: FC
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☑	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☑	☑	☐	☐	☐	☐

Bars: N ☐ SIDE ☐ DIAG ☐ MID ☑ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Spawning Habitat	IMPORTANT - POCKETS OF CLEAN GRAVEL
Rearing Habitat	IMPORTANT - WHILE THE US SIDE IS LARGELY RIFFLE HABITAT, BAHIND THE BEND THERE ARE AREAS OF SHALLOW SCOUR POOLS, SWD, AND OVERHANGING VEGETATION

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	1	F:	3960	STD	D	EDGEWATER POOL HABITAT DS OF THE END OF THE SITE
R:	1	F:	3961	STD	U	SAME AS 3960
R:	1	F:	3962	STD	U	VIEW OF BOULDER AND COBBLE RIFFLE HABITAT UPSTREAM END OF THE SITE

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-409900-38400-00000-0000-0000-000-000-000-000-000-000	3.0			107

P H O T O S

Photo				Foc Lg	Dir	Comments
R:	1	F:	3963	STD	D	SAME AS 3962
R:	1	F:	3964	STD	X	ARIAL VIEW OF SITE LOOKING NORTH

Site # 107 Photo: IMGP3965
Site 107 - An aerial view of the site.

Site # 107 Photo: IMGP3961
Site 107 - An upstream view from the bottom of the site.

Site # 107 Photo: IMGP3962
Site 107 - An upstream view showing the top of the site.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-409900-38400-00000-0000-0000-000-000-000-000-000-000	2.0			108

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER — Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: TODEDADA CREEK — Local Name:
Watershed Code: 560-409900-38400-00000-0000-0000-000-000-000-000-000-000
ILP Map#: — ILP #: — NID Map #: — NID #: — Reach #: 2.0 — Site #: 108
Field UTM (Z.E.N): .. — Method: — Site Lg: 120 — Method: HC — Access: H
GIS UTM (Z.E.N): 9.452498.6262132 — Ref. Name:
Date: 2010/06/25 — Time: 15:00 — Agency: C660 — Crew: KM/LT/KW — Fish Crd?: ☑ — Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	T	32.70	39.60	39.60	39.40							37.82
Wetted Width (m):	T	22.70	27.10	19.00	13.30							20.53
Pool Depth (m):	MS	0.16	0.13									0.14

	Gadient %		Mtd	Avg
Method I:	3.0	2.0	C	2.50
Method II:			C	

No Vis.Ch.: ☐ Intermittent: ☐ Dw: ☐ Tribs.: ☐

Wb Depth:	.6	.8	

Avg: 0.70 — Method: MS — Stage: L ☐ M ☑ H ☐

COVER — Total: T

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	T	S	D	T	T	T	N
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
1 — 1-20%
INSTREAM VEG: N ☐ A ☐ M ☐ V ☐

LWD: F — DIST: E

LB SHP: V
Texture: F ☑ G ☐ C ☑ B ☐ R ☐ A ☐
RIP: N
STG:

RB SHP: V
Texture: F ☑ G ☐ C ☑ B ☐ R ☐ A ☐
RIP: D
STG: MF

WATER

EMS: — Req #:
Temp: 6 — Method: T3 — Cond.: 100 — Method: S3
pH: 8.1 — Method: P2 — Turb.: T ☑ M ☐ L ☐ C ☐ — Method: GE
Flood Signs: SCOURED BANKS — Method: GE

MORPHOLOGY

Bed Material: — Dominant: C — Subdom: B
D95: 29.0 — D (cm): 27.00 — Morph: RPC
Pattern: ME
Islands: I
Coupling: DC
Confinement: OC
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☑	☑	☐	☐	☑	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☑	☐	☐	☐	☐	☑	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☑ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Rearing Habitat	IMPORTANT - LOCATED ALONG OFF CHANNEL. LOW COVER. ONE POOL AT CONFLUENCE AS WELL AS SEVERAL SHALLOW POOLS. LIMITED LWD

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	1	F:	3966	STD	U	VIEW OF MAIN RIVER CHANNEL BELOW SITE, SHOWING EROSION
R:	1	F:	3971	STD	D	VIEW OF DS END OF SITE 108 DOWNSTREAM OF SIDECHANNEL
R:	1	F:	3972	STD	U	SAME AS 3971
R:	1	F:	3973	STD	U	VIEW OF US END OF SIDE CHANNEL AND SITE

FDIS Site Card

Watershed Code	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-409900-38400-00000-0000-0000-000-000-000-000-000-000	2.0			108

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	1	F:	3974	STD	D	SAME AS 3973

WILDLIFE

Group	Observations
MAM	BLACK BEAR AND MOOSE TRACKS

Site # 108 Photo: IMGP3972
Site 108 - An upstream view of the site.

Site # 108 Photo: IMGP3966
Site 108 - The banks at the bottom end of the site showed evidence of erosion.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-409900-38400-00000-0000-0000-000-000-000-000-000-000	1.0			109

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: TODEDADA CREEK   Local Name:
Watershed Code: 560-409900-38400-00000-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 1.0   Site #: 109
Field UTM (Z.E.N): ..   Method: Site Lg: 131   Method: HC   Access: H
GIS UTM (Z.E.N): 9.451577.6260592   Ref. Name:
Date: 2010/06/26   Time: 08:00   Agency: C660   Crew: KM/LT/KW   Fish Crd?: ☑   Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	T	14.90	25.90	18.00	14.20	23.90	19.30					19.37
Wetted Width (m):	T	10.90	11.70	17.20	16.30	10.90	20.90					14.65
Pool Depth (m):	MS	0.21	0.90									0.55

	Gadient %		Mtd	Avg
Method I:	8.0	3.0	C	5.33
Method II:	5.0		C	

Wb Depth: 3.0 | .3 | Avg: 1.65   Method: MS   Stage: L ☐ M ☑ H ☐

No Vis.Ch.: ☐   Intermittent: ☐   Dw: ☐   Tribs.: ☐

COVER   Total: T

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	N	T	D	N	S	T	T
Loc: P/S/O:	☑☐☐	☑☐☐	☑☑☐	☑☐☐	☑☑☐	☑☐☐	☑☑☐

CROWN CLOSURE
0   0%
INSTREAM VEG: N ☐ A ☐ M ☑ V ☐

LWD: F   DIST: C

LB SHP: S
Texture: F ☐ G ☐ C ☑ B ☑ R ☐ A ☐
RIP: M
STG: MF

RB SHP: V
Texture: F ☐ G ☐ C ☑ B ☑ R ☐ A ☐
RIP: M
STG: MF

WATER

EMS: Req #:
Temp: 4   Method: T3   Cond.: 100   Method: S3
pH: 8.5   Method: P2   Turb.: T ☑ M ☐ L ☐ C ☐   Method: GE
Flood Signs: Method: GE

MORPHOLOGY

Bed Material: Dominant: B   Subdom: C
D95: 0.70   D (cm): 0.70   Morph: CPB
Pattern: TM
Islands: O
Coupling: CO
Confinement: CO
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☑	☐	☐	☑	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☑	☐	☑	☐	☐	☑	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☑ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
OverWinter Habitat	POOR - FAR TOO FAST WITH NO DEEP POOLS
Spawning Habitat	POOR - SMALL PATCHES OF GRAVEL IN SECONDARY CHANNEL, BUT NOT MUCH
Rearing Habitat	FAIR - LIMITED TO PARTS OF SECONDARY CHANNEL AND EDGEWATER AREAS EVERYWHERE ELSE VERY HIGH VELOCITY WITH NO COVER

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	DIG	F:	3977	STD	D	VIEW OF SECONDARY CHANNEL AND LOWER END OF SITE
R:	DIG	F:	3978	STD	U	VIEW OF EDGEWATER HABITAT, FROM 40M UPSTREAM TO SITE 109

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-409900-38400-00000-0000-0000-000-000-000-000-000-000	1.0			109

PHOTOS						
Photo				Foc Lg	Dir	Comments
R:	DIG	F:	3979	STD	D	VIEW AT 80M
R:	DIG	F:	3980	STD	D	CONTINUATION OF 3979
R:	DIG	F:	3981	STD	U	SAME AS 3979
R:	DIG	F:	3982	STD	D	VIEW FROM 120M TO END OF SITE
R:	DIG	F:	3983	STD	U	SAME AS 3982

Site # 109 Photo: IMGP3981
Site 109 - An upstream view of the top end of the site.

Site # 109 Photo: IMGP3980
Site 109 - A downstream view of the bottom end of the site.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-409900-38400-41700-0000-0000-000-000-000-000-000-000	1.0			110

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER — Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: — Local Name:
Watershed Code: 560-409900-38400-41700-0000-0000-000-000-000-000-000-000
ILP Map#: — ILP #: — NID Map #: — NID #: — Reach #: 1.0 — Site #: 110

Field UTM (Z.E.N): 9.451075.6263098 — Method: GP3 — Site Lg: 118 — Method: HC — Access: H
GIS UTM (Z.E.N): .. — Ref. Name:

Date: 2010/06/26 — Time: 12:00 — Agency: C660 — Crew: KM/LT/KW — Fish Crd?: ☑ — Incomplete: ☑

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):												0.00
Wetted Width (m):	T	13.60	8.60	15.00								12.40
Pool Depth (m):	MS	0.20										0.20

	Gadient %		Mtd	Avg
Method I:	0.5		C	0.50
Method II:			C	

No Vis.Ch.: ☐ — Intermittent: ☐ — Dw: ☐ — Tribs.: ☐

Wb Depth:	.6		

Avg: 0.60 — Method: MS — Stage: L ☑ M ☐ H ☐

COVER — Total: A

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	T	S	N	T	D	S	S
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
1 — 1-20%
INSTREAM VEG: N ☐ A ☐ M ☐ V ☑

LWD: F — DIST: C

LB SHP: S
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: C
STG: MF

RB SHP: O
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: S
STG: SHR

WATER

EMS: — Req #:
Temp: 6 — Method: T3 — Cond.: 110 — Method: S3
pH: 8.1 — Method: P2 — Turb.: T ☑ M ☐ L ☐ C ☐ — Method: GE
Flood Signs: — Method: GE

MORPHOLOGY

Bed Material: — Dominant: F — Subdom: G
D95: 4.00 — D (cm): 4.00 — Morph: RP
Pattern: IR
Islands: F
Coupling: PC
Confinement: UN
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☑	☐	☑	☐	☐	☐	☐

Bars: N ☐ SIDE ☐ DIAG ☐ MID ☐ SPAN ☐ BR ☑

HABITAT QUALITY

Name	Comments
Spawning Habitat	FAIR - SOME AREAS OF GRAVEL IN THE RIFFLES
OverWinter Habitat	GOOD - ABUNDANT DEEP POOLS
Rearing Habitat	EXCELLENT - ABUNDANT POOLS AND OVERHEAD COVER, SOME LWD

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	1	F:	3986	STD	D	LOWER END OF SITE WITH BRAIDED CHANNEL
R:	1	F:	3987	STD	U	SAME AS 3986
R:	1	F:	3988	STD	U	T2 WITH OPEN, POOLED AREA

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-409900-38400-41700-0000-0000-000-000-000-000-000-000	1.0			110

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	1	F:	3989	STD	D	SAME AS 3988
R:	1	F:	3990	STD	U	TOP END OF SITE WITH EXTENSIVE INSTREAM VEGETATION

COMMENTS

Section	Comments
SITE CARD	WETLAND CARD FILLED OUT FOR THIS SITE

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-40700-00000-0000-0000-000-000-000-000-000-000	1.0			111

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER — Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: TODD CREEK — Local Name:
Watershed Code: 560-208600-40700-00000-0000-0000-000-000-000-000-000-000
ILP Map#: — ILP #: — NID Map #: — NID #: — Reach #: 1.0 — Site #: 111
Field UTM (Z.E.N): .. — Method: — Site Lg: 220 — Method: HC — Access: H
GIS UTM (Z.E.N): 9.450882.6247507 — Ref. Name:
Date: 2010/06/27 — Time: 15:00 — Agency: C660 — Crew: KM/LT/KW — Fish Crd?: ☑ — Incomplete: ☑

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	RF	49.30	72.30									60.80
Wetted Width (m):	RF	34.30	45.50									39.90
Pool Depth (m):	MS	0.47	2.80	0.20								1.16

	Gadient %		Mtd	Avg
Method I:	0.5	0.5	C	0.50
Method II:			C	

No Vis.Ch.: ☐ Intermittent: ☐ Dw: ☐ Tribs.: ☐

Wb Depth:	.5	.6	

Avg: 0.55 — Method: MS — Stage: L ☐ M ☑ H ☐

COVER — Total: T

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	T	T	S	N	S	D	T
Loc: P/S/O:	☑☑☐	☑☑☐	☑☑☐	☑☑☐	☑☑☐	☑☑☐	☑☑☐

CROWN CLOSURE
1 1-20%
INSTREAM VEG: N ☐ A ☐ M ☐ V ☑

LWD: F — DIST: C

LB SHP: V
Texture: F ☐ G ☐ C ☐ B ☐ R ☑ A ☐
RIP: S
STG: SHR

RB SHP: S
Texture: F ☑ G ☐ C ☑ B ☐ R ☐ A ☐
RIP: M
STG: MF

WATER

EMS: — Req #:
Temp: — Method: T3 — Cond.: — Method: S3
pH: — Method: P2 — Turb.: T ☑ M ☐ L ☐ C ☐ — Method: GE
Flood Signs: RAFTED DEBRIS — Method: GE

MORPHOLOGY

Bed Material: — Dominant: C — Subdom: B
D95: 1.30 — D (cm): 0.82 — Morph: RPC
Pattern: SI
Islands: F
Coupling: CO
Confinement: FC
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☐ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Spawning Habitat	GOOD - AREAS OF GRAVEL
Rearing Habitat	FAIR - LARGE SECTIONS OF SLOW WATER HABITAT BUT LITTLE COVER

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	1	F:	4000	STD	U	VIEW ALONG LEFT SIDE OF MAIN STEM NEAR MID ISLAND
R:	1	F:	4001	STD	D	SAME AS 4000
R:	1	F:	4031	STD	U	LEFT SIDE OF MAIN STEM NEAR BOTTOM OF ISLAND
R:	1	F:	4032	STD	U	TRIBUTARY OUTLET, DS END OF ISLAND

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-40700-00000-0000-0000-000-000-000-000-000-000	1.0			111

P H O T O S

Photo				Foc Lg	Dir	Comments
R:	1	F:	4033	STD	U	SAME AS4032
R:	1	F:	4034	STD	D	VIEW OF HABITAT UNIT 1 POOL
R:	1	F:	4035	STD	U	LOWER END OF HABITAT UNIT 2
R:	1	F:	4036	STD	D	SAME AS 4035
R:	1	F:	4037	STD	U	SAME AS 4036
R:	1	F:	4038	STD	D	POOL ALONG HABITAT UNIT 2
R:	1	F:	4039	STD	U	HABITAT UNIT 3
R:	1	F:	4040	STD	NS	FALLS FEEDING TRIBUTARY AT 220M
R:	1	F:	4041	STD	NS	POOL IMMEDIATELY D/S OF FALLS. GOES SUBSURFACE FOR 5M BEFORE ENTERING HABITAT UNIT 2

C O M M E N T S

Section	Comments
WATER	HIGH CONDUCTIVITY IN THE CHANNEL FED BY THE TRIBUTARY BEFORE IT ENTERS TODD CREEK

Site # 111 Photo: IMGP4042
Site 111 - An aerial view of the site.

Site # 111 Photo: IMGP4000
Site 111 - An upstream view of the mainstem habitat.

Site # 111 Photo: IMGP4034
Site 111 - A downstream view of Habitat Unit 1, a tributary to Todd Creek.

Site # 111 Photo: IMGP4040
Site 111 - The waterfall directly upstream of the site.

FDIS Site Card

Watershed Code	Reach #	ILP Map #	ILP #	Site
960-250000-55300-00000-0000-0000-000-000-000-000-000-000	1.0			112

PROJECT

Project Name: Snowfields
Stream Name (gaz.): ALASKA RIVERS — Project Code: 20635
Project Watershed Code: 960-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: SULPHURETS CREEK — Local Name:
Watershed Code: 960-250000-55300-00000-0000-0000-000-000-000-000-000-000
ILP Map#: — ILP #: — NID Map #: — NID #: — Reach #: 1.0 — Site #: 112

Field UTM (Z.E.N): .. — Method: — Site Lg: 180 — Method: HC — Access: H
GIS UTM (Z.E.N): 9.408363.6261530 — Ref. Name:

Date: 2010/06/27 — Time: 08:00 — Agency: C660 — Crew: KM/LT/KW — Fish Crd?: ☐ — Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	T	43.80	40.60	39.60	44.50							42.12
Wetted Width (m):	T	29.10	27.30	23.70	29.10							27.30
Pool Depth (m):	MS	0.20										0.20

	Gadient %		Mtd	Avg
Method I:	1.5	2.5	C	2.00
Method II:			C	

Wb Depth:	1.6	.8	

Avg: 1.20 — Method: MS — Stage: L ☐ M ☑ H ☐

No Vis.Ch.: ☐ — Intermittent: ☐ — Dw: ☐ — Tribs.: ☐

COVER — Total: T

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	N	N	D	N	S	T	N
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
1 — 1-20%
INSTREAM VEG: N ☑ A ☐ M ☐ V ☐

LWD: F — DIST: E

LB SHP: V
Texture: F ☐ G ☐ C ☐ B ☐ R ☑ A ☐
RIP: C
STG: MF

RB SHP: V
Texture: F ☐ G ☐ C ☑ B ☐ R ☐ A ☐
RIP: C
STG: MF

WATER

EMS: — Req #:
Temp: 3 — Method: T3 — Cond.: 150 — Method: S3
pH: 8.2 — Method: P2 — Turb.: T ☑ M ☐ L ☐ C ☐ — Method: GE
Flood Signs: — Method: GE

MORPHOLOGY

Bed Material: — Dominant: C — Subdom: B
D95: 1.10 — D (cm): 35.00 — Morph: RP
Pattern: IM
Islands: O
Coupling: CO
Confinement: CO
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☑	☑	☐	☐	☑	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☑	☐	☑	☐	☐	☐	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☐ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Spawning Habitat	FAIR - SOME GRAVEL ON BARS
Rearing Habitat	MARGINAL - HIGH FLOWS, LOW COVER

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	1	F:	4002	STD	D	LOWER AND MID SITE
R:	1	F:	4003	STD	U	SAME AS 4002
R:	1	F:	4007	STD	U	MID SITE SHOWING SECONDARY CHANNEL ON LEFT SIDE
R:	1	F:	4008	STD	U	PAN FROM 4007

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 960-250000-55300-00000-0000-0000-000-000-000-000-000-000	1.0			112

PHOTOS						
Photo				Foc Lg	Dir	Comments
R:	1	F:	4009	STD	D	SECONDARY CHANNEL
R:	1	F:	4010	STD	U	SECONDARY CHANNEL

Site # 112 Photo: IMGP4003
Site 112 - An upstream view of the lower and mid portions of the site.

Site # 112 Photo: IMGP4002
Site 112 - A downstream view of the bottom end of the site.

Site # 112 Photo: IMGP4009
Site 112 - The secondary channel.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 960-250000-00000-00000-0000-0000-000-000-000-000-000-000	2.0			113

PROJECT

Project Name: Snowfields
Stream Name (gaz.): ALASKA RIVERS — Project Code: 20635
Project Watershed Code: 960-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: UNUK RIVER — Local Name:
Watershed Code: 960-250000-00000-00000-0000-0000-000-000-000-000-000-000
ILP Map#: — ILP #: — NID Map #: — NID #: — Reach #: 2.0 — Site #: 113
Field UTM (Z.E.N): .. — Method: — Site Lg: 138 — Method: HC — Access: H
GIS UTM (Z.E.N): 9.407571.6262191 — Ref. Name:
Date: 2010/06/27 — Time: 10:47 — Agency: C660 — Crew: KM/LT/KW — Fish Crd?: ☑ — Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	GE	70.00										70.00
Wetted Width (m):	GE	40.00										40.00
Pool Depth (m):	GE	0.25										0.25

	Gadient %		Mtd	Avg
Method I:	2.5		C	2.50
Method II:			C	

No Vis.Ch.: ☐ Intermittent: ☐ Dw: ☐ Tribs.: ☐

Wb Depth: — Avg: 0.00 — Method: — Stage: L ☐ M ☑ H ☐

COVER — Total: NS

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	N	S	T	N	D	N	N
Loc: P/S/O:	☐☑☐	☐☑☐	☐☑☐	☐☑☐	☐☑☐	☐☑☐	☐☑☐

CROWN CLOSURE
0 0%
INSTREAM VEG: N ☑ A ☐ M ☐ V ☐

LWD: F — DIST: C

LB SHP: S
Texture: F ☑ G ☐ C ☑ B ☐ R ☐ A ☐
RIP: N
STG:

RB SHP: S
Texture: F ☑ G ☐ C ☑ B ☐ R ☐ A ☐
RIP: N
STG:

WATER

EMS: — Req #:
Temp: 13 — Method: T3 — Cond.: — Method: S3
pH: — Method: P2 — Turb.: T ☑ M ☐ L ☐ C ☐ — Method: GE
Flood Signs: — Method: GE

MORPHOLOGY

Bed Material: — Dominant: F — Subdom: G
D95: 0.17 — D (cm): 0.12 — Morph: RP
Pattern: IM
Islands: F
Coupling: DC
Confinement: UN
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☑ MID ☑ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
OverWinter Habitat	FAIR - SEE REARING HABITAT FOR DESCRIPTION
Rearing Habitat	FAIR - SOME DEEP POOLS, GENTAL RIFFLES, AND A SHALLOW WARM SECTION WITH CLEAR WATER WHERE THE YOUNGEST CO WERE CAUGHT. LWD ABUNDANT ON ISLANDS AND BARS. MAIN COVER FROM POOLS AND LWD

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	DIG	F:	4022	STD	D	LOWER END OF SITE, HU1
R:	DIG	F:	4023	STD	U	LOWER END OF SITE
R:	DIG	F:	4024	STD	U	VIEW OF HU2

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 960-250000-00000-00000-0000-0000-000-000-000-000-000-000	2.0			113

PHOTOS							
Photo				Foc Lg	Dir	Comments
R:	DIG	F:	4025	STD	U	CHANNEL AT TOP END OF PICTURE IS HABITAT UNIT 3, WITH POOL NEAR LWD (HU4)
R:	DIG	F:	4046	STD	U	PAN TO LEFT OF 4025

COMMENTS	
Section	Comments
CHANNEL	SITE INCLUDES SECONDARY CHANNELS

Site # 113 Photo: IMGP4023
Site 113 - An upstream view of Habitat Unit 1.

Site # 113 Photo: IMGP4024
Site 113 - An upstream view of Habitat Unit 2.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 960-250000-55300-00000-0000-0000-000-000-000-000-000-000	1.1			203

PROJECT

Project Name: Snowfields
Stream Name (gaz.): ALASKA RIVERS — Project Code: 20635
Project Watershed Code: 960-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: SULPHURETS CREEK — Local Name:
Watershed Code: 960-250000-55300-00000-0000-0000-000-000-000-000-000-000
ILP Map#: — ILP #: — NID Map #: — NID #: — Reach #: 1.1 — Site #: 203

Field UTM (Z.E.N): .. — Method: — Site Lg: 100 — Method: GE — Access: H
GIS UTM (Z.E.N): 9.408387.6261597 — Ref. Name: SC1

Date: 2010/08/29 — Time: 14:45 — Agency: C660 — Crew: KM/LT/KW — Fish Crd?: ☑ — Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	RF	58.00	67.00	64.00	59.00							62.00
Wetted Width (m):	RF	35.50	40.90	40.10	45.20							40.43
Pool Depth (m):	MS	0.20										0.20

	Gadient %		Mtd	Avg
Method I:	2.0		C	2.00
Method II:			C	

No Vis.Ch.: ☐ — Intermittent: ☐ — Dw: ☐ — Tribs.: ☐

Wb Depth:	.9	.8	

Avg: 0.85 — Method: MS — Stage: L ☐ M ☑ H ☐

COVER — Total: T

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	N	N	D	N	T	S	N
Loc: P/S/O:	☑☑☐	☑☑☐	☑☑☐	☑☑☐	☑☑☐	☑☑☐	☑☑☐

CROWN CLOSURE
1 — 1-20%
INSTREAM VEG: N ☑ A ☐ M ☐ V ☐

LWD: N — DIST: NA

LB SHP: V
Texture: F ☐ G ☑ C ☑ B ☐ R ☐ A ☐
RIP: C
STG: MF

RB SHP: S
Texture: F ☐ G ☑ C ☑ B ☐ R ☐ A ☐
RIP: C
STG: MF

WATER

EMS: — Req #:
Temp: 6 — Method: T3 — Cond.: 130 — Method: S3
pH: 7.8 — Method: P2 — Turb.: T ☐ M ☑ L ☐ C ☐ — Method: GE
Flood Signs: — Method: GE

MORPHOLOGY

Bed Material: — Dominant: B — Subdom: C
D95: 37.0 — D (cm): 33.00 — Morph: RP

Pattern: TM
Islands: O
Coupling: CO
Confinement: EN
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☑ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
OverWinter Habitat	POOR - NO DEEP POOLS
Rearing Habitat	FAIR - VERY LITTLE LOW VELOCITY HABITAT, BUT SOME IN EDGEWATERS AND RIFFLES DOWNSTREAM OF GRAVEL BARS. LEFT BANK HAD SOME OVERHEAD COVER
Spawning Habitat	POOR - NO SPAWNING GRAVEL OBSERVED, BUT MAY HAVE BEEN OBSCURED BY TURBID WATERS

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	DIG	F:	4353	STD	D	PAN FROM LEFT TO RIGHT AT BOTTOM OF SITE
R:	DIG	F:	4354	STD	D	CONTINUED FROM 4353

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 960-250000-55300-00000-0000-0000-000-000-000-000-000-000	1.1			203

PHOTOS							
Photo				Foc Lg	Dir	Comments
R:	DIG	F:	4355	STD	D	CONTINUED FROM 4355
R:	DIG	F:	4356	STD	U	AERIAL VIEW OF SITE WITH CASCADES AT TOP OF PICTURE
R:	DIG	F:	4357	STD	U	SAME AS 4356

COMMENTS	
Section	Comments
CHANNEL	IMMEDIATELY DOWNSTREAM OF CASCADE BARRRIER

Site # 203 Photo: IMGP4357
Site 203 - An aerial view of the site.

Site # 203 Photo: IMGP4353
Site 203 - A downstream view of the site.

FDIS Site Card

Watershed Code: 560-409900-38400-00000-0000-0000-000-000-000-000-000-000	Reach #	ILP Map #	ILP #	Site
	1.1			204

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: TODEDADA CREEK   Local Name:
Watershed Code: 560-409900-38400-00000-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 1.1   Site #: 204
Field UTM (Z.E.N): ..   Method: Site Lg: 75   Method: GE   Access: H
GIS UTM (Z.E.N): 9.451575.6260610   Ref. Name: TC1
Date: 2010/08/28   Time: 11:00   Agency: C660   Crew: KM/LT/KW   Fish Crd?: ☐   Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	RF	25.00	14.00	11.30	10.60							15.23
Wetted Width (m):	RF	15.00	7.00	10.00	9.00							10.25
Pool Depth (m):	MS	0.18										0.18

	Gadient %		Mtd	Avg
Method I:	12.0	3.5	C	7.75
Method II:			C	

No Vis.Ch.: ☐   Intermittent: ☐   Dw: ☐   Tribs.: ☐

Wb Depth: 1.4   Avg: 1.40   Method: MS   Stage: L ☑ M ☐ H ☐

COVER   Total: T

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	N	T	D	N	T	S	N
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
1   1-20%
INSTREAM VEG: N ☑ A ☐ M ☐ V ☐

LWD: F   DIST: C

LB SHP: V
Texture: F ☐ G ☐ C ☑ B ☑ R ☐ A ☐
RIP: M
STG: YF

RB SHP: V
Texture: F ☐ G ☑ C ☑ B ☐ R ☐ A ☐
RIP: S
STG: SHR

WATER

EMS: Req #:
Temp: 4   Method: T3   Cond.: 120   Method: S3
pH: 8.0   Method: P2   Turb.: T ☐ M ☑ L ☐ C ☐   Method: GE
Flood Signs: Method: GE

MORPHOLOGY

Bed Material: Dominant: B   Subdom: C
D95: 120.0   D (cm): 75.00   Morph: CPB
Pattern: TM
Islands: O
Coupling: DC
Confinement: CO
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☑	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☑	☑	☐	☐	☑	☐	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☐ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Rearing Habitat	FAIR
OverWinter Habitat	POOR
Other	MIGRATION PAST CASCADE POSSIBLE AT HIGH FLOWS DUE TO SECONDARY CHANNEL AND SOME BOULDER EDDIES ALONG CREEK EDGES. BARRIER DOWNSTREAM
Spawning Habitat	POOR - THIS REACH EXPERIENCES TORRENTIAL FLOWS THAT RESULT IN A DOMINANT BOULDER SUBSTRATE WITH VERY LITTLE SPAWNING POTENTIAL

PHOTOS

Photo	Foc Lg	Dir	Comments

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-409900-38400-00000-0000-0000-000-000-000-000-000-000	1.1			204

P H O T O S

Photo				Foc Lg	Dir	Comments
R:	DIG	F:	4310	STD	U	AERIAL VIEW OF SITE
R:	DIG	F:	4311	STD	D	VIEW FROM UPSTREAM END OF SITE
R:	DIG	F:	4312	STD	U	VIEW OF CASCADE AT TOP OF SITE
R:	DIG	F:	4313	STD	D	VIEW OF RIFFLE AT 0+31M
R:	DIG	F:	4314	STD	X	VIEW OF SHORELINE CREATING BACK-EDDY POOL ALONG LEFT BANK
R:	DIG	F:	4315	STD	U	VIEW FROM DOWNSTREAM END OF SITE (0+75M)

C O M M E N T S

Section	Comments
SITE CARD	NO FISH FORM DUE TO LOW TEMPERATURE PROHIBITING ELECTROFISHING

Site # 204 Photo: IMGP4312
Site 204 - An upstream view of the site.

Site # 204 Photo: IMGP4313
Site 204 - A downstream view of the site.

FDIS Site Card

Watershed Code	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-409900-38400-00000-0000-0000-000-000-000-000-000-000	2.1			205

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: TODEDADA CREEK   Local Name:
Watershed Code: 560-409900-38400-00000-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 2.1   Site #: 205
Field UTM (Z.E.N): ..   Method: Site Lg: 150   Method: GE   Access: H
GIS UTM (Z.E.N): 9.452477.6261738   Ref. Name: TC2
Date: 2010/08/28   Time: 08:45   Agency: C660   Crew: KM/LT/KW   Fish Crd?: ☑   Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	RF	22.00	22.00	18.00	20.00	21.00	20.00	15.00				19.71
Wetted Width (m):	RF	11.00	9.00	7.00	7.00	6.00	12.00	11.00				9.00
Pool Depth (m):	MS	0.10	0.05									0.08

	Gadient %		Mtd	Avg
Method I:	1.5	2.0	C	1.83
Method II:	2.0		C	

No Vis.Ch.: ☐   Intermittent: ☐
Dw: ☐   Tribs.: ☐

Wb Depth:	1.0		

Avg: 1.00   Method: MS   Stage: L ☑ M ☐ H ☐

COVER   Total: M

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	N	T	S	N	T	D	N
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
1   1-20%
INSTREAM VEG: N ☑ A ☐ M ☐ V ☐

LWD: F   DIST: C

LB SHP: S
Texture: F ☐ G ☑ C ☑ B ☐ R ☐ A ☐
RIP: S
STG: INIT

RB SHP: V
Texture: F ☐ G ☐ C ☑ B ☑ R ☐ A ☐
RIP: D
STG: SHR

WATER

EMS: Req #:
Temp: 2   Method: T3   Cond.: 110   Method: S3
pH: 8.4   Method: P2   Turb.: T ☐ M ☑ L ☐ C ☐   Method: GE
Flood Signs: DEBRIS, SCOURING   Method: GE

MORPHOLOGY

Bed Material: Dominant: B   Subdom: C
D95: 38.0   D (cm): 38.00   Morph: RP
Pattern: ME
Islands: O
Coupling: DC
Confinement: FC
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☑	☐	☐	☑	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☑	☐	☐	☑	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☐ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Other	MIGRATION - FAIR
Spawning Habitat	POOR - SCOURING FLOWS AND LIMITED GRAVEL AREAS
OverWinter Habitat	FAIR
Rearing Habitat	FAIR - VELOCITY SHADOWS FROM BOULDERS IN SHALLOW RIFFLE AREAS MAKE THE BEST HOLDING AND REARING HABITAT OCCURRING NEAR THE BENDS AND ~200M APART
Cover	COVER MOSTLY FROM TURBID WATER, OV, AND BOULDERS

PHOTOS

Photo	Foc Lg	Dir	Comments

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-409900-38400-00000-0000-0000-000-000-000-000-000-000	2.1			205

PHOTOS						
Photo				Foc Lg	Dir	Comments
R:	DIG	F:	4294	STD	X	AERIAL VIEW OF SITE
R:	DIG	F:	4305	STD	U	VIEW OF SITE AT 0M (DOWNSTREAM END)
R:	DIG	F:	4306	STD	D	VIEW FROM 75M
R:	DIG	F:	4307	STD	D	VIEW FROM 100M
R:	DIG	F:	4308	STD	D	VIEW FROM 15M - RIFFLE WHERE MOST FISH CAUGHT THE DAY PRIOR
R:	DIG	F:	4309	STD	U	VIEW FROM TOP END OF SITE AT 100M

Site # 205 Photo: IMGP4305
Site 205 - An upstream view of the site.

Site # 205 Photo: IMGP4307
Site 205 - A downstream view of the site.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-409900-38400-00000-0000-0000-000-000-000-000-000-000	3.1			206

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER — Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: TODEDADA CREEK — Local Name:
Watershed Code: 560-409900-38400-00000-0000-0000-000-000-000-000-000-000
ILP Map#: — ILP #: — NID Map #: — NID #: — Reach #: 3.1 — Site #: 206
Field UTM (Z.E.N): .. — Method: — Site Lg: 75 — Method: GE — Access: H
GIS UTM (Z.E.N): 9.452234.6267150 — Ref. Name: TC3
Date: 2010/08/28 — Time: 15:00 — Agency: C660 — Crew: KM/LT/KW — Fish Crd?: ☑ — Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	RF	18.60	21.00	20.00	17.70	11.00	14.00					17.05
Wetted Width (m):	RF	8.00	11.00	14.00	14.00	8.00	10.00					10.83
Pool Depth (m):	MS	0.10	1.50	0.50								0.70

	Gadient %		Mtd	Avg
Method I:	1.0	1.0	C	1.00
Method II:			C	

Wb Depth:	.7	.9	1.0

Avg: 0.87 — Method: MS — Stage: L ☑ M ☐ H ☐
No Vis.Ch.: ☐ — Intermittent: ☐ — Dw: ☐ — Tribs.: ☐

COVER — Total: A

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	T	S	S	N	D	S	N
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
1 — 1-20%
INSTREAM VEG: N ☑ A ☐ M ☐ V ☐

LWD: NS — DIST: NS

LB SHP: S
Texture: F ☑ G ☐ C ☑ B ☐ R ☐ A ☐
RIP: S
STG: SHR

RB SHP: S
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: D
STG: PS

WATER

EMS: — Req #:
Temp: — Method: T3 — Cond.: — Method: S3
pH: — Method: P2 — Turb.: T ☑ M ☐ L ☐ C ☐ — Method: GE
Flood Signs: — Method: GE

MORPHOLOGY

Bed Material: — Dominant: C — Subdom: F
D95: 33.0 — D (cm): 25.00 — Morph: RP
Pattern: SI
Islands: I
Coupling: PC
Confinement: CO
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☑ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Rearing Habitat	EXCELLENT - COMPLEX HABITAT TYPES IN SITE
Other	MIGRATION - EXCELLENT
OverWinter Habitat	EXCELLENT - DEEP POOLS IN MEANDERS
Spawning Habitat	EXCELLENT - LARGE MEANDERS CREATE POCKETS OF EXCELLENT SPAWNING ON THE INSIDE OF THE BEND WHEN FLOWS ARE HIGH ENOUGH TO STAY WETTED

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	DIG	F:	4320	STD	U	VIEW FROM 0M

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-409900-38400-00000-0000-0000-000-000-000-000-000-000	3.1			206

PHOTOS						
Photo				Foc Lg	Dir	Comments
R:	DIG	F:	4321	STD	D	VIEW FROM 30M
R:	DIG	F:	4322	STD	D	VIEW OF BEND IN RIVER AT 60M
R:	DIG	F:	4323	STD	D	VIEW OF LARGE POOL AT RIVER BEN (27M) 2M DEPTH
R:	DIG	F:	4324	STD	D	VIEW OF TOP END OF SITE (85M)
R:	DIG	F:	4325	STD	U	AERIAL VIEW OF SITE

Site # 206 Photo: IMGP4325
Site 206 - An aerial view of the site.

Site # 206 Photo: IMGP4320
Site 206 - An upstream view of the site.

Site # 206 Photo: IMGP4321
Site 206 - A downstream view of the site.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-40700-00000-0000-0000-000-000-000-000-000-000	1.1			207

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: TODD CREEK   Local Name:
Watershed Code: 560-208600-40700-00000-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 1.1   Site #: 207
Field UTM (Z.E.N): ..   Method: Site Lg: 125   Method: GE   Access: H
GIS UTM (Z.E.N): 9.450797.6247264   Ref. Name: TD1
Date: 2010/08/30   Time: 15:00   Agency: C660   Crew: KM/LT/KW   Fish Crd?: ☑   Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	RF	41.00	78.00	78.00	79.00	65.00	62.00					67.17
Wetted Width (m):	RF	38.00	34.00	42.30	40.10	41.70	47.40					40.58
Pool Depth (m):	MS	4.00	21.10									12.55

	Gadient %		Mtd	Avg
Method I:	1.5		C	1.50
Method II:			C	

No Vis.Ch.: ☐   Intermittent: ☐   Dw: ☐   Tribs.: ☐

Wb Depth:	1.2	1.1	

Avg: 1.15   Method: MS   Stage: L ☑ M ☐ H ☐

COVER   Total: T

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	T	T	S	N	D	T	N
Loc: P/S/O:	☑☑☐	☑☑☐	☑☑☐	☑☑☐	☑☑☐	☑☑☐	☑☑☐

CROWN CLOSURE
0   0%
INSTREAM VEG: N ☑ A ☐ M ☐ V ☐

LWD: F   DIST: C

LB SHP: V
Texture: F ☑ G ☐ C ☐ B ☑ R ☐ A ☐
RIP: S
STG: SHR

RB SHP: V
Texture: F ☑ G ☐ C ☐ B ☑ R ☐ A ☐
RIP: S
STG: SHR

WATER

EMS: Req #:
Temp: 8   Method: T3   Cond.: 90   Method: S3
pH: 7.9   Method: P2   Turb.: T ☐ M ☑ L ☐ C ☐   Method: GE
Flood Signs: Method: GE

MORPHOLOGY

Bed Material: Dominant: B   Subdom: F
D95: 32.0   D (cm): 32.00   Morph: RPG
Pattern: IR
Islands: O
Coupling: CO
Confinement: FC
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☑	☐	☐	☑	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☑	☐	☐	☐	☐	☑	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☑ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Spawning Habitat	FAIR - IN MAINSTEM BEHIND LARGE BOULDERS AND IN SECONDARY CHANNEL WHERE THERE ARE DEEP POOLS
Rearing Habitat	FAIR - LIKELY IN SHALLOW RIFFLES IN SECONDARY CHANNEL
OverWinter Habitat	POOR - LIKELY FLUCTUATES IN FLOWS TOO MUCH

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	DIG	F:	4327	STD	X	AERIAL VIEW OF SITE TAKEN AUG 29
R:	DIG	F:	4365	STD	D	
R:	DIG	F:	4366	STD	U	PAN FROM RIGHT BANK TO LEFT AT 0M

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-40700-00000-0000-0000-000-000-000-000-000-000	1.1			207

PHOTOS							
Photo				Foc Lg	Dir	Comments
R:	DIG	F:	4367	STD	U	CONTINUED FROM 4366
R:	DIG	F:	4368	STD	U	CONTINUED FROM 4367
R:	DIG	F:	4369	STD	D	VIEW FROM TOP END OF SITE
R:	DIG	F:	4370	STD	U	SECONDARY CHANNEL, LOWER END OF SITE
R:	DIG	F:	4371	STD	D	SAME AS 4370

Site # 207 Photo: IMGP4366
Site 207 - An upstream view of the mainstem.

Site # 207 Photo: IMGP4371
Site 207 - A downstream view of the secondary channel.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-39300-00000-0000-0000-000-000-000-000-000-000	1.1			208

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: SCOTT CREEK   Local Name:
Watershed Code: 560-208600-39300-00000-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 1.1   Site #: 208

Field UTM (Z.E.N): ..   Method: Site Lg: 100   Method: GE   Access: H
GIS UTM (Z.E.N): 9.453468.6260718   Ref. Name: ST1

Date: 2010/08/30   Time: 12:00   Agency: C660   Crew: KM/LT/KW   Fish Crd?: ☑   Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	T	7.00	3.80	3.20	4.40	5.00	4.00					4.57
Wetted Width (m):	T	3.00	2.60	4.00	3.00	3.60						3.24
Pool Depth (m):	MS	0.15	0.27	0.12	0.19	0.07						0.16

	Gadient %		Mtd	Avg
Method I:	2.0		C	2.00
Method II:			C	

Wb Depth:	.2	.3	.2

Avg: 0.23   Method: MS   Stage: L ☑ M ☐ H ☐
No Vis.Ch.: ☐   Intermittent: ☐   Dw: ☐   Tribs.: ☐

COVER   Total: A

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	S	S	T	T	S	D	T
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
5   >90%
INSTREAM VEG: N ☐ A ☐ M ☑ V ☐

LWD: A   DIST: E

LB SHP: S
Texture: F ☑ G ☑ C ☐ B ☐ R ☐ A ☐
RIP: C
STG: MF

RB SHP: S
Texture: F ☐ G ☐ C ☐ B ☑ R ☐ A ☐
RIP: C
STG: MF

WATER

EMS: Req #:
Temp: 9   Method: T3   Cond.: 130   Method: S3
pH: 8.1   Method: P2   Turb.: T ☐ M ☐ L ☐ C ☑   Method: GE
Flood Signs: Method: GE

MORPHOLOGY

Bed Material: Dominant: G   Subdom: F
D95: 35.0   D (cm): 10.00   Morph: RPG
Pattern: SI
Islands: N
Coupling: CO
Confinement: CO
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☑	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☐ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Spawning Habitat	FAIR - GRAVEL IS ANGULAR AND HIGH LEVELS OF FINES
Rearing Habitat	EXCELLENT - ABUNDANT LWD, GOOD CONNECTION WITH TERRESTRIAL AREA, DEEP POOLS, ABUNDANT OVERHEAD COVER
OverWinter Habitat	EXCELLENT - DEEP POOLS

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	DIG	F:	4360	STD	U	VIEW FROM TOP END OF SITE (0M)
R:	DIG	F:	4361	STD	U	AT 38M

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-39300-00000-0000-0000-000-000-000-000-000-000	1.1			208

PHOTOS						
Photo				Foc Lg	Dir	Comments
R:	DIG	F:	4362	STD	D	AT 38M
R:	DIG	F:	4363	STD	U	AT 62M
R:	DIG	F:	4364	STD	U	VIEW OF LOWER END OF SITE AT 100M

COMMENTS	
Section	Comments
COVER	EXCELLENT HABITAT ALL AROUND, FISH WOULD BE HERE IF THEY COULD, BUT THEY'RE NOT

Site # 208 Photo: IMGP4363
Site 208 - An upstream view of the site.

Site # 208 Photo: IMGP4362
Site 208 - A downstream view of the site.

Site # 208 Photo: IMGP4364
Site 208 - A view of the bottom of the site.

FDIS Site Card

Watershed Code	Reach #	ILP Map #	ILP #	Site
560-208600-39300-00000-0000-0000-000-000-000-000-000-000	2.1			209

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: SCOTT CREEK   Local Name:
Watershed Code: 560-208600-39300-00000-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 2.1   Site #: 209
Field UTM (Z.E.N): ..   Method: Site Lg: 110   Method: GE   Access: H
GIS UTM (Z.E.N): 9.452937.6253083   Ref. Name: ST2
Date: 2010/08/27   Time: 11:10   Agency: C660   Crew: KM/LT/KW   Fish Crd?: ☑   Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	RF	29.00	30.10	24.10	16.50	20.60						24.06
Wetted Width (m):	RF	26.00	10.10	10.70	14.90	17.30						15.80
Pool Depth (m):	MS	0.22										0.22

	Gadient %		Mtd	Avg
Method I:	4.0	2.5	C	3.25
Method II:			C	

No Vis.Ch.: ☐   Intermittent: ☐
Dw: ☐   Tribs.: ☐

Wb Depth:	1.1	1.2	

Avg: 1.15   Method: MS   Stage: L ☑ M ☐ H ☐

COVER   Total: A

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	S	S	T	T	S	D	N
Loc: P/S/O:	☐☑☐	☐☑☐	☐☑☐	☐☑☐	☐☑☐	☐☑☐	☐☑☐

CROWN CLOSURE
1   1-20%
INSTREAM VEG: N ☑ A ☐ M ☐ V ☐

LWD: A   DIST: E

LB SHP: S
Texture: F ☐ G ☑ C ☑ B ☐ R ☐ A ☐
RIP: M
STG: SHR

RB SHP: S
Texture: F ☑ G ☑ C ☑ B ☐ R ☐ A ☐
RIP: S
STG: SHR

WATER

EMS: Req #:
Temp: 5   Method: T3   Cond.: 110   Method: S3
pH: 7.4   Method: P2   Turb.: T ☑ M ☐ L ☐ C ☐   Method: GE
Flood Signs: RAFTED LWD   Method: GE

MORPHOLOGY

Bed Material: Dominant: G   Subdom: C
D95: 37.0   D (cm): 37.00   Morph: RPC
Pattern: TM
Islands: F
Coupling: DC
Confinement: OC
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☑	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☑	☐

Bars: N ☐ SIDE ☑ DIAG ☑ MID ☑ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Spawning Habitat	GOOD - GOOD SORTING OF SEDIMENT TYPE AND LOTS OF GRAVEL, BUT HIGH EMBEDDEDNESS OF BOULDER AND COBBLE
Rearing Habitat	EXCELLENT - DIVERSE HABITAT, SHALLOW POOLS, ABUNDANT OVERHEAD COVER AND LWD
OverWinter Habitat	GOOD - DEEP POOLS IN DOWNSTREAM END

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	DIG	F:	4274	STD	U	PAN FROM LEFT TO RIGHT FROM 17M.
R:	DIG	F:	4275	STD	U	PAN FROM 4274

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-39300-00000-0000-0000-000-000-000-000-000-000	2.1			209

PHOTOS						
Photo				Foc Lg	Dir	Comments
R:	DIG	F:	4276	STD	D	VIEW OF SIDECHANNEL HABITAT AT 0M
R:	DIG	F:	4277	STD	U	VIEW OF SIDECHANNEL AT 25M
R:	DIG	F:	4278	STD	U	VIEW OF MAINSTEM ADJACENT TO SIDECHANNEL
R:	DIG	F:	4279	STD	U	PAN FROM LEFT TO RIGHT AT BOTTOM END OF ISLAND AND SITE
R:	DIG	F:	4280	STD	U	PAN FROM 4279
R:	DIG	F:	4281	STD	U	PAN FROM 4280
R:	DIG	F:	4283	STD	U	AERIAL VIEW OF SITE
R:	DIG	F:	4284	STD	U	AERIAL VIEW OF SITE

Site # 209 Photo: IMGP4284
Site 209 - An aerial view of the site.

Site # 209 Photo: IMGP4275
Site 209 - An upstream view of the mainstem and side channel habitat in the site.

Site # 209 Photo: IMGP4277
Site 209 - An upstream view of the side channel habitat.

Site # 209 Photo: IMGP4278
Site 209 - An upstream view of the main channel habitat.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-39300-00000-0000-0000-000-000-000-000-000-000	3.1			210

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: SCOTT CREEK   Local Name:
Watershed Code: 560-208600-39300-00000-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 3.1   Site #: 210

Field UTM (Z.E.N): ..   Method: Site Lg: 100   Method: GE   Access: H
GIS UTM (Z.E.N): 9.452306.6257398   Ref. Name: ST3

Date: 2010/08/27   Time: 14:20   Agency: C660   Crew: KM/LT/KW   Fish Crd?: ☑   Incomplete: ☑

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	RF	18.00	24.00	21.60	39.10	36.40	37.00					29.35
Wetted Width (m):	RF	9.00	10.00	15.60	9.60	10.20	19.00					12.23
Pool Depth (m):	MS	0.22	0.11									0.16

	Gadient %		Mtd	Avg
Method I:	2.0	7.0	C	6.00
Method II:	9.0		C	

No Vis.Ch.: ☐   Intermittent: ☐
Dw: ☐   Tribs.: ☐

Wb Depth:	2.0		

Avg: 2.00   Method: MS   Stage: L ☐ M ☐ H ☐

COVER   Total: T

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	N	T	D	N	T	T	N
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
0   0%
INSTREAM VEG: N ☑ A ☐ M ☐ V ☐

LWD: F   DIST: C

LB SHP: V
Texture: F ☑ G ☐ C ☐ B ☑ R ☐ A ☐
RIP: D
STG: PS

RB SHP: S
Texture: F ☑ G ☐ C ☐ B ☑ R ☐ A ☐
RIP: S
STG: INIT

WATER

EMS: Req #:
Temp: 6   Method: T3   Cond.: 90   Method: S3
pH: 7.3   Method: P2   Turb.: T ☑ M ☐ L ☐ C ☐   Method: GE
Flood Signs: RAFTED DEBRIS   Method: GE

MORPHOLOGY

Bed Material: Dominant: B   Subdom: C
D95: 72.0   D (cm): 56.00   Morph:

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☑	☑	☑	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☑	☑	☑	☑	☐	☐	☐	☐	☑	☐

Pattern: IM
Islands: O
Coupling: DC
Confinement: OC
FSZ: ☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☐ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Spawning Habitat	POOR
Rearing Habitat	POOR
OverWinter Habitat	POOR

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	DIG	F:	4285	STD	D	AERIAL VIEW OF SITE
R:	DIG	F:	4286	STD	D	VIEW AT START OF SITE.
R:	DIG	F:	4287	STD	U	VIEW AT START OF SITE. ASSISTANT AT MOUTH OF SECONDARY CHANNEL

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-39300-00000-0000-0000-000-000-000-000-000-000	3.1			210

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	DIG	F:	4288	STD	D	VIEW AT 51M
R:	DIG	F:	4289	STD	U	VIEW AT 51
R:	DIG	F:	4290	STD	D	VIEW OF SITE FROM TOP END
R:	DIG	F:	4291	STD	U	SECONDARY CHANNEL HABITAT

COMMENTS

Section	Comments
CHANNEL	RIVER SHOWS SIGNS OF FLASH FLOODS, LARGE BOULDERS DEPOSITED ON BANKS. LATERAL SHIFTS OF CHANNEL EVIDENT FROM ELEVATED BARS AND OLD CHANNELS. BARRIER DOWNSTREAM OF SITE

Site # 210 Photo: IMGP4285
Site 210 - An aerial view of the site.

Site # 210 Photo: IMGP4289
Site 210 - An upstream view of the site.

Site # 210 Photo: IMGP4291
Site 210 - A view of the secondary channel habitat.

Site # 210 Photo: IMGP4286
Site 210 - A downstream view of the site.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 960-250000-00000-00000-0000-0000-000-000-000-000-000-000	1.1			211

PROJECT

Project Name: Snowfields
Stream Name (gaz.): ALASKA RIVERS — Project Code: 20635
Project Watershed Code: 960-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: UNUK RIVER — Local Name:
Watershed Code: 960-250000-00000-00000-0000-0000-000-000-000-000-000-000
ILP Map#: — ILP #: — NID Map #: — NID #: — Reach #: 1.1 — Site #: 211
Field UTM (Z.E.N): .. — Method: — Site Lg: 100 — Method: GE — Access: H
GIS UTM (Z.E.N): 9.406786.6260036 — Ref. Name: UR1
Date: 2010/08/29 — Time: 09:00 — Agency: C660 — Crew: KM/LT/KW — Fish Crd?: ☐ — Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	RF	165.00	169.00	176.00								170.00
Wetted Width (m):	RF	74.80	78.00	73.00								75.27
Pool Depth (m):		0.00										0.00

	Gadient %		Mtd	Avg
Method I:	1.0	0.5	C	0.75
Method II:			C	

No Vis.Ch.: ☐ — Intermittent: ☐ — Dw: ☐ — Tribs.: ☐

Wb Depth:	1.6		

Avg: 1.60 — Method: GE — Stage: L ☑ M ☐ H ☐

COVER — Total: M

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	S	D	T	N	S	T	N
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
1 1-20%
INSTREAM VEG: N ☑ A ☐ M ☐ V ☐

LWD: A — DIST: C

LB SHP: S
Texture: F ☑ G ☐ C ☑ B ☐ R ☐ A ☐
RIP: D
STG: PS

RB SHP: S
Texture: F ☑ G ☐ C ☑ B ☐ R ☐ A ☐
RIP: D
STG: PS

WATER

EMS: — Req #:
Temp: 3 — Method: T3 — Cond.: 110 — Method: S3
pH: 8.2 — Method: P2 — Turb.: T ☐ M ☑ L ☐ C ☐ — Method: GE
Flood Signs: — Method: GE

MORPHOLOGY

Bed Material: — Dominant: C — Subdom: G
D95: 19.0 — D (cm): 19.00 — Morph: RPC
Pattern: SI
Islands: F
Coupling: DC
Confinement: OC
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☑	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☑	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☑ MID ☐ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Spawning Habitat	FAIR - ONLY SMALL POCKETS OF GRAVEL DOWNSTREAM OF ISLANDS ALONG SHALLOW RIFFLES
OverWinter Habitat	EXCELLENT - DEEP POOLS
Rearing Habitat	EXCELLENT - DEEP POOLS, ABUNDANT LWD, GOOD COVER, SECONDARY CHANNELS MAY BE GOOD REARING FOR COHO

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	DIG	F:	4331	STD	D	VIEW OF BOTTOM END OF SITE (ASSISTANT IS STANDING AT 0M) FROM 38M
R:	DIG	F:	4332	STD	U	PAN FROM RIGHT TO LEFT AT BOTTOM OF SITE
R:	DIG	F:	4333	STD	U	PAN FROM 4332

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 960-250000-00000-00000-0000-0000-000-000-000-000-000-000	1.1			211

PHOTOS							
Photo				Foc Lg	Dir	Comments
R:	DIG	F:	4334	STD	U	PAN FROM 4333
R:	DIG	F:	4346	STD	X	AERIAL VIEW OF SITE

WILDLIFE	
Group	Observations
MAM	MOOSE, WOLF AND BEAR TRACKS

Site # 211 Photo: IMGP4346
Site 211 - An aerial view of the site.

Site # 211 Photo: IMGP4332
Site 211 - An upstream view of the site.

Site # 211 Photo: IMGP4331
Site 211 - A downstream view of the site.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 960-250000-00000-00000-0000-0000-000-000-000-000-000-000	1.2			212

PROJECT

Project Name: Snowfields
Stream Name (gaz.): ALASKA RIVERS   Project Code: 20635
Project Watershed Code: 960-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: UNUK RIVER   Local Name:
Watershed Code: 960-250000-00000-00000-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 1.2   Site #: 212

Field UTM (Z.E.N): ..   Method: Site Lg: 100   Method: GE   Access: H
GIS UTM (Z.E.N): 9.406857.6260112   Ref. Name: UR1.1

Date: 2010/08/29   Time: 10:00   Agency: C660   Crew: KM/LT/KW   Fish Crd?: ☑   Incomplete: ☑

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):		0.00										0.00
Wetted Width (m):	T	0.95	0.60	0.85	0.55	1.00	1.20					0.86
Pool Depth (m):	MS	0.02	0.13									0.07

	Gadient %		Mtd	Avg
Method I:	1.0		C	1.00
Method II:			C	

No Vis.Ch.: ☐   Intermittent: ☐
Dw: ☐   Tribs.: ☐

Wb Depth:			

Avg: 0.00   Method: Stage: L ☑ M ☐ H ☐

COVER   Total: M

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	T	T	S	N	S	D	S
Loc: P/S/O:	☐☑☐	☐☑☐	☐☑☐	☐☑☐	☐☑☐	☐☑☐	☐☑☐

CROWN CLOSURE
2   21-40%
INSTREAM VEG: N ☐ A ☐ M ☐ V ☑

LWD: N   DIST: NA

LB SHP: S
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: S
STG: SHR

RB SHP: S
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: S
STG: SHR

WATER

EMS: Req #:
Temp: 5   Method: T3   Cond.: 330   Method: S3
pH: 7.5   Method: P2   Turb.: T ☐ M ☐ L ☐ C ☑   Method: GE
Flood Signs: Method: GE

MORPHOLOGY

Bed Material: Dominant: F   Subdom: G
D95: 24.0   D (cm): 5.50   Morph: RP
Pattern: IR
Islands: N
Coupling: DC
Confinement: OC
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☑ SIDE ☐ DIAG ☐ MID ☐ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Spawning Habitat	MARGINAL - TOO SHALLOW, LOTS OF FINES
Rearing Habitat	EXCELLENT - RIFFLE/POOL HABITAT WITH SUBMERGENT VEGETATION, OVERHEAD COVER ALONG LEFT BANK AND RUSHES ALONG RIGHT BANK
OverWinter Habitat	EXCELLENT - SLOW MOVING POOLS IN UPPER END

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	DIG	F:	4335	STD	D	LOWER END OF CHANNEL
R:	DIG	F:	4336	STD	U	LOWER END OF CHANNEL

FDIS Site Card

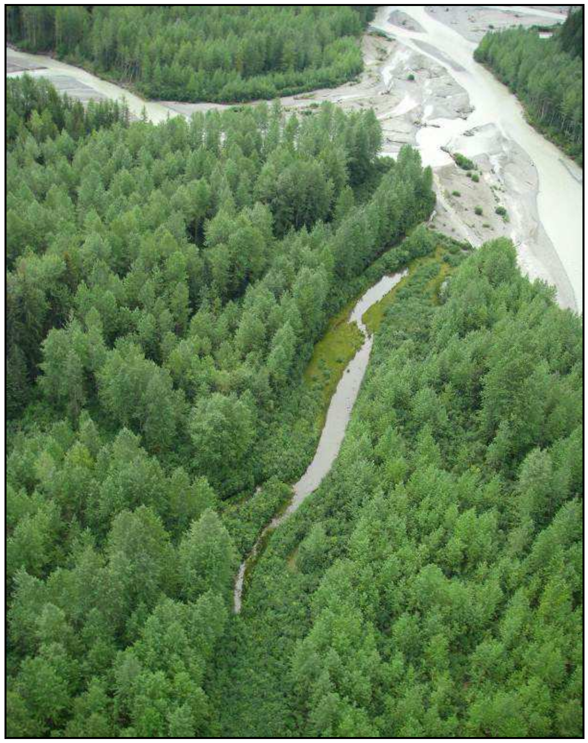
	Reach #	ILP Map #	ILP #	Site
Watershed Code: 960-250000-00000-00000-0000-0000-000-000-000-000-000-000	1.2			212

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	DIG	F:	4337	STD	D	SHALLOW RIFFLE SECTION
R:	DIG	F:	4338	STD	U	SHALLOW RIFFLE SECTION
R:	DIG	F:	4339	STD	U	SHORT SECTION OF POOL WITH BOULDERS WHERE IT NARROWS
R:	DIG	F:	4345	STD	D	AERIAL VIEW OF SECONDARY CHANNEL AND LOWER END OF ISLAND

COMMENTS

Section	Comments
CHANNEL	SMALL SECONDARY CHANNEL CUTTING ACROSS LARGE ISLAND IN HABITAT UNIT 1 OF SITE UN1. LOWER 100M SHALLOW RIFFLE, NARROW CHANNEL, THEN WIDENS UPSTREAM TO SLOW MOVING POOLS



Site # 212 Photo: IMGP4345
Site 212 - An aerial view of the site.

Site # 212 Photo: IMGP4336
Site 212 - An upstream view of the site.

Site # 212 Photo: IMGP4339
Site 212 - An upstream view of the site showing the short pool section.

Site # 212 Photo: IMGP4335
Site 212 - A downstream view of the site.

FDIS Site Card

Watershed Code	Reach #	ILP Map #	ILP #	Site
960-250000-00000-00000-0000-0000-000-000-000-000-000-000	2.1			213

PROJECT

Project Name: Snowfields
Stream Name (gaz.): ALASKA RIVERS   Project Code: 20635
Project Watershed Code: 960-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: UNUK RIVER   Local Name:
Watershed Code: 960-250000-00000-00000-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 2.1   Site #: 213
Field UTM (Z.E.N): ..   Method: Site Lg: 125   Method: GE   Access: H
GIS UTM (Z.E.N): 9.407633.6262443   Ref. Name: UR1A
Date: 2010/08/29   Time: 12:00   Agency: C660   Crew: KM/LT/KW   Fish Crd?: ☐   Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	RF	114.00	60.00	116.00	109.00	119.00	123.00					106.83
Wetted Width (m):	RF	36.00	30.00	47.00	31.00	40.00	39.00					37.17
Pool Depth (m):	MS	1.60										1.60

	Gadient %		Mtd	Avg
Method I:	2.0	1.5	C	1.75
Method II:			C	

No Vis.Ch.: ☐   Intermittent: ☐
Dw: ☐   Tribs.: ☐

Wb Depth:	2.4		

Avg: 2.40   Method: MS   Stage: L ☑ M ☐ H ☐

COVER   Total: M

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	S	D	T	N	S	T	N
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
0   0%
INSTREAM VEG: N ☑ A ☐ M ☐ V ☐

LWD: A   DIST: C

LB SHP: V
Texture: F ☐ G ☑ C ☑ B ☐ R ☐ A ☐
RIP: S
STG: INIT

RB SHP: V
Texture: F ☑ G ☑ C ☐ B ☐ R ☐ A ☐
RIP: S
STG: INIT

WATER

EMS: Req #:
Temp: 6   Method: T3   Cond.: 100   Method: S3
pH: 7.6   Method: P2   Turb.: T ☐ M ☑ L ☐ C ☐   Method: GE
Flood Signs: Method: GE

MORPHOLOGY

Bed Material: Dominant: G   Subdom: C
D95: 20.0   D (cm): 20.00   Morph: RP
Pattern: SI
Islands: F
Coupling: DC
Confinement: OC
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☑ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Spawning Habitat	EXCELLENT - SHALLOW RIFFLE WITH GRAVEL SUBSTRATE FOR SPAWNING, NUMEROUS SCOUR POOLS FOR HOLDING
Rearing Habitat	EXCELLENT - LWD JAM PROVIDES GOOD COVER

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	DIG	F:	4347	STD	D	VIEW OF LOG JAM FROM BOTTOM END OF SITE
R:	DIG	F:	4348	STD	D	VIEW FROM 75M
R:	DIG	F:	4352	STD	D	AERIAL VIEW OF SITE

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 960-250000-00000-00000-0000-0000-000-000-000-000-000-000	2.1			213

COMMENTS	
Section	Comments
CHANNEL	SITE ALONG SECONDARY CHANNEL UPSTREAM OF A LOG JAM. THE LOG JAM WAS ELECTROFISHED FOR THIS SITE

Site # 213 Photo: IMGP4352
Site 213 - An aerial view of the site.

Site # 213 Photo: IMGP4347
Site 213 - A downstream view of the bottom end of the site.

Site # 213 Photo: IMGP4348
Site 213 - A downstream view of the site.

FDIS Site Card

Watershed Code	Reach #	ILP Map #	ILP #	Site
560-208600-42900-76200-0000-0000-000-000-000-000-000-000	1.0			500

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: Local Name:
Watershed Code: 560-208600-42900-76200-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 1.0   Site #: 500
Field UTM (Z.E.N): ..   Method: Site Lg: 200   Method: GE   Access: H
GIS UTM (Z.E.N): 9.444405.6252126   Ref. Name:
Date: 2010/06/23   Time: 10:05   Agency: C660   Crew: KM/LT/KW   Fish Crd?: ☑   Incomplete: ☑

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	T	7.90	6.40	8.60	5.00							6.98
Wetted Width (m):	T	1.10	1.70	3.90	1.50							2.05
Pool Depth (m):												0.00

	Gadient %		Mtd	Avg
Method I:	13.0		C	13.00
Method II:			C	

No Vis.Ch.: ☐   Intermittent: ☐
Dw: ☐   Tribs.: ☑

Wb Depth:	.5	.4	

Avg: 0.45   Method: MS   Stage: L ☐ M ☑ H ☐

COVER   Total: M

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	S	S	T	N	N	D	N
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
2   21-40%
INSTREAM VEG: N ☐ A ☑ M ☐ V ☐

LWD: F   DIST: E

LB SHP: S
Texture: F ☐ G ☐ C ☑ B ☑ R ☐ A ☐
RIP: D
STG: PS

RB SHP: S
Texture: F ☑ G ☐ C ☐ B ☑ R ☑ A ☐
RIP: D
STG: PS

WATER

EMS: Req #:
Temp: 5   Method: T3   Cond.: 200   Method: S3
pH: 8.6   Method: P2   Turb.: T ☐ M ☐ L ☐ C ☑   Method: GE
Flood Signs: Method: GE

MORPHOLOGY

Bed Material: Dominant: G   Subdom: C
D95: 13.0   D (cm): 68.00   Morph: CP
Pattern: ST
Islands: N
Coupling: CO
Confinement: OC
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☑	☐	☐	☑	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☑ SPAN ☐ BR ☐

FEATURES

NID Map	NID	Type	Hgt	Method	Lg	Method	Photo				AirPhoto				UTM (Z/E/N)	Method
104A.050	5001	F	20.0	GE			R:	111	F:	8778	L:		#:		..	

Comments: RB and gradient barrier

HABITAT QUALITY

Name	Comments
OverWinter Habitat	poor - no pools
Rearing Habitat	poor - no pools
Spawning Habitat	poor to fair at bottom, poor upstream of fan - too steep and shallow

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-42900-76200-0000-0000-000-000-000-000-000-000	1.0			500

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	111	F:	8779	STD	U	Abundant riparian cover
R:	111	F:	8780	STD	D	Open section
R:	111	F:	8781	STD	D	Fan with lake in background

WILDLIFE

Group	Observations
AMP	western toad
BIR	sandpiper eggs on fan

COMMENTS

Section	Comments
SITE CARD	Fish seen in the lake at outlet, and good BT spawning habitat for about 10m at outlet to lake, but too steep and shallow for most fish use
CHANNEL	moderate gradient stream down side of an avalanche chute. It arises from the forest at the waterfall.

Site # 500 Photo: IMGP8779
Site 500 - An upstream view of the site.

Site # 500 Photo: IMGP8781
Site 500 - A downstream view of the site.

FDIS Site Card

Watershed Code	Reach #	ILP Map #	ILP #	Site
560-208600-42900-00000-0000-0000-000-000-000-000-000-000	1.0			501

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: Local Name:
Watershed Code: 560-208600-42900-00000-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 1.0   Site #: 501
Field UTM (Z.E.N): ..   Method: Site Lg: 200   Method: GE   Access: H
GIS UTM (Z.E.N): 9.450512.6251650   Ref. Name:
Date: 2010/06/23   Time: 12:45   Agency: C660   Crew: KM/LT/KW   Fish Crd?: ☑   Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	T	10.80	7.70	6.40	5.50	14.00						8.88
Wetted Width (m):	T	10.20	6.30	5.50	4.60	9.90						7.30
Pool Depth (m):												0.00

	Gadient %		Mtd	Avg
Method I:	2.0		C	2.00
Method II:			C	

No Vis.Ch.: ☐   Intermittent: ☐
Dw: ☐   Tribs.: ☐

Wb Depth:	.6	.9	

Avg: 0.75   Method: MS   Stage: L ☐ M ☑ H ☐

COVER   Total: M

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	S	T	S	T	T	D	S
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
1   1-20%
INSTREAM VEG: N ☐ A ☑ M ☑ V ☐

LWD: F   DIST: E

LB SHP: S   RB SHP: S
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐   Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: M   RIP: M
STG: MF   STG: MF

WATER

EMS: Req #:
Temp: Method: T3   Cond.: 190   Method: S3
pH: 8.0   Method: P2   Turb.: T ☐ M ☐ L ☐ C ☑   Method: GE
Flood Signs: Method: GE

MORPHOLOGY

Bed Material: Dominant: C   Subdom: G
D95: 21.0   D (cm): 21.00   Morph: RP
Pattern: ST
Islands: N
Coupling: DC
Confinement: UN
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☑	☐	☐	☐	☐

Bars: N ☑ SIDE ☐ DIAG ☐ MID ☐ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
OverWinter Habitat	Fair - deep at outlet but few pools upstream
Rearing Habitat	Fair - some good cover along margins and behind rocks, few pools
Spawning Habitat	Fair - some patches of gravel but lots of fines. No evidence of spawning

COMMENTS

Section	Comments
SITE CARD	clear stream flowing down possible old side channel - large substrate (too large for stream, some spawning gravel but also lots of fines. Channel is up to 0.5m deep, but no real pools IMPORTANT HABITAT

Site # 501 Photo: IMGP8784
Site 501 - An upstream view of the site.

Site # 501 Photo: IMGP8785
Site 501 - A downstream view of the site.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-39300-29900-0000-0000-000-000-000-000-000-000	1.0			502

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER
Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name:
Local Name:
Watershed Code: 560-208600-39300-29900-0000-0000-000-000-000-000-000-000
ILP Map#: ILP #: NID Map #: NID #: Reach #: 1.0 Site #: 502
Field UTM (Z.E.N): .. Method: Site Lg: 200 Method: GE Access: H
GIS UTM (Z.E.N): 9.452291.6257669 Ref. Name: Scott Creek tributary
Date: 2010/06/23 Time: 16:30 Agency: C660 Crew: KM/LT/KW Fish Crd?: ☑ Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	RF	13.00	22.00	21.00	30.00	29.00	32.00					24.50
Wetted Width (m):	RF	9.00	11.00	8.00	29.00	18.00	25.00					16.67
Pool Depth (m):												0.00

	Gadient %		Mtd	Avg
Method I:	5.0	10.0	C	7.50
Method II:			C	

No Vis.Ch.: ☐ Intermittent: ☐
Dw: ☐ Tribs.: ☐

Wb Depth:	.8	1.0	

Avg: 0.90 Method: GE Stage: L ☐ M ☑ H ☐

COVER Total: T

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	N	T	D	N	N	T	N
Loc: P/S/O:	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑

CROWN CLOSURE
0 0%
INSTREAM VEG: N ☑ A ☐ M ☐ V ☐

LWD: N DIST: E

LB SHP: V
Texture: F ☐ G ☐ C ☐ B ☑ R ☑ A ☐
RIP: M
STG: YF

RB SHP: S
Texture: F ☐ G ☐ C ☑ B ☑ R ☐ A ☐
RIP: M
STG: SHR

WATER

EMS:
Req #:
Temp: 5 Method: T3
Cond.: 130 Method: S3
pH: 8.2 Method: P2
Turb.: T ☑ M ☐ L ☐ C ☐ Method: GE
Flood Signs: Method: GE

MORPHOLOGY

Bed Material: Dominant: B Subdom: G
D95: 75.0 D (cm): 35.00 Morph: CP
Pattern: SI
Islands: F
Coupling: CO
Confinement: FC
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☑	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☑	☑	☐	☐	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☑ MID ☑ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
OverWinter Habitat	poor - no pools
Spawning Habitat	poor - too fast and large substrate
Rearing Habitat	poor - too fast and high gradient

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	111	F:	8786	STD	U	downstream of the cascades
R:	111	F:	8787	STD	D	upstream of the cascades

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-39300-29900-0000-0000-000-000-000-000-000-000	1.0			502

WILDLIFE	
Group	Observations
MAM	wolf

COMMENTS	
Section	Comments
SITE CARD	steep, turbid glacial stream with few pools and low cover. Not impassable, but not good habitat. Cascades get steeper upstream MARGINAL HABITAT

Site # 502 Photo: IMGP8787
Site 502 - An upstream view of the site.

Site # 502 Photo: IMGP8786
Site 502 - A downstream view of the site.

FDIS Site Card

Watershed Code	Reach #	ILP Map #	ILP #	Site
560-409900-38400-71300-6050-0000-000-000-000-000-000-000	1.0			503

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: Local Name:
Watershed Code: 560-409900-38400-71300-6050-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 1.0   Site #: 503
Field UTM (Z.E.N): ..   Method: Site Lg: 100   Method: GE   Access: H
GIS UTM (Z.E.N): 9.451695.6259604   Ref. Name:
Date: 2010/06/24   Time: 08:55   Agency: C660   Crew: KM/LT/KW   Fish Crd?: ☑   Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	MS	1.10	0.80	1.40	1.50	1.00	1.00					1.13
Wetted Width (m):	MS	1.10	0.70	1.10	1.40	0.90	1.10					1.05
Pool Depth (m):	MS	0.08	0.27	0.09								0.15

	Gadient %		Mtd	Avg
Method I:	3.0	19.0	C	11.00
Method II:			C	

Wb Depth:	.4	.3	.5

Avg: 0.40   Method: MS   Stage: L ☐ M ☑ H ☐

No Vis.Ch.: ☐   Intermittent: ☐   Dw: ☐   Tribs.: ☑

COVER   Total: M

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	T	D	N	S	N	S	N
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
1   1-20%
INSTREAM VEG: N ☐ A ☐ M ☑ V ☐

LWD: A   DIST: E

LB SHP: U
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: S
STG: SHR

RB SHP: U
Texture: F ☑ G ☑ C ☐ B ☐ R ☐ A ☐
RIP: C
STG: MF

WATER

EMS: Req #:
Temp: 6   Method: T3   Cond.: 170   Method: S3
pH: 8.7   Method: P2   Turb.: T ☐ M ☐ L ☐ C ☑   Method: GE
Flood Signs: Method: GE

MORPHOLOGY

Bed Material: Dominant: G   Subdom: F
D95: 5.00   D (cm): 5.00   Morph: RP
Pattern: IR
Islands: N
Coupling: DC
Confinement: OC
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☑	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☑ SIDE ☐ DIAG ☐ MID ☐ SPAN ☐ BR ☐

FEATURES

NID Map	NID	Type	Hgt	Method	Lg	Method	Photo	AirPhoto	UTM (Z/E/N)	Method
		C	5.0	GE	25	GE	R: F:	L: #:	9.451627.6259541	GP3

Comments: 19% cascade over SWD - possible barrier

NID Map	NID	Type	Hgt	Method	Lg	Method	Photo	AirPhoto	UTM (Z/E/N)	Method
		TR					R: F:	L: #:	9.451639.6259559	GP3

Comments:

FDIS Site Card

Watershed Code	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-409900-38400-71300-6050-0000-000-000-000-000-000-000	1.0			503

F E A T U R E S

NID Map	NID	Type	Hgt	Method	Lg	Method	Photo				AirPhoto				UTM (Z/E/N)	Method
		BD	1.5	GE	1	GE	R:	100	F:	8794	L:		#:		9.451652.6259573	GP3
Comments:	1.5 meter drop through hole in BD															
NID Map	NID	Type	Hgt	Method	Lg	Method	Photo				AirPhoto				UTM (Z/E/N)	Method
		BD	2.0	GE	70	GE	R:	100	F:	8793	L:		#:		9.451652.6259573	GP3
Comments:	BD with hole busted through															

H A B I T A T   Q U A L I T Y

Name	Comments
OverWinter Habitat	fair - not deep but may not freeze in covered areas
Rearing Habitat	good - lots of cover and some small pools
Spawning Habitat	excellent - lots of great gravels both upstream and downstream of beaver dam

P H O T O S

Photo				Foc Lg	Dir	Comments
R:	100	F:	8795	STD	U	upstream of BD at drained pond and inflow channel
R:	100	F:	8798	STD	D	upstream of cascade looking DS down channel
R:	100	F:	8799	STD	U	upstream of BD
R:	100	F:	8800	STD	X	DV/BT

C O M M E N T S

Section	Comments
SITE CARD	lovely clear stream with good habitat for RB. Gravel downstream of cascade is clean and light coloured. Upstream of cascade gravel looks untouched. Shocked to base of cascade, only one DV caught and no fish seen

Site # 503 Photo: IMGP8794
Site 503 - A 1.5 m vertical drop through a beaver dam that may prevent fish passage.

Site # 503 Photo: IMGP8795
Site 503 - An upstream view from the bottom end of the site.

Site # 503 Photo: IMGP8798
Site 503 - A downstream view from the top end of the site.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-409900-38400-00000-0000-0000-000-000-000-000-000-000	2.0			504

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: TODEDADA CREEK   Local Name:
Watershed Code: 560-409900-38400-00000-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 2.0   Site #: 504

Field UTM (Z.E.N): ..   Method: Site Lg: 100   Method: GE   Access: H
GIS UTM (Z.E.N): 9.451657.6260735   Ref. Name:

Date: 2010/06/24   Time: 11:40   Agency: C660   Crew: KM/LT/KW   Fish Crd?: ☑   Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	MS	2.40	2.60	3.70	3.40	4.00	3.20					3.22
Wetted Width (m):	MS	2.10	2.60	3.50	3.00	3.70	2.80					2.95
Pool Depth (m):	MS	0.22	0.12	0.17								0.17

	Gadient %		Mtd	Avg
Method I:	2.0	4.0	C	2.33
Method II:	1.0		C	

Wb Depth:	.3	.4	

Avg: 0.35   Method: MS   Stage: L ☐ M ☑ H ☐
No Vis.Ch.: ☐   Intermittent: ☐
Dw: ☐   Tribs.: ☐

COVER   Total: A

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	S	S	T	T	N	D	N
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
5   >90%
INSTREAM VEG: N ☐ A ☑ M ☐ V ☐

LWD: F   DIST: E

LB SHP: S
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: D
STG: PS

RB SHP: S
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: M
STG: PS

WATER

EMS: Req #:
Temp: 15   Method: T3   Cond.: 150   Method: S3
pH: 7.7   Method: P2   Turb.: T ☐ M ☐ L ☐ C ☑   Method: GE
Flood Signs: Method: GE

MORPHOLOGY

Bed Material: Dominant: F   Subdom: G
D95: 70.0   D (cm): 8.00   Morph: RP

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☑	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Pattern: SI
Islands: N
Coupling: PC
Confinement: OC
FSZ: ☐

Bars: N ☑ SIDE ☐ DIAG ☐ MID ☐ SPAN ☐ BR ☐

FEATURES

NID Map	NID	Type	Hgt	Method	Lg	Method	Photo				AirPhoto				UTM (Z/E/N)	Method
		BD	1.0	GE	4	GE	R:	100	F:	8810	L:		#:		9.451637.6260569	GP3
Comments:	BEAVER DAM BLOCKING OUTLET, MAY BE FISH BARRIER															
NID Map	NID	Type	Hgt	Method	Lg	Method	Photo				AirPhoto				UTM (Z/E/N)	Method
		C	1.5	GE	6	GE	R:	100	F:	8802	L:		#:		9.451657.6260735	GP3
Comments:	SMALL CASCADE ABOUT 30M UPSTREAM OF CONFLUENCE															

HABITAT QUALITY

Name	Comments

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-409900-38400-00000-0000-0000-000-000-000-000-000-000	2.0			504

HABITAT QUALITY	
Name	Comments
OverWinter Habitat	POOR - TOO SHALLOW
Rearing Habitat	GOOD
Spawning Habitat	TRACE AMOUNTS - POOR WITH OCCASIONAL PATCHES

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	100	F:	8801	STD	U	RIFFLE-POOL SECTION
R:	100	F:	8808	STD	U	GLIDE WITH BOULDERS
R:	100	F:	8809	STD	U	GLIDE WITH BOULDERS
R:	100	F:	8810	STD	U	BEAVER DAM

Site # 504 Photo: IMGP8801
Site 504 - An upstream view from the bottom of the site.

Site # 504 Photo: IMGP8808
Site 504 - An upstream view of the site.

FDIS Site Card

Watershed Code	Reach #	ILP Map #	ILP #	Site
560-409900-38400-48500-0000-0000-000-000-000-000-000-000	1.0			505

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: Local Name:
Watershed Code: 560-409900-38400-48500-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 1.0   Site #: 505
Field UTM (Z.E.N): ..   Method: Site Lg: 150   Method: GE   Access: H
GIS UTM (Z.E.N): 9.453024.6262582   Ref. Name:
Date: 2010/06/24   Time: 15:00   Agency: C660   Crew: KM/LT/KW   Fish Crd?: ☑   Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	RF	10.00	15.00	8.00	11.00	15.00	10.00					11.50
Wetted Width (m):	GE	9.00	14.00	6.00	6.00	14.00	10.00					9.83
Pool Depth (m):	GE	1.00										1.00

	Gadient %		Mtd	Avg
Method I:	8.0		C	8.00
Method II:			C	

No Vis.Ch.: ☐   Intermittent: ☐
Dw: ☐   Tribs.: ☐

Wb Depth:	.4	1.0	.5

Avg: 0.63   Method: GE   Stage: L ☐ M ☑ H ☐

COVER   Total: M

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	N	D	T	T	S	T	N
Loc: P/S/O:	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑

CROWN CLOSURE
1   1-20%
INSTREAM VEG: N ☑ A ☐ M ☐ V ☐

LWD: F   DIST: C

LB SHP: V
Texture: F ☐ G ☐ C ☑ B ☐ R ☑ A ☐
RIP: C
STG: MF

RB SHP: V
Texture: F ☐ G ☐ C ☑ B ☐ R ☑ A ☐
RIP: C
STG: MF

WATER

EMS: Req #:
Temp: 9   Method: T3   Cond.:   Method: S3
pH: 8.2   Method: P2   Turb.: T ☐ M ☑ L ☐ C ☐   Method: GE
Flood Signs: Method: GE

MORPHOLOGY

Bed Material: Dominant: C   Subdom: B
D95: 40.0   D (cm): 23.00   Morph: CP
Pattern: SI
Islands: N
Coupling: CO
Confinement: CO
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☑	☐	☐	☑

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☑	☐	☐

Bars: N ☑ SIDE ☐ DIAG ☐ MID ☐ SPAN ☐ BR ☐

FEATURES

NID Map	NID	Type	Hgt	Method	Lg	Method	Photo		AirPhoto		UTM (Z/E/N)	Method
		C	15.0	GE	30	GE	R:	F:	L:	#:	9.453122.6262438	O

Comments: MAJOR CASCADE DROPS 2M THEN 5M, LOCATION APPROXIMATE

NID Map	NID	Type	Hgt	Method	Lg	Method	Photo		AirPhoto		UTM (Z/E/N)	Method
		X	2.5	GE	3	GE	R: 100	F: 8813	L:	#:	9.453092.6262478	GP3

Comments: LOG JAM, POSSIBLE FISH BARRIER

HABITAT QUALITY

Name	Comments

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-409900-38400-48500-0000-0000-000-000-000-000-000-000	1.0			505

HABITAT QUALITY

Name	Comments
Other	POOR OVERALL HABITAT
OverWinter Habitat	POOR - TOO FAST, NO SHELTER FROM FLOW
Rearing Habitat	FAIR - SOME GOOD POOLS BUT POOR ACCESS
Spawning Habitat	POOR- FAST AND STEEP WITH LARGE SUBSTRATE

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	100	F:	8813	STD	D	LOG JAM
R:	100	F:	8818	STD	U	UPSTREAM OF LOG JAM
R:	100	F:	8819	STD	U	START OF CASCADES
R:	100	F:	8820	STD	U	15 M CASCADE, UPPER PART
R:	100	F:	8821	STD	D	2 M DROP
R:	100	F:	8822	STD	D	UPSTREAM OF LOG JAM
R:	100	F:	8823	STD	D	AVULSION

COMMENTS

Section	Comments
SITE CARD	STEEP TRIBUTARY TO TODEDADA WETLAND. EFU ABOUT 100M UPSTREAM OF WETLAND AT CASCADE AND FALLS. LOTS OF WATER - MAY LINK UP TO UPPER SCOTT AT WETLAND

Site # 505 Photo: IMGP8820
Site 505 - The cascades at the upstream end of the site.

Site # 505 Photo: IMGP8814
Site 505 - A log jam in the middle of the site.

Site # 505 Photo: IMGP8818
Site 505 - A downstream view of the site

Site # 505 Photo: IMGP8823
Site 505 - A view of the avulsion at the bottom end of the site.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 000-000000-00000-00000-0000-0000-000-000-000-000-000-000	1.0	104A.042	506	506

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: Local Name:
Watershed Code: 000-000000-00000-00000-0000-0000-000-000-000-000-000-000
ILP Map#: 104A.042   ILP #: 506   NID Map #:   NID #:   Reach #: 1.0   Site #: 506
Field UTM (Z.E.N): ..   Method: Site Lg: 200   Method: GE   Access: H
GIS UTM (Z.E.N): 9.453594.6262260   Ref. Name:
Date: 2010/06/25   Time: 09:00   Agency: C660   Crew: KM/LT/KW   Fish Crd?: ☑   Incomplete: ☑

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):												0.00
Wetted Width (m):												0.00
Pool Depth (m):												0.00

	Gadient %		Mtd	Avg
Method I:			C	0.00
Method II:			C	

No Vis.Ch.: ☐   Intermittent: ☐
Dw: ☐   Tribs.: ☐

Wb Depth: | | | Avg: 0.00   Method: Stage: L ☐ M ☑ H ☐

COVER   Total: A

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	S	T	N	T	S	D	S
Loc: P/S/O:	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑

CROWN CLOSURE
2   21-40%
INSTREAM VEG: N ☐ A ☐ M ☑ V ☑

LWD: N   DIST: E

LB SHP: V   RB SHP: V
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐   Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: S   RIP: S
STG: SHR   STG: SHR

WATER

EMS: Req #:
Temp: 5   Method: T3   Cond.:   Method: S3
pH: 8.3   Method: P2   Turb.: T ☐ M ☑ L ☐ C ☐   Method: GE
Flood Signs: Method: GE

MORPHOLOGY

Bed Material: Dominant: F   Subdom: G
D95:   D (cm):   Morph:
Pattern:
Islands:
Coupling: DC
Confinement: UN
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☑	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☑	☐	☐	☐	☐	☐	☐

Bars: N ☐ SIDE ☐ DIAG ☐ MID ☐ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Spawning Habitat	POOR - SOME GRAVEL PRESENT, ESPECIALLY AT INLET TO W/L BUT LOTS OF FINES
OverWinter Habitat	FAIR - SOME POOLS AND PONDS ARE PROBABLY DEEP ENOUGH AND STREAM HAS GOOD FLOW
Rearing Habitat	GOOD - LOTS OF COVER, POOLS, PONDED WATER

COMMENTS

Section	Comments
SITE CARD	MORE WETLAND THAN STREAM - SOME FIELDS WERE NOT ABLE TO BE FILLED OUT
CHANNEL	TOO MANY CHANNELS TO DO ACCURATE CHANNEL WIDTHS

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 000-000000-00000-00000-0000-0000-000-000-000-000-000-000	1.0	104A.042	506	506

COMMENTS	
Section	Comments
SITE CARD	UPPER TODEDADA FLOWS THROUGH WETLAND COMPLEX WITH MULTIPLE CHANNELS. STREAM IS MAPPED WRONG - MOST OF WATER FROM "UPPER SCOTT" ACTUALLY FLOWS THROUGH HERE. SOME CROSSOVER INTO SCOTT CK DRAINAGE THROUGH WETLAND AND BEAVER PONDS

Site # 506 Photo: IMGP8832
Site 506 - An aerial view of the site.

Site # 506 Photo: IMGP8828
Site 506 - A view of the braided wetland area.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-39300-78600-0000-0000-000-000-000-000-000-000	1.0			507

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: Local Name:
Watershed Code: 560-208600-39300-78600-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 1.0   Site #: 507

Field UTM (Z.E.N): ..   Method: Site Lg: 100   Method: GE   Access: H
GIS UTM (Z.E.N): 9.456275.6263109   Ref. Name:

Date: 2010/06/25   Time: 11:50   Agency: C660   Crew: KM/LT/KW   Fish Crd?: ☑   Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	MS	1.30	1.50	1.20	2.50	1.20	1.10					1.47
Wetted Width (m):	MS	1.00	1.40	1.80	2.00	1.90	0.90					1.50
Pool Depth (m):	MS	0.15	0.25	0.16	0.42	0.25	0.20					0.24

	Gadient %		Mtd	Avg
Method I:	10.0	8.0	C	9.00
Method II:			C	

No Vis.Ch.: ☐   Intermittent: ☐
Dw: ☐   Tribs.: ☐

Wb Depth:	.2	.1	.1

Avg: 0.13   Method: MS   Stage: L ☐ M ☑ H ☐

COVER   Total: M

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	S	T	N	N	N	D	T
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
1   1-20%
INSTREAM VEG: N ☐ A ☑ M ☑ V ☑

LWD: N   DIST: E

LB SHP: S
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: C
STG: MF

RB SHP: S
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: C
STG: MF

WATER

EMS: Req #:
Temp: 15   Method: T3   Cond.:   Method: S3
pH: 8.3   Method: P2   Turb.: T ☐ M ☐ L ☐ C ☑   Method: GE
Flood Signs: Method: GE

MORPHOLOGY

Bed Material: Dominant: F   Subdom: G
D95: 19.0   D (cm): 6.00   Morph: SP
Pattern: IR
Islands: N
Coupling: DC
Confinement: OC
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☑ SIDE ☐ DIAG ☐ MID ☐ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Other	MARGINAL OVERALL
OverWinter Habitat	POOR - SHALLOW, LOW FLOW
Spawning Habitat	POOR - SMALL AND FULL OF FINES
Rearing Habitat	FAIR- MANY POOLS BUT NOT WELL CONNECTED AND SOMEWHAT STEEP

COMMENTS

Section	Comments
SITE CARD	SMALL STEEP STREAM DRAINING A SMALL WETLAND. LOW VELOCITY AND FLOWS WITH MANY SMALL POOLS. STAGNANT WATER AT THE TOP END AND STEEPER FARTHER DOWN

FDIS Site Card

Watershed Code	Reach #	ILP Map #	ILP #	Site
560-368300-81200-00000-0000-0000-000-000-000-000-000-000	1.0			508

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER — Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: — Local Name:
Watershed Code: 560-368300-81200-00000-0000-0000-000-000-000-000-000-000
ILP Map#: — ILP #: — NID Map #: — NID #: — Reach #: 1.0 — Site #: 508
Field UTM (Z.E.N): .. — Method: — Site Lg: 100 — Method: GE — Access: H
GIS UTM (Z.E.N): 9.458326.6263660 — Ref. Name:
Date: 2010/06/25 — Time: 12:50 — Agency: C660 — Crew: KM/LT/KW — Fish Crd?: ☑ — Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	T	6.30	9.90	5.90	3.20	5.00	3.30					5.60
Wetted Width (m):	T	3.90	5.80	3.40	3.20	2.70	2.10					3.52
Pool Depth (m):	MS	0.12	0.45	0.53	0.34							0.36

	Gadient %		Mtd	Avg
Method I:	2.0	1.0	C	1.50
Method II:			C	

No Vis.Ch.: ☐ Intermittent: ☐ Dw: ☐ Tribs.: ☑

Wb Depth:	.3	.4	.3

Avg: 0.33 Method: MS Stage: L ☐ M ☑ H ☐

COVER Total: A

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	T	D	N	S	N	T	T
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
2 21-40%
INSTREAM VEG: N ☐ A ☑ M ☑ V ☐

LWD: A DIST: C

LB SHP: U
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: C
STG: MF

RB SHP: U
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: C
STG: MF

WATER

EMS: — Req #:
Temp: 8 — Method: T3 — Cond.: — Method: S3
pH: 8.0 — Method: P2 — Turb.: T ☐ M ☐ L ☐ C ☑ — Method: GE
Flood Signs: — Method: GE

MORPHOLOGY

Bed Material: Dominant: G Subdom: C
D95: 20.0 D (cm): 8.00 Morph: RP
Pattern: SI
Islands: N
Coupling: DC
Confinement: UN
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☑ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Other	OVERAL IMPORTANT
OverWinter Habitat	GOOD - DEEP POOLS
Spawning Habitat	GOOD - GOOD GRAVEL WITH LOW EMBEDDEDNESS
Rearing Habitat	GOOD - LOTS OF COVER AND POOLS

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	101	F:	8834	STD	U	LWD IN STREAM
R:	101	F:	8837	STD	U	BARS

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-368300-81200-00000-0000-0000-000-000-000-000-000-000	1.0			508

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	101	F:	8838	STD	U	TRIBUTARY FROM WETLAND
R:	101	F:	8839	STD	D	TYPICAL HABITAT

COMMENTS

Section	Comments
SITE CARD	LOW GRADIENT RIFFLE-POOL STREAM INFLUENCED BY WATER DRAINING FROM WETLAND VIA TRIBUTARY. ABUNDANT LWD AND SEVERAL DEEP POOLS

Site # 508 Photo: IMGP8837
Site 508 - An upstream view of the site.

Site # 508 Photo: IMGP8839
Site 508 - A downstream view of the site.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-368300-59800-00000-0000-0000-000-000-000-000-000-000	1.0			509

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER — Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: — Local Name:
Watershed Code: 560-368300-59800-00000-0000-0000-000-000-000-000-000-000
ILP Map#: — ILP #: — NID Map #: — NID #: — Reach #: 1.0 — Site #: 509
Field UTM (Z.E.N): .. — Method: — Site Lg: 100 — Method: GE — Access: H
GIS UTM (Z.E.N): 9.459307.6264890 — Ref. Name:
Date: 2010/06/25 — Time: 14:50 — Agency: C660 — Crew: KM/LT/KW — Fish Crd?: ☑ — Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	MS	3.00	3.30	2.90	1.60	2.50	2.40					2.62
Wetted Width (m):	MS	1.40	1.80	2.50	1.30	1.80	2.40					1.87
Pool Depth (m):												0.00

	Gadient %		Mtd	Avg
Method I:	2.0		C	2.00
Method II:			C	

Wb Depth:	.7	.5	.4

Avg: 0.53 — Method: MS — Stage: L ☐ M ☑ H ☐
No Vis.Ch.: ☐ — Intermittent: ☐ — Dw: ☐ — Tribs.: ☑

COVER — Total: T

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	N	N	T	T	N	D	T
Loc: P/S/O:	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑

CROWN CLOSURE
0 — 0%
INSTREAM VEG: N ☐ A ☑ M ☑ V ☐

LWD: N — DIST: E

LB SHP: V
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: S
STG: SHR

RB SHP: V
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: S
STG: SHR

WATER

EMS: — Req #:
Temp: 10 — Method: T3 — Cond.: — Method: S3
pH: 0.7 — Method: P2 — Turb.: T ☐ M ☐ L ☐ C ☑ — Method: GE
Flood Signs: — Method: GE

MORPHOLOGY

Bed Material: — Dominant: C — Subdom: G
D95: 32.0 — D (cm): 7.00 — Morph: RP
Pattern: IM
Islands: O
Coupling: DC
Confinement: UN
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☑ SIDE ☐ DIAG ☐ MID ☐ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Other	IMPORTANT HABITAT
OverWinter Habitat	FAIR - MODERATELY DEEP AND FAST BUT FEW DEEP POOLS
Spawning Habitat	FAIR - PATCHES OF GRAVEL, BUT HIGH EMBEDDEDNESS
Rearing Habitat	FAIR- A BIT FAST BUT MAY PROVIDE HABITAT

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	101	F:	8840	STD	U	POOL
R:	101	F:	8841	STD	D	MEANDERING CHANNEL THROUGH WETLAND

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-368300-59800-00000-0000-0000-000-000-000-000-000-000	1.0			509

PHOTOS						
Photo				Foc Lg	Dir	Comments
R:	101	F:	8852	STD	U	MEADERING CHANNEL

COMMENTS	
Section	Comments
CHANNEL	CHANNEL IS DEEP AND FAST BUT HAS FEW POOLS. MEANDERS DIRECTLY BELOW WETLAND AND DRAINS SEVERAL SMALL PONDS
SITE CARD	ROAD CROSSING UPSTREAM IS IN LARGE WETLAND AND SHOULD BE MOVED TO THIS LOCATION.

Site # 509 Photo: IMGP8840
Site 509 - An upstream view of the site.

Site # 509 Photo: IMGP8852
Site 509 - A view of the meandering stream channel.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-368300-50900-00000-0000-0000-000-000-000-000-000-000	1.0			510

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER — Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: — Local Name:
Watershed Code: 560-368300-50900-00000-0000-0000-000-000-000-000-000-000
ILP Map#: — ILP #: — NID Map #: — NID #: — Reach #: 1.0 — Site #: 510
Field UTM (Z.E.N): .. — Method: — Site Lg: 100 — Method: GE — Access: H
GIS UTM (Z.E.N): 9.461746.6264122 — Ref. Name:
Date: 2010/06/26 — Time: 08:15 — Agency: C660 — Crew: KM/LT/KW — Fish Crd?: ☑ — Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	T	5.40	3.20	2.00	2.60	1.80	3.40					3.07
Wetted Width (m):	T	5.30	2.80	1.60	2.30	1.60	3.20					2.80
Pool Depth (m):												0.00

	Gadient %		Mtd	Avg
Method I:	1.0	2.0	C	1.50
Method II:			C	

No Vis.Ch.: ☐ Intermittent: ☐ Dw: ☐ Tribs.: ☐

Wb Depth: .4 | .3 | — Avg: 0.35 — Method: MS — Stage: L ☐ M ☑ H ☐

COVER — Total: M

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	N	T	T	T	N	D	N
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
1 — 1-20%
INSTREAM VEG: N ☐ A ☐ M ☑ V ☐

LWD: F — DIST: E

LB SHP: V
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: C
STG: MF

RB SHP: V
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: C
STG: MF

WATER

EMS: — Req #:
Temp: 7 — Method: T3 — Cond.: — Method: S3
pH: 7.5 — Method: P2 — Turb.: T ☐ M ☐ L ☐ C ☑ — Method: GE
Flood Signs: — Method: GE

MORPHOLOGY

Bed Material: — Dominant: C — Subdom: G
D95: 145.0 — D (cm): 7.00 — Morph: RP
Pattern: SI
Islands: O
Coupling: DC
Confinement: OC
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☑ SIDE ☐ DIAG ☐ MID ☐ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Spawning Habitat	POOR - LOTS OF FINES
OverWinter Habitat	FAIR - MIGHT BE DEEP ENOUGH NOT TO FREEZE, BUT THERE ARE NO POOLS
Rearing Habitat	GOOD - DEEP, SLOW, LOTS OF COVER

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	100	F:	8855	STD	U	CHANNEL
R:	100	F:	8856	STD	D	OVERHANGING VEG
R:	100	F:	8857	STD	U	WETLAND PONDS

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-368300-50900-00000-0000-0000-000-000-000-000-000-000	1.0			510

COMMENTS	
Section	Comments
SITE CARD	RUNS THROUGH WETLAND DRAINING SEVERAL SMALL PONDS. MODERATELY DEEP CHANNEL WITH LOW FLOWS AND OVERHANGING VEG

Site # 510 Photo: IMGP8857
Site 510 - Ponds at the top end of the site.

Site # 510 Photo: IMGP8856
Site 510 - A downstream view of the site.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-368300-00000-00000-0000-0000-000-000-000-000-000-000	1.0			511

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: WILDFIRE CREEK   Local Name:
Watershed Code: 560-368300-00000-00000-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 1.0   Site #: 511
Field UTM (Z.E.N): ..   Method: Site Lg: 100   Method: GE   Access: H
GIS UTM (Z.E.N): 9.468322.6263846   Ref. Name:
Date: 2010/06/26   Time: 10:30   Agency: C660   Crew: KM/LT/KW   Fish Crd?: ☑   Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	RF	19.00	47.00	28.00	15.00	17.00	20.00					24.33
Wetted Width (m):	RF	17.00	18.00	7.00	14.00	12.00	17.00					14.17
Pool Depth (m):												0.00

	Gadient %		Mtd	Avg
Method I:	2.0		C	2.00
Method II:			C	

No Vis.Ch.: ☐   Intermittent: ☐
Dw: ☐   Tribs.: ☐

Wb Depth:	.5	.6	

Avg: 0.55   Method: GE   Stage: L ☐ M ☑ H ☐

COVER   Total: T

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	N	T	D	N	N	S	N
Loc: P/S/O:	☑☑☑	☑☐☐	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑

CROWN CLOSURE
1   1-20%
INSTREAM VEG: N ☐ A ☑ M ☐ V ☐

LWD: F   DIST: C

LB SHP: S
Texture: F ☐ G ☐ C ☑ B ☐ R ☐ A ☐
RIP: D
STG: PS

RB SHP: S
Texture: F ☐ G ☐ C ☑ B ☐ R ☐ A ☐
RIP: M
STG: MF

WATER

EMS: Req #:
Temp: 6   Method: T3   Cond.:   Method: S3
pH: 7.2   Method: P2   Turb.: T ☐ M ☑ L ☐ C ☐   Method: GE
Flood Signs: Method: GE

MORPHOLOGY

Bed Material: Dominant: C   Subdom: B
D95: 42.0   D (cm): 25.00   Morph: RP
Pattern: SI
Islands: N
Coupling: PC
Confinement: FC
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☐	☑

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☑ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
OverWinter Habitat	POOR - NO POOLS
Spawning Habitat	POOR - FAST, LARGE SUBSTRATE
Rearing Habitat	POOR IN PRIMARY CHANNEL- FAST, NO POOLS, LOW COVER, FAIR IN SECONDARY CHANNEL

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	100	F:	8858	STD	U	CHANNEL
R:	100	F:	8859	STD	D	MIDCHANNEL BAR AND LOG JAM
R:	100	F:	8860	STD	X	SLOPE FAILURE ON RIGHT BANK

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-368300-00000-00000-0000-0000-000-000-000-000-000-000	1.0			511

COMMENTS

Section	Comments
SITE CARD	ROAD CROSSING LAID OUT AT BOTTOM OF SITE - GOOD LOCATION. FAST STREAM WITH SIDE CHANNELS AND LOG JAMS. HABITAT OK IN SIDECHANNELS BUT MARGINAL ELSEWHERE

Site # 511 Photo: IMGP8858
Site 511 - A view upstream of the site.

Site # 511 Photo: IMGP8859
Site 511 - A view downstream of the site with mid-channel bar.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-00000-00000-0000-0000-000-000-000-000-000-000	4.0			512

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER — Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: BOWSER RIVER — Local Name:
Watershed Code: 560-208600-00000-00000-0000-0000-000-000-000-000-000-000
ILP Map#: — ILP #: — NID Map #: — NID #: — Reach #: 4.0 — Site #: 512
Field UTM (Z.E.N): .. — Method: — Site Lg: 150 — Method: GE — Access: H
GIS UTM (Z.E.N): 9.469811.6263784 — Ref. Name:
Date: 2010/06/26 — Time: 14:00 — Agency: C660 — Crew: KM/LT/KW — Fish Crd?: ☐ — Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	GE	18.00	30.00	20.00								22.67
Wetted Width (m):	GE	1.70	29.00	20.00								16.90
Pool Depth (m):												0.00

	Gadient %	Mtd	Avg
Method I:	1.0	C	1.00
Method II:		C	

No Vis.Ch.: ☐ Intermittent: ☐
Dw: ☐ Tribs.: ☐

Wb Depth:	1.3		

Avg: 1.30 — Method: GE — Stage: L ☐ M ☑ H ☐

COVER — Total: T

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	N	N	D	N	T	T	N
Loc: P/S/O:	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑

CROWN CLOSURE
0 — 0%
INSTREAM VEG: N ☑ A ☐ M ☐ V ☐

LWD: N — DIST: E

LB SHP: V
Texture: F ☐ G ☐ C ☑ B ☐ R ☑ A ☐
RIP: C
STG: MF

RB SHP: V
Texture: F ☐ G ☐ C ☑ B ☐ R ☑ A ☐
RIP: C
STG: MF

WATER

EMS: — Req #:
Temp: 6 — Method: T3 — Cond.: — Method: S3
pH: 7.3 — Method: P2 — Turb.: T ☑ M ☐ L ☐ C ☐ — Method: GE
Flood Signs: RAFTED DEBRIS — Method: GE

MORPHOLOGY

Bed Material: — Dominant: B — Subdom: R
D95: 40.0 — D (cm): 25.00 — Morph: LC
Pattern: SI
Islands: I
Coupling: DC
Confinement: CO
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☐ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
OverWinter Habitat	FAIR - TOO DEEP AND FAST TO FREEZE
Spawning Habitat	POOR - SUBSTRATE TOO LARGE
Rearing Habitat	FAIR- SLOW AREA BEHIND ROCK AND SIDE OF CHANNEL

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	100	F:	8861	STD	U	CROSSING SITE
R:	100	F:	8862	STD	D	LEFT BANK CHANNEL
R:	100	F:	8863	STD	D	RIGHT BANK CHANNEL

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-208600-00000-00000-0000-0000-000-000-000-000-000-000	4.0			512

COMMENTS	
Section	Comments
SITE CARD	MOST MEASUREMENTS ESTIMATES
SITE CARD	CONSTRICTION OF MAIN STEM OF BELL-IRVING RIVER. GOOD SPOT FOR CROSSING, BEDROCK ON BOTH BANKS, RELATIVELY NARROW BANKFUL WIDTH. NO CRITICAL HABITAT AT CROSSING SPOT

Site # 512 Photo: IMGP8861
Site 512 - An upstream view of the crossing site.

Site # 512 Photo: IMGP8862
Site 512 - A view downstream site.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-368300-50000-00000-0000-0000-000-000-000-000-000-000	1.0			513

PROJECT

Project Name: Snowfields
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 20635
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: Local Name:
Watershed Code: 560-368300-50000-00000-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 1.0   Site #: 513
Field UTM (Z.E.N): ..   Method: Site Lg: 100   Method: GE   Access: H
GIS UTM (Z.E.N): 9.462158.6264044   Ref. Name:
Date: 2010/06/26   Time: 15:00   Agency: C660   Crew: KM/LT/KW   Fish Crd?: ☑   Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	T	3.00	4.10	4.10	4.20	3.40	5.30					4.02
Wetted Width (m):	T	2.50	3.50	2.20	2.80	2.60	4.90					3.08
Pool Depth (m):	MS	0.36	0.40	0.40	0.30							0.37

	Gadient %		Mtd	Avg
Method I:	4.0	5.0	C	4.50
Method II:			C	

Wb Depth:	.5	.6	

Avg: 0.55   Method: MS   Stage: L ☐ M ☑ H ☐
No Vis.Ch.: ☐   Intermittent: ☐   Dw: ☐   Tribs.: ☐

COVER   Total: A

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	S	D	S	N	N	T	N
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
1   1-20%
INSTREAM VEG: N ☐ A ☐ M ☑ V ☐

LWD: F   DIST: E

LB SHP: V
Texture: F ☑ G ☐ C ☐ B ☐ R ☑ A ☐
RIP: C
STG: MF

RB SHP: S
Texture: F ☑ G ☐ C ☑ B ☐ R ☑ A ☐
RIP: C
STG: MF

WATER

EMS: Req #:
Temp: 7   Method: T3   Cond.:   Method: S3
pH: 7.6   Method: P2   Turb.: T ☐ M ☐ L ☐ C ☑   Method: GE
Flood Signs: Method: GE

MORPHOLOGY

Bed Material: Dominant: B   Subdom: C
D95: 85.0   D (cm): 21.00   Morph: SP
Pattern: IR
Islands: N
Coupling: DC
Confinement: CO
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☐ SPAN ☐ BR ☐

FEATURES

NID Map	NID	Type	Hgt	Method	Lg	Method	Photo				AirPhoto				UTM (Z/E/N)	Method
		C	5.0	GE	30	GE	R:	100	F:	8864	L:		#:		9.462158.6264044	GP3

Comments: chute with 2-4m falls

HABITAT QUALITY

Name	Comments
OverWinter Habitat	FAIR - POOLS, BUT MAY FREEZE
Spawning Habitat	POOR - NO GRAVEL
Rearing Habitat	GOOD - ABUNDANT COVER AND POOLS

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-368300-50000-00000-0000-0000-000-000-000-000-000-000	1.0			513

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	100	F:	8865	STD	U	CASCADE AND LWD
R:	100	F:	8866	STD	D	STEP-POOL MORPHOLOGY
R:	100	F:	8867	STD	U	STEEP CASCADE SECTION

COMMENTS

Section	Comments
SITE CARD	HIGH GRADIENT BUT WITH ABUNDANT POOLS AND COVER. CHUTE-CASCADE AT BOTTOM OF SITE MAY BE A BARRIER. SMALL CASCADES THROUGHOUT

Site # 513 Photo: IMGP8867
Site 513 - An upstream view of the site.

Site # 513 Photo: IMGP8866
Site 513 - A downstream view of the site.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 960-250000-00000-00000-0000-0000-000-000-000-000-000-000	1.0			514

PROJECT

Project Name: Snowfields
Stream Name (gaz.): ALASKA RIVERS — Project Code: 20635
Project Watershed Code: 960-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: UNUK RIVER — Local Name:
Watershed Code: 960-250000-00000-00000-0000-0000-000-000-000-000-000-000
ILP Map#: — ILP #: — NID Map #: — NID #: — Reach #: 1.0 — Site #: 514
Field UTM (Z.E.N): .. — Method: — Site Lg: 312 — Method: RF — Access: H
GIS UTM (Z.E.N): 9.407051.6260489 — Ref. Name:
Date: 2010/06/27 — Time: 09:20 — Agency: C660 — Crew: KM/LT/KW — Fish Crd?: ☑ — Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	RF	137.00	118.00	146.00								133.67
Wetted Width (m):	RF	10.70	90.00	80.00								60.23
Pool Depth (m):												0.00

	Gadient %		Mtd	Avg
Method I:	1.0	1.0	C	0.83
Method II:	0.5		C	

No Vis.Ch.: ☐ Intermittent: ☐ Dw: ☐ Tribs.: ☐

Wb Depth:	1.0	1.0	.5

Avg: 0.83 — Method: GE — Stage: L ☐ M ☑ H ☐

COVER — Total: T

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	N	T	T	N	N	D	N
Loc: P/S/O:	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑

CROWN CLOSURE
0 — 0%
INSTREAM VEG: N ☑ A ☐ M ☐ V ☐

LWD: F — DIST: E

LB SHP: V
Texture: F ☐ G ☑ C ☑ B ☐ R ☐ A ☐
RIP: M
STG: MF

RB SHP: V
Texture: F ☐ G ☐ C ☑ B ☐ R ☑ A ☐
RIP: C
STG: MF

WATER

EMS: — Req #:
Temp: 5 — Method: T3 — Cond.: — Method: S3
pH: 7.8 — Method: P2 — Turb.: T ☑ M ☐ L ☐ C ☐ — Method: GE
Flood Signs: RAFTED DEBRIS — Method: GE

MORPHOLOGY

Bed Material: — Dominant: C — Subdom: F
D95: 26.0 — D (cm): 26.00 — Morph: LC
Pattern: SI
Islands: O
Coupling: DC
Confinement: OC
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☐	☑

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☐ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
OverWinter Habitat	FAIR - DOESN'T FREEZE, BUT LOW COVER AND SWIFT FLOW
Spawning Habitat	POOR - NOT MUCH GRAVEL
Rearing Habitat	FAIR ALONG MARGINS OF MAIN CHANNEL. MOST USEFUL COVER FROM ROCKS AND OV

PHOTOS

Photo				Foc Lg	Dir	Comments
R:	101	F:	8869	STD	D	LB CHANNEL
R:	101	F:	8873	STD	D	RB CHANNEL
R:	101	F:	8890	STD	U	LB CHANNEL

Site # 514 Photo: IMGP8869
Site 514 - A downstream view of the left bank channel.

Site # 514 Photo: IMGP8870
Site 514 - A downstream view of the right bank channel.

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-331600-00000-00000-0000-0000-000-000-000-000-000-000	1.0			107

PROJECT

Project Name: Brucejack Project
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 21596
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: MCINNES CREEK   Local Name:
Watershed Code: 560-331600-00000-00000-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 1.0   Site #: 107
Field UTM (Z.E.N): ..   Method: Site Lg: 100   Method: GE   Access: H
GIS UTM (Z.E.N): 9.472737.6261147   Ref. Name: MC1
Date: 2011/09/11   Time: 13:30   Agency: C660   Crew: KW, KJ   Fish Crd?: ☑   Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	T	16.00										16.00
Wetted Width (m):	T	16.00										16.00
Pool Depth (m):												0.00

	Gadient %		Mtd	Avg
Method I:	1.0	1.0	GE	1.00
Method II:				

No Vis.Ch.: ☐   Intermittent: ☐
Dw: ☐   Tribs.: ☐

Wb Depth:	.2	.5	.2

Avg: 0.30   Method: T   Stage: L ☐ M ☐ H ☑

COVER   Total: M

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	S	N	N	T	T	D	N
Loc: P/S/O:	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑

CROWN CLOSURE
2   21-40%
INSTREAM VEG: N ☑ A ☐ M ☐ V ☐

LWD: F   DIST: C

LB SHP: U
Texture: F ☑ G ☐ C ☑ B ☐ R ☐ A ☐
RIP: D
STG: YF

RB SHP: U
Texture: F ☑ G ☐ C ☑ B ☐ R ☐ A ☐
RIP: D
STG: MF

WATER

EMS: Req #:
Temp: 9   Method: T3   Cond.: 30   Method: S4
pH: 7.7   Method: P1   Turb.: T ☐ M ☐ L ☐ C ☑   Method: GE
Flood Signs: rafted debris   Method: GE

MORPHOLOGY

Bed Material: Dominant: G   Subdom: C
D95: 40.0   D (cm): 45.00   Morph: RP
Pattern: IM
Islands: N
Coupling: DC
Confinement: UN
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☑	☐	☑	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☐ SPAN ☐ BR ☐

FEATURES

NID Map	NID	Type	Hgt	Method	Lg	Method	Photo				AirPhoto				UTM (Z/E/N)	Method
		BD	.8	T	1	T	R:	DIG	F:	6367	L:		#:		9.472683.6261131	GP3

Comments: LARGE BEAVER DAM ON THE LB OF SITE

HABITAT QUALITY

Name	Comments
Spawning Habitat	EXCELLENT - RUN SECTION WITH GOOD SPAWNING GRAVEL AND DEPTH
Rearing Habitat	EXCELLENT - HIGH COVER, LWD, SLOW WATER AND SIDE CHANNELS
OverWinter Habitat	FAIR - ONE DEEP SLOW POOL OF SUFFICIENT DEPTH TO NOT FREEZE

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-331600-00000-00000-0000-0000-000-000-000-000-000-000	1.0			107

COMMENTS	
Section	Comments
COVER	CLEAR WATER, OV, LWD AND SWD. NICE GRAVE SUBSTRATE
CHANNEL	DEEP AND SANDY AT MOUTH, FOLLOWED BY SMALL RIFFLE, DEEP POOL BELOW BEAVER DAM AND THEN FASTER RAPIDS AS IT CLIMBS

MC-1 P9116368
MC-1 Beaver dam near site

MC-1 P9116370
MC-1 Downstream view of site and Bell-Irving River confluence

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-355000-00000-00000-0000-0000-000-000-000-000-000-000	1.0			104

PROJECT

Project Name: Brucejack Project
Stream Name (gaz.): BELL-IRVING RIVER — Project Code: 21596
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: — Local Name:
Watershed Code: 560-355000-00000-00000-0000-0000-000-000-000-000-000-000
ILP Map#: ILP #: NID Map #: NID #: Reach #: 1.0 Site #: 104
Field UTM (Z.E.N): .. Method: Site Lg: 100 Method: GE Access: H
GIS UTM (Z.E.N): 9.469564.6262888 Ref. Name: BIT1
Date: 2011/09/09 Time: 13:50 Agency: C660 Crew: KW, KJ Fish Crd?: ☑ Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	T	3.40	2.60	4.00	2.70	4.80						3.50
Wetted Width (m):	T	2.69	2.80	3.80	2.60	5.00						3.38
Pool Depth (m):	T		0.20	0.15	0.50	0.70						0.39

	Gadient %		Mtd	Avg
Method I:	2.0	4.0	GE	2.67
Method II:	2.0		GE	

No Vis.Ch.: ☐ Intermittent: ☐ Dw: ☐ Tribs.: ☐

Wb Depth:	.2	.3	

Avg: 0.25 Method: T Stage: L ☐ M ☑ H ☐

COVER Total: M

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	S	D	N	N	T	S	T
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
2 21-40%
INSTREAM VEG: N ☐ A ☑ M ☑ V ☐

LWD: A DIST: E

LB SHP: V
Texture: F ☑ G ☐ C ☐ B ☐ R ☑ A ☐
RIP: C
STG: PS

RB SHP: S
Texture: F ☑ G ☐ C ☑ B ☐ R ☐ A ☐
RIP: C
STG: MF

WATER

EMS: Req #:
Temp: 9 Method: T3 Cond.: 20 Method: S4
pH: 6.6 Method: P1 Turb.: T ☐ M ☐ L ☐ C ☑ Method: GE
Flood Signs: NONE Method: GE

MORPHOLOGY

Bed Material: Dominant: C Subdom: G
D95: 60.0 D (cm): 8.00 Morph: SP
Pattern: IR
Islands: N
Coupling: DC
Confinement: CO
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☑	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☑ SIDE ☐ DIAG ☐ MID ☐ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Spawning Habitat	POOR - TOO FAST AND STEEP, LITTLE APPROPRIATE SUBSTRATE
Rearing Habitat	FAIR - STEEP BUT SMALL DEEP POOLS
OverWinter Habitat	POOR - SHALLOW AND FAST

COMMENTS

Section	Comments
CHANNEL	SMALL STEEP STREAM. AT FLOOD TO EDGES OF BANKS. HIGHLY ENTRENCHED. BESIDE CUTBLOCK - LOTS OF BLOW DOWN IN STREAM

BIT-1 P9096318
BIT-1 Downstream view of site

BIT-1 P9096318
BIT-1 Pool mid-site

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-368300-00000-00000-0000-0000-000-000-000-000-000-000	1.0			100

PROJECT

Project Name: Brucejack Project
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 21596
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: WILDFIRE CREEK   Local Name:
Watershed Code: 560-368300-00000-00000-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 1.0   Site #: 100

Field UTM (Z.E.N): ..   Method: Site Lg: 100   Method: GE   Access: H
GIS UTM (Z.E.N): 9.046833.6264201   Ref. Name: WC1

Date: 2011/09/07   Time: 15:10   Agency: C660   Crew: KW, KJ   Fish Crd?: ☑   Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	GE	40.00	60.00	50.00	40.00							47.50
Wetted Width (m):	GE	20.00	18.00	40.00	35.00							28.25
Pool Depth (m):												0.00

	Gadient %		Mtd	Avg
Method I:	1.0	1.0	GE	1.00
Method II:				

No Vis.Ch.: ☐   Intermittent: ☐
Dw: ☐   Tribs.: ☐

Wb Depth:			

Avg: 0.00   Method: Stage: L ☐ M ☑ H ☐

COVER   Total: T

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	T	T	N	T	D	S	N
Loc: P/S/O:	☐☑☐	☑☑☐	☑☑☐	☑☐☐	☐☑☐	☑☑☐	☑☑☐

CROWN CLOSURE
1   1-20%
INSTREAM VEG: N ☐ A ☑ M ☐ V ☐

LWD: F   DIST: C

LB SHP: V
Texture: F ☑ G ☐ C ☑ B ☐ R ☐ A ☐
RIP: C
STG: MF

RB SHP: S
Texture: F ☑ G ☑ C ☐ B ☐ R ☐ A ☐
RIP: M
STG: MF

WATER

EMS: Req #:
Temp: 9   Method: T3   Cond.: 30   Method: S4
pH: 8.2   Method: P2   Turb.: T ☑ M ☐ L ☐ C ☐   Method: GE
Flood Signs: RAFTED DEBRIS   Method: GE

MORPHOLOGY

Bed Material: Dominant: G   Subdom: F
D95: 19.0   D (cm): 19.00   Morph: RP

Pattern: IR
Islands: O
Coupling: PC
Confinement: UN
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☑ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Other	OVERALL - GOOD
Spawning Habitat	POOR - TOO FAST WITH TOO LARGE SUBSTRATE
Rearing Habitat	FAIR - MAIN CHANNEL TOO FAST EXCEPT FOR THE MARGINS, BUT THE SECONDARY CHANNEL PROVIDED GOOD HABITAT
OverWinter Habitat	GOOD - ONE LARGE DEEP POOL

COMMENTS

Section	Comments
CHANNEL	THE MAIN CHANNEL WAS FAST AND VERY TURBID. COVER IN THE MAIN CHANNEL CAME PRIMARILY FROM A LARGE POOL BEHIND A RAFT OF LWD. THE LEFT BANK WAS HIGHLY UNSTABLE, COLLAPSING AS WE WATCHED. A SECONDARY

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-368300-00000-00000-0000-0000-000-000-000-000-000-000	1.0			100

COMMENTS	
Section	Comments
	CHANNEL RAN ON THE RIGHT BANK PROVIDING SLOWER HABITAT.

WC-1 P9076290
WC-1 Log jam and pool at downstream end of site

WC-1 P9076292
WC-1 Upstream view of site

FDIS Site Card

Watershed Code	Reach #	ILP Map #	ILP #	Site
560-368300-00000-00000-0000-0000-000-000-000-000-000-000	2.0			101

PROJECT

Project Name: Brucejack Project
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 21596
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: WILDFIRE CREEK   Local Name:
Watershed Code: 560-368300-00000-00000-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 2.0   Site #: 101
Field UTM (Z.E.N): ..   Method: Site Lg: 100   Method: GE   Access: H
GIS UTM (Z.E.N): 9.467314.6261775   Ref. Name: WC2
Date: 2011/09/08   Time: 09:35   Agency: C660   Crew: KW, KJ   Fish Crd?: ☑   Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	GE	12.00	8.00	9.00								9.67
Wetted Width (m):	GE	10.00	8.00	9.00								9.00
Pool Depth (m):	GE	2.00										2.00

	Gadient %		Mtd	Avg
Method I:	1.0	2.0	GE	1.50
Method II:				

No Vis.Ch.: ☐   Intermittent: ☐
Wb Depth: [ ] [ ] [ ]   Avg: 0.00   Method: Stage: L ☐ M ☐ H ☑   Dw: ☐   Tribs.: ☐

COVER   Total: M

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	N	N	N	T	T	D	N
Loc: P/S/O:	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑

CROWN CLOSURE
2   21-40%
INSTREAM VEG: N ☐ A ☑ M ☐ V ☐

LWD: N   DIST: E

LB SHP: S
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: D
STG: MF

RB SHP: S
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: M
STG: MF

WATER

EMS: Req #:
Temp: 10   Method: T3   Cond.: 20   Method: S4
pH: 7.9   Method: P2   Turb.: T ☐ M ☐ L ☑ C ☐   Method: GE
Flood Signs: Method:

MORPHOLOGY

Bed Material: Dominant: G   Subdom: F
D95: 12.0   D (cm): 12.00   Morph: RP
Pattern: SI
Islands: N
Coupling: DC
Confinement: OC
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☑	☑	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☑ SIDE ☐ DIAG ☐ MID ☐ SPAN ☐ BR ☐

FEATURES

NID Map	NID	Type	Hgt	Method	Lg	Method	Photo	AirPhoto	UTM (Z/E/N)	Method
		C	1.0	GE	1	GE	R: 101 F: 6303	L: #:	9.046733.6261734	GP3

Comments: CASCADE AND POOL

HABITAT QUALITY

Name	Comments
Spawning Habitat	FAIR - SUBSTRATE IS MOSTLY TOO LARGE AND STREAM TOO HIGH GRADIENT, BUT THERE ARE AREAS OF GRAVEL
Rearing Habitat	GOOD - WATER WAS FAST AND HIGH AT THE TIME OF SAMPLING, BUT THERE WAS ABUNDANT COVER AND WOODY DEBRIS TO PROVIDE REFUGE
OverWinter Habitat	FAIR - ONE LARGISH POOL

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-368300-00000-00000-0000-0000-000-000-000-000-000-000	2.0			101

COMMENTS

Section	Comments
MORPHOLOGY	THE STREAM WAS COMPRISED OF STEEPER SECTIONS, INCLUDING A CASCADE, AND LOW GRADIENT SECTIONS. HIGH CANOPY COVER AND OVERHANGING VEGETATION
WATER	WATER WAS VERY HIGH AT TIME OF SAMPLING, REACHING OR EXCEEDING THE BANKS IN SOME AREAS

WC-2 P9086296
WC-2 High water seen in view across site

WC-2 P9086298
WC-2 High water seen in downstream view

WC-2 P9086304
WC-2 Cascade at downstream end of site

WC-2 P9086305
WC-2 Pool below cascade at downstream end of site

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-368300-18300-00000-0000-0000-000-000-000-000-000-000	3.0			103

PROJECT

Project Name: Brucejack Project
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 21596
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: Local Name:
Watershed Code: 560-368300-18300-00000-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 3.0   Site #: 103

Field UTM (Z.E.N): ..   Method: Site Lg: 150   Method: GE   Access: H
GIS UTM (Z.E.N): 9.468371.6259238   Ref. Name: WC3

Date: 2011/09/09   Time: 11:15   Agency: C660   Crew: KW, KJ   Fish Crd?: ☑   Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	GE	2.50	3.00	4.00								3.17
Wetted Width (m):	GE	10.00	15.00	15.00								13.33
Pool Depth (m):												0.00

	Gadient %		Mtd	Avg
Method I:	0.0	0.0	GE	0.00
Method II:				

No Vis.Ch.: ☐   Intermittent: ☐
Dw: ☐   Tribs.: ☐

Wb Depth:	1.0	1.5	

Avg: 1.25   Method: GE   Stage: L ☐ M ☐ H ☑

COVER   Total: A

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	N	N	N	N	S	N	D
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
0   0%
INSTREAM VEG: N ☐ A ☑ M ☐ V ☑

LWD: N   DIST: E

LB SHP: S
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: G
STG: MF

RB SHP: S
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: C
STG: MF

WATER

EMS: Req #:
Temp: 12   Method: T3   Cond.: 20   Method: S4
pH: 7.6   Method: P1   Turb.: T ☐ M ☐ L ☐ C ☑   Method: GE
Flood Signs: Method:

MORPHOLOGY

Bed Material: Dominant: F   Subdom: G
D95: 0.10   D (cm): 0.10   Morph: NS
Pattern: ME
Islands: N
Coupling: DC
Confinement: UN
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☑	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☑ SIDE ☐ DIAG ☐ MID ☐ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Spawning Habitat	POOR - NO GRAVEL, MUDDY SUBSTRATE
Rearing Habitat	GOOD - SLOW WATER, PLENTY OF COVER
OverWinter Habitat	GOOD - DEEP CHANNELS

WILDLIFE

Group	Observations
MAM	MOTHER MOOSE AND CALF AT BOTTOM OF SITE

COMMENTS

Section	Comments

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-368300-18300-00000-0000-0000-000-000-000-000-000-000	3.0			103

MORPHOLOGY	THERE IS PROBABLY A BEAVER DAM DOWNSTREAM AND THERE IS AN OLD DAM IN THE MIDDLE OF THE SITE. AT THE TOP OF THE SITE THE GRADIENT INCREASES SLIGHTLY AND CHANNEL IS APPEARS TO BE A RECENT AVULSION
CHANNEL	MORE WETLAND THAN STREAM. DISTINCT CHANNELS BUT 0.5M WATER OUTSIDE CHANNELS.

WC-3 P9096316
WC-3 Submerged vegetation

WC-3 P9096318
WC-3 Avulsion at upstream end of site

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-388500-00000-00000-0000-0000-000-000-000-000-000-000	1.0			105

PROJECT

Project Name: Brucejack Project
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 21596
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: DELTAIC CREEK   Local Name:
Watershed Code: 560-388500-00000-00000-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 1.0   Site #: 105
Field UTM (Z.E.N): ..   Method: Site Lg: 150   Method: GE   Access: H
GIS UTM (Z.E.N): 9.466159.6266674   Ref. Name: DC1
Date: 2011/09/11   Time: 10:35   Agency: C660   Crew: KW, KJ   Fish Crd?: ☐   Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	GE	55.00	35.00	30.00								40.00
Wetted Width (m):	GE	15.00	14.00	15.00								14.67
Pool Depth (m):												0.00

	Gadient %		Mtd	Avg
Method I:	1.0	1.0	GE	1.00
Method II:				

No Vis.Ch.: ☐   Intermittent: ☐
Dw: ☐   Tribs.: ☐

Wb Depth:	1.0		

Avg: 1.00   Method: GE   Stage: L ☐ M ☑ H ☐

COVER   Total: T

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	T	T	D	N	N	S	N
Loc: P/S/O:	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑

CROWN CLOSURE
0   0%
INSTREAM VEG: N ☐ A ☑ M ☐ V ☐

LWD: N   DIST: E

LB SHP: V
Texture: F ☑ G ☐ C ☑ B ☐ R ☐ A ☐
RIP: M
STG: MF

RB SHP: S
Texture: F ☑ G ☐ C ☑ B ☐ R ☐ A ☐
RIP: C
STG: MF

WATER

EMS: Req #:
Temp: 5   Method: T3   Cond.: 120   Method: S4
pH: 8.6   Method: P2   Turb.: T ☑ M ☐ L ☐ C ☐   Method: GE
Flood Signs: RAFTED DEBRIS   Method: GE

MORPHOLOGY

Bed Material: Dominant: F   Subdom: G
D95: 55.0   D (cm): 55.00   Morph: RP
Pattern: IR
Islands: I
Coupling: DC
Confinement: UN
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☑	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☑ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Spawning Habitat	FAIR - LOTS OF FINES BUT SOME GRAVEL TOO
OverWinter Habitat	POOR - NO DEEP POOLS
Rearing Habitat	FAIR - BRAIDED CHANNELS WITH SMALL AREAS OF SLOW WATER AND SWD

COMMENTS

Section	Comments
CHANNEL	MID-SIZED HIGHLY TURBID STREAM. SHOCKED BRAIDED CHANNELS ON GRAVEL BARS ~2 DAYS AFTER FLOOD. THERE WERE FEW AREAS OF SLACK WATER AND LITTLE COVER FOR DV

DC-1 P9116359
DC-1 Midstream view of main channel

DC-1 P9116360
DC-1 Upstream view of side channel with extensive bars

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 960-250000-00000-00000-0000-0000-000-000-000-000-000-000	1.0			106

PROJECT

Project Name: Brucejack Project
Stream Name (gaz.): UNUK RIVER
Project Code: 21596
Project Watershed Code: 960-250000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: UNUK RIVER
Local Name:
Watershed Code: 960-250000-00000-00000-0000-0000-000-000-000-000-000-000
ILP Map#: ILP #: NID Map #: NID #: Reach #: 1.0 Site #: 106
Field UTM (Z.E.N): .. Method: Site Lg: 200 Method: GE Access: H
GIS UTM (Z.E.N): 9.407061.6260634 Ref. Name: UR1
Date: 2011/09/10 Time: 12:15 Agency: C660 Crew: KW, KJ Fish Crd?: ☑ Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	GE	65.00	60.00	50.00								58.33
Wetted Width (m):	GE	20.00	30.00	18.00								22.67
Pool Depth (m):												0.00

	Gadient %		Mtd	Avg
Method I:	1.0	1.0	GE	1.00
Method II:				

No Vis.Ch.: ☐ Intermittent: ☐
Dw: ☐ Tribs.: ☐

Wb Depth:	1.0		

Avg: 1.00 Method: GE Stage: L ☐ M ☑ H ☐

COVER Total: T

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	S	S	D	N	N	N	N
Loc: P/S/O:	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑

CROWN CLOSURE
0 0%
INSTREAM VEG: N ☐ A ☐ M ☐ V ☐

LWD: F DIST: C

LB SHP: S
Texture: F ☐ G ☑ C ☑ B ☐ R ☐ A ☐
RIP: C
STG: MF

RB SHP: S
Texture: F ☑ G ☐ C ☑ B ☑ R ☐ A ☐
RIP: M
STG: MF

WATER

EMS:
Req #:
Temp: Method:
Cond.: Method:
pH: Method:
Turb.: T ☑ M ☐ L ☐ C ☐ Method: GE
Flood Signs: RAFTED DEBRIS/MUD Method: GE

MORPHOLOGY

Bed Material: Dominant: F Subdom: C
D95: 36.0 D (cm): 36.00 Morph: LC
Pattern: SI
Islands: O
Coupling: DC
Confinement: UN
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☑	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☑	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☐ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Spawning Habitat	POOR- MOSTLY LARGE SUBSTRATE OR FINES
Rearing Habitat	FAIR - FAST WATER IN THE MAINSTEM, BUT SLOW WATER ALONG MARGINS
OverWinter Habitat	FAIR - NO SLOW POOLS, BUT CHANNEL DEEP ENOUGH NOT TO FREEZE

UC-1 P9106347
UC-1 Downstream view of site

UC-1 P9106348
UC-1 Upstream view of site

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 960-250000-55300-00000-0000-0000-000-000-000-000-000-000	1.0			105

PROJECT

Project Name: Brucejack Project
Stream Name (gaz.): UNUK RIVER — Project Code: 21596
Project Watershed Code: 960-250000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: SULPHURETS CREEK — Local Name: SC1
Watershed Code: 960-250000-55300-00000-0000-0000-000-000-000-000-000-000
ILP Map#: ILP #: NID Map #: NID #: Reach #: 1.0 Site #: 105

Field UTM (Z.E.N): .. Method: Site Lg: 250 Method: GE Access: H
GIS UTM (Z.E.N): 9.407511.6261580 Ref. Name:

Date: 2011/09/10 Time: 09:04 Agency: C660 Crew: KW, KJ Fish Crd?: ☑ Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	GE	100.00	80.00									90.00
Wetted Width (m):	GE	45.00	40.00									42.50
Pool Depth (m):												0.00

	Gadient %		Mtd	Avg
Method I:	1.0	1.0	GE	1.00
Method II:				

No Vis.Ch.: ☐ Intermittent: ☐
Dw: ☐ Tribs.: ☐

Wb Depth: Avg: 0.00 Method: Stage: L ☐ M ☑ H ☐

COVER Total: T

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	T	D	S	N	N	T	N
Loc: P/S/O:	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑	☑☑☑

CROWN CLOSURE
0 0%
INSTREAM VEG: N ☐ A ☑ M ☐ V ☐

LWD: F DIST: E

LB SHP: V
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: M
STG: YF

RB SHP: S
Texture: F ☑ G ☐ C ☑ B ☐ R ☐ A ☐
RIP: M
STG: YF

WATER

EMS:
Temp: 3 Method: T3
pH: 8.2 Method: P2
Flood Signs: RAFTED DEBRIS Method: GE

Req #:
Cond.: 170 Method: S4
Turb.: T ☑ M ☐ L ☐ C ☐ Method: GE

MORPHOLOGY

Bed Material: Dominant: B Subdom: F
D95: 34.0 D (cm): 34.00 Morph: LC

Pattern: SI
Islands: F
Coupling: DC
Confinement: UN
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☑	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☐ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Spawning Habitat	POOR - FAST WITH LARGE SUBSTRATE
Rearing Habitat	FAIR - FAST WATER, BUT POCKETS OF SLOW WATER ALONG MARGINS
OverWinter Habitat	GOOD - DEEP CHANNEL, ALTHOUGH FAST WATER

WILDLIFE

Group	Observations
MAM	JUVENILE BLACK BEAR STRANDED ON ISLAND MID-CHANNEL. NO MOTHER OBSERVED

COMMENTS

Section	Comments

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 960-250000-55300-00000-0000-0000-000-000-000-000-000-000	1.0			105

CHANNEL	CHANNEL WAS HIGHLY BRAIDED. STREAM IN FLOOD. CHANNEL WAS IN THE PROCESS OF MOVING, LEAVING A LARGE GRAVEL BAR ON RB, ERODING THE BANK ON THE LB

SC-1 P9106335
SC-1 Downstream view of site

SC-1 P9106337
SC-1 Upstream view of site

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-331600-00000-00000-0000-0000-000-000-000-000-000-000	1.0			204

PROJECT

Project Name: Brucejack Project
Stream Name (gaz.): BELL-IRVING RIVER — Project Code: 21596
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: MCINNES CREEK — Local Name:
Watershed Code: 560-331600-00000-00000-0000-0000-000-000-000-000-000-000
ILP Map#: ILP #: NID Map #: NID #: Reach #: 1.0 Site #: 204

Field UTM (Z.E.N): .. Method: Site Lg: 600 Method: GE Access: H
GIS UTM (Z.E.N): 9.473727.6261147 Ref. Name:

Date: 2012/08/29 Time: 07:30 Agency: C660 Crew: KW/TM Fish Crd?: ☐ Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	T	5.20	5.50	9.00	4.80	8.00						6.50
Wetted Width (m):	T	4.00	3.50	4.00	6.00							4.38
Pool Depth (m):	MS	1.00	0.50									0.75

	Gadient %		Mtd	Avg
Method I:	5.0	8.0	GE	6.50
Method II:				

No Vis.Ch.: ☐ Intermittent: ☐ Dw: ☐ Tribs.: ☐

Wb Depth:	.4	.5	

Avg: 0.45 Method: MS Stage: L ☐ M ☑ H ☐

COVER Total: M

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	S	N	D	N	T	S	N
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
1 1-20%
INSTREAM VEG: N ☐ A ☑ M ☑ V ☐

LWD: F DIST: E

LB SHP: S
Texture: F ☑ G ☑ C ☐ B ☐ R ☐ A ☐
RIP: C
STG: MF

RB SHP: S
Texture: F ☐ G ☐ C ☐ B ☐ R ☑ A ☐
RIP: C
STG: MF

WATER

EMS: Req #:
Temp: 6 Method: T3 Cond.: Method:
pH: Method: Turb.: T ☐ M ☐ L ☐ C ☑ Method: GE
Flood Signs: Method:

MORPHOLOGY

Bed Material: Dominant: B Subdom: C
D95: 120.0 D (cm): 500.00 Morph: SP
Pattern: SI
Islands: N
Coupling: CO
Confinement: EN
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☑ SIDE ☐ DIAG ☐ MID ☐ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Spawning Habitat	POOR, NOT MUCH GRAVEL
Rearing Habitat	GOOD, STEEP BUT GOOD, STEP-POOL STRUCTURE
OverWinter Habitat	FAIR, FEW DEEP POOLS

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-368300-00000-00000-0000-0000-000-000-000-000-000-000	2.0			203

PROJECT

Project Name: Brucejack Project
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 21596
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: WILDFIRE CREEK   Local Name:
Watershed Code: 560-368300-00000-00000-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 2.0   Site #: 203

Field UTM (Z.E.N): ..   Method: Site Lg: 80   Method: GE   Access: H
GIS UTM (Z.E.N): 9.466688.6262896   Ref. Name: WC-5

Date: 2012/08/28   Time: 13:50   Agency: C660   Crew: KW/TM   Fish Crd?: ☐   Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	GE	16.00	18.00	150.00								61.33
Wetted Width (m):	GE	4.50	5.00	10.00								6.50
Pool Depth (m):	GE	0.50										0.50

	Gadient %		Mtd	Avg
Method I:	3.0	8.0	GE	4.33
Method II:	2.0		GE	

No Vis.Ch.: ☐   Intermittent: ☐   Dw: ☐   Tribs.: ☐

Wb Depth:	1.5	1.2	.8

Avg: 1.17   Method: MS   Stage: L ☐ M ☑ H ☐

COVER   Total: T

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	S	N	D	N	N	T	N
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
0   0%
INSTREAM VEG: N ☑ A ☐ M ☐ V ☐

LWD: N   DIST: E

LB SHP: V
Texture: F ☐ G ☐ C ☐ B ☐ R ☑ A ☐
RIP: D
STG: PS

RB SHP: S
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: M
STG: MF

WATER

EMS: Req #:
Temp: 4   Method: T3   Cond.: 60   Method: S4
pH: Method: Turb.: T ☐ M ☑ L ☐ C ☐   Method: GE
Flood Signs: Method:

MORPHOLOGY

Bed Material: Dominant: B   Subdom: C
D95: 110.0   D (cm): 95.00   Morph: RP
Pattern: SI
Islands: O
Coupling: CO
Confinement: EN
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☐ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Spawning Habitat	POOR, FEW POCKETS OF GRAVEL
Rearing Habitat	FAIR, FAST, BUT SLOW AREAS AT EDGES AND POOLS BEHIND ROCKS
OverWinter Habitat	POOR, NO DEEP POOLS

COMMENTS

Section	Comments
SITE CARD	FAIRLY HIGH GRADIENT, BUT WITH POOLS AND SPOTS OF SLOW WATER TO ALLOW FISH PASSAGE. ENTRENCHED IN CANYON. VERY LARGE BOULDERS SHOW SIGNS OF MOVEMENT. LIKELY VERY FAST DURING FLOODS

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-368300-18300-00000-0000-0000-000-000-000-000-000-000	2.0			200

PROJECT

Project Name: Brucejack Project
Stream Name (gaz.): BELL-IRVING RIVER
Project Code: 21596
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name:
Local Name:
Watershed Code: 560-368300-18300-00000-0000-0000-000-000-000-000-000-000
ILP Map#: ILP #: NID Map #: NID #: Reach #: 2.0 Site #: 200

Field UTM (Z.E.N): .. Method: Site Lg: 100 Method: GE Access: H
GIS UTM (Z.E.N): 9.467306.6261771 Ref. Name: WC-2

Date: 2012/08/28 Time: 09:05 Agency: C660 Crew: KW/TM Fish Crd?: ☑ Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	T	9.80	12.30	10.40	8.00							10.13
Wetted Width (m):	T	2.50	4.00	8.00	0.50							3.75
Pool Depth (m):	MS	1.05	0.80									0.92

	Gadient %		Mtd	Avg
Method I:	10.0		GE	10.00
Method II:				

No Vis.Ch.: ☐ Intermittent: ☐
Dw: ☐ Tribs.: ☐

Wb Depth:	1.0	1.1	

Avg: 1.05 Method: MS Stage: L ☑ M ☐ H ☐

COVER Total: M

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	T	T	D	T	S	S	N
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
1 1-20%
INSTREAM VEG: N ☐ A ☑ M ☑ V ☐

LWD: F DIST: E

LB SHP: S
Texture: F ☑ G ☐ C ☐ B ☑ R ☐ A ☐
RIP: M
STG: MF

RB SHP: S
Texture: F ☑ G ☐ C ☐ B ☑ R ☐ A ☐
RIP: M
STG: MF

WATER

EMS:
Req #:
Temp: 7 Method: T3
Cond.: 20 Method: S4
pH: Method:
Turb.: T ☐ M ☐ L ☐ C ☑ Method: GE
Flood Signs: none Method: GE

MORPHOLOGY

Bed Material: Dominant: C Subdom: B
D95: 0.50 D (cm): 0.23 Morph: RP
Pattern: IR
Islands: N
Coupling: DC
Confinement: CO
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☑	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☐ SIDE ☑ DIAG ☐ MID ☐ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
OverWinter Habitat	GOOD, NUMEROUS DEEP POOLS
Spawning Habitat	POOR, SUBSTRATE TOO LARGE
Rearing Habitat	GOOD, LOTS OF COVER

COMMENTS

Section	Comments
SITE CARD	LITTLE WATER BUT EVIDENCE OF VERY HIGH FLOWS AT FLOOD. DOWNED TREES CREATE NUMEROUS DEEP POOLS

FDIS Site Card

	Reach #	ILP Map #	ILP #	Site
Watershed Code: 560-368300-18300-00000-0000-0000-000-000-000-000-000-000	3.0			201

PROJECT

Project Name: Brucejack Project
Stream Name (gaz.): BELL-IRVING RIVER   Project Code: 21596
Project Watershed Code: 560-000000-00000-00000-0000-0000-000-000-000-000-000-000

WATERSHED

Gazetted Name: Local Name:
Watershed Code: 560-368300-18300-00000-0000-0000-000-000-000-000-000-000
ILP Map#:   ILP #:   NID Map #:   NID #:   Reach #: 3.0   Site #: 201
Field UTM (Z.E.N): ..   Method: Site Lg: 100   Method: GE   Access: H
GIS UTM (Z.E.N): 9.468036.6259424   Ref. Name: wc-3
Date: 2012/08/28   Time: 12:00   Agency: C660   Crew: KW/TM   Fish Crd?: ☐   Incomplete: ☐

CHANNEL

	Mtd	width	width	width	width	width	width	width	width	width	width	Avg
Channel Width (m):	T	4.50	4.00	5.50	4.30							4.58
Wetted Width (m):	T	4.50	4.00	5.00	4.30							4.45
Pool Depth (m):												0.00

	Gadient %		Mtd	Avg
Method I:	0.0	0.0	GE	0.00
Method II:				

No Vis.Ch.: ☐   Intermittent: ☐
Dw: ☐   Tribs.: ☐

Wb Depth:	.4	1.0	1.2

Avg: 0.87   Method: MS   Stage: L ☐ M ☑ H ☐

COVER   Total: M

Type:	SWD	LWD	B	U	DP	OV	IV
Amount:	N	T	N	S	D	S	S
Loc: P/S/O:	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐	☑☐☐

CROWN CLOSURE
0   0%
INSTREAM VEG: N ☐ A ☑ M ☑ V ☑

LWD: F   DIST: E

LB SHP: U
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: C
STG: MF

RB SHP: S
Texture: F ☑ G ☐ C ☐ B ☐ R ☐ A ☐
RIP: C
STG: MF

WATER

EMS: Req #:
Temp: 8   Method: T3   Cond.:   Method:
pH: Method: Turb.: T ☐ M ☐ L ☐ C ☑   Method: GE
Flood Signs: Method:

MORPHOLOGY

Bed Material: Dominant: F   Subdom: G
D95: 1.00   D (cm): 0.10   Morph: LC
Pattern: ME
Islands: N
Coupling: DC
Confinement: UN
FSZ: ☐

DISTURBANCE INDICATORS

O1	B1	B2	B3	D1	D2	D3
☐	☐	☐	☐	☐	☐	☐

C1	C2	C3	C4	C5	S1	S2	S3	S4	S5
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Bars: N ☑ SIDE ☐ DIAG ☐ MID ☐ SPAN ☐ BR ☐

HABITAT QUALITY

Name	Comments
Spawning Habitat	POOR, ALL FINE SUBSTRATE
Rearing Habitat	GOOD, SLOW, LOTS OF COVER
OverWinter Habitat	GOOD, DEEP AND SLOW

COMMENTS

Section	Comments
SITE CARD	SINGLE DEFINED CHANNEL IN A WETLAND. NO WATER VELOCITY. WATER LILIES AND OTHER INSTREAM COVER ABUNDANT

Appendix 7.2-2

Detailed Habitat Characteristics from Stream Sites, Brucejack Gold Mine Project, 2010 to 2012

Engineers and Scientists

Appendix 7.2-2. Detailed Habitat Characteristics from Stream Sites, Brucejack Gold Mine Project, 2010 to 2012

				UTM Coordinates (Zone 9)				Water Quality				
Watershed	Site	Date	Crew	DS Easting	DS Northing	US Easting	US Northing	Temp (°C)	pH	Turbidity	CD (µS/cm)	Current Flow
Bowser	100	23/06/2010	LT/BS	453917	6252990	-	-	6	8.6	Turbid	100	M
Bowser	101	23/06/2010	LT/BS	451616	6251657	-	-	6	8.3	Turbid	100	M
Bowser	102	23/06/2010	LT/BS	451275	6251714	-	-	6	8.3	Turbid	100	M
Bowser	102	23/06/2010	LT/BS	451275	6251714	-	-	6	8.3	Turbid	100	M
Bowser	102	23/06/2010	LT/BS	451275	6251714	-	-	6	8.3	Turbid	100	M
Bowser	102	23/06/2010	LT/BS	451275	6251714	-	-	6	8.3	Turbid	100	M
Scott	103	24/06/2010	LT/BS	452949	6253051	-	-	5	8.8	Turbid	100	M
Scott	104	24/06/2010	LT/BS	452364	6256689	-	-	6	8	Turbid	90	M
Scott	104	24/06/2010	LT/BS	452364	6256689	-	-	6	8	Turbid	90	M
Scott	106	25/06/2010	LT/BS	453763	6261089	-	-	8	7.9	Turbid	90	M
Scott	106	25/06/2010	LT/BS	453763	6261089	-	-	8	7.9	Turbid	90	M
Todedada	107	25/06/2010	LT/BS	453763	6261089	-	-	6.5	7.9	Turbid	110	M
Todedada	108	25/06/2010	LT/BS	452498	6262132	-	-	6	8.1	Turbid	100	M
Todedada	109	26/06/2010	LT/BS	451577	6260592	-	-	4	8.5	Turbid	100	M
Todedada	109	26/06/2010	LT/BS	451577	6260592	-	-	4	8.5	Turbid	100	M
Todedada	109	26/06/2010	LT/BS	451577	6260592	-	-	4	8.5	Turbid	100	M
Todd	111	27/06/2010	LT/BS	450882	6247507	-	-	7.5	8.2	Clear	240	M
Todd	111	27/06/2010	LT/BS	450882	6247507	-	-	7.5	8.2	Clear	240	M
Unuk	112	27/06/2010	LT/BS	408363	6261530	-	-	3	8.2	Turbid	150	M
Unuk	113	27/06/2010	LT/BS	407571	6262191	-	-	6.5	8.1	Clear/Turbid	100	M
Unuk	113	27/06/2010	LT/BS	407571	6262191	-	-	6.5	8.1	Clear/Turbid	100	M
Unuk	113	27/06/2010	LT/BS	407571	6262191	-	-	6.5	8.1	Clear/Turbid	100	M
Unuk	113	27/06/2010	LT/BS	407571	6262191	-	-	6.5	8.1	Clear/Turbid	100	M
Unuk	113	27/06/2010	LT/BS	407571	6262191	-	-	6.5	8.1	Clear/Turbid	100	M
Unuk	113	27/06/2010	LT/BS	407571	6262191	-	-	6.5	8.1	Clear/Turbid	100	M
Unuk	UR-1a	27/06/2010	KM/KW	407051	6260783	407182	6260783	5	7.8	Turbid	-	M
Unuk	UR-1a	27/06/2010	KM/KW	407051	6260783	407182	6260783	5	7.8	Turbid	-	M
Unuk	UR-1a	27/06/2010	KM/KW	407051	6260783	407182	6260783	5	7.8	Turbid	-	M
Unuk	UR-1b	27/06/2010	KM/KW	407051	6260783	407182	6260783	5	7.8	Turbid	-	M
Unuk	UR-1b	27/06/2010	KM/KW	407051	6260783	407182	6260783	5	7.8	Turbid	-	M

M = moderate *R = riffle* *U = unstable*
L = low *P = pool* *S = stable*
G = glide *O = other* *T = trace*

Appendix 7.2-2. Detailed Habitat Characteristics from Stream Sites, Brucejack Gold Mine Project, 2010 to 2012

				Habitat Unit				Depth (m)		Width (m)	
Watershed	Site	Date	Crew	Habitat Type	Dist from Start (m)	Length (m)	Slope (%)	Wetted	Bankfull	Wetted	Bankfull
Bowser	100	23/06/2010	LT/BS	G	0	200	1.8	0.23	0.25	27.2	25.1
Bowser	101	23/06/2010	LT/BS	G	0	104	1.0	0.35	0.44	92.0	102.0
Bowser	102	23/06/2010	LT/BS	G	21	21	1.0	0.12	0.15	8.0	8.5
Bowser	102	23/06/2010	LT/BS	R	73	52	3.5	0.14	0.15	4.9	5.3
Bowser	102	23/06/2010	LT/BS	G	212	144	0.5	0.28	0.15	13.7	15.9
Bowser	102	23/06/2010	LT/BS	R	233	16	1.0	0.13	0.12	15.0	15.5
Scott	103	24/06/2010	LT/BS	R	0	126	1.5	0.28	1.00	15.5	28.3
Scott	104	24/06/2010	LT/BS	R	0	65	4.0	0.35	0.40	14.8	17.9
Scott	104	24/06/2010	LT/BS	G	40	12.5	0.5	0.14	0.17	6.6	6.6
Scott	106	25/06/2010	LT/BS	R-P	0	65	2.1	0.25	0.32	4.1	4.7
Scott	106	25/06/2010	LT/BS	R	65	80	1.5	0.25	0.50	3.2	3.5
Todedada	107	25/06/2010	LT/BS	R	0	100	1.0	0.30	1.10	13.3	15.9
Todedada	108	25/06/2010	LT/BS	R	0	120	2.5	0.15	0.67	20.5	37.8
Todedada	109	26/06/2010	LT/BS	O	0	40	8.0	0.12	0.29	2.6	0.0
Todedada	109	26/06/2010	LT/BS	C	0	100	5.0	0.50	0.90	14.8	19.4
Todedada	109	26/06/2010	LT/BS	R	100	31	3.0	0.50	0.90	20.9	23.9
Todd	111	27/06/2010	LT/BS	P	40	40	0.5	0.40	0.50	7.2	10.6
Todd	111	27/06/2010	LT/BS	R	220	180	0.6	0.17	0.60	3.7	13.3
Unuk	112	27/06/2010	LT/BS	R	0	180	2.0	0.50	1.30	27.3	42.1
Unuk	113	27/06/2010	LT/BS	R	0	30	2.5	0.20	1.40	7.5	0.0
Unuk	113	27/06/2010	LT/BS	P	30	5	1.0	0.40	1.40	7.5	0.0
Unuk	113	27/06/2010	LT/BS	R	0	40	8.5	0.20	0.70	5.6	0.0
Unuk	113	27/06/2010	LT/BS	P	40	5	0.5	0.50	0.75	8.0	0.0
Unuk	113	27/06/2010	LT/BS	R	35	45	2.5	0.05	0.25	3.1	0.0
Unuk	113	27/06/2010	LT/BS	P	80	58	1.0	0.25	0.45	6.0	0.0
Unuk	UR-1a	27/06/2010	KM/KW	R	0	132	1.0	0.50	1.00	62.0	88.0
Unuk	UR-1a	27/06/2010	KM/KW	G	132	75	0.5	0.70	1.00	45.0	70.0
Unuk	UR-1a	27/06/2010	KM/KW	R	207	111	1.0	1.00	1.50	22.0	97.0
Unuk	UR-1b	27/06/2010	KM/KW	G	0	108	0.5	1.20	1.50	45.0	49.0
Unuk	UR-1b	27/06/2010	KM/KW	R	108	144	1.0	1.00	1.60	35	48

M = moderate *R = riffle* *U = unstable*
L = low *P = pool* *S = stable*
G = glide *O = other* *T = trace*

Appendix 7.2-2. Detailed Habitat Characteristics from Stream Sites, Brucejack Gold Mine Project, 2010 to 2012

				Substrate					Pool		
Watershed	Site	Date	Crew	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Type	Max Depth (m)	Crest
Bowser	100	23/06/2010	LT/BS	70	30	0	0	0	S	0.38	0.09
Bowser	101	23/06/2010	LT/BS	20	60	20	0	0	-	-	-
Bowser	102	23/06/2010	LT/BS	20	50	30	0	0	S	0.19	0.12
Bowser	102	23/06/2010	LT/BS	20	50	30	T	0	S	0.20	0.15
Bowser	102	23/06/2010	LT/BS	60	30	10	T	0	U	0.80	0.12
Bowser	102	23/06/2010	LT/BS	10	40	40	10	0	S	0.60	0.13
Scott	103	24/06/2010	LT/BS	30	40	30	0	0	S	0.47	0.33
Scott	104	24/06/2010	LT/BS	10	20	30	40	0	S	0.40	0.25
Scott	104	24/06/2010	LT/BS	50	50	0	0	0	U	0.25	0.04
Scott	106	25/06/2010	LT/BS	40	50	10	0	0	S	0.40	0.1
Scott	106	25/06/2010	LT/BS	60	35	5	0	0	S	0.30	0.25
Todedada	107	25/06/2010	LT/BS	55	25	15	5	0	S	0.50	0.4
Todedada	108	25/06/2010	LT/BS	20	30	40	10	0	S	0.30	0.14
Todedada	109	26/06/2010	LT/BS	15	15	30	40	0	U	0.33	0.12
Todedada	109	26/06/2010	LT/BS	5	5	40	50	0	U	0.65	0.4
Todedada	109	26/06/2010	LT/BS	5	5	40	50	0	U	0.55	0.4
Todd	111	27/06/2010	LT/BS	75	15	5	5	0	S	3.00	0.2
Todd	111	27/06/2010	LT/BS	10	40	40	10	0	S	0.57	0.17
Unuk	112	27/06/2010	LT/BS	5	10	60	20	5	S	1.00	0.5
Unuk	113	27/06/2010	LT/BS	80	10	10	0	0	-	-	-
Unuk	113	27/06/2010	LT/BS	100	0	0	0	0	S	0.65	0.4
Unuk	113	27/06/2010	LT/BS	80	10	10	0	0	-	-	-
Unuk	113	27/06/2010	LT/BS	90	10	0	0	0	S	0.90	0.15
Unuk	113	27/06/2010	LT/BS	80	10	10	0	0	-	-	-
Unuk	113	27/06/2010	LT/BS	80	10	10	0	0	S	0.32	0.05
Unuk	UR-1a	27/06/2010	KM/KW	5	10	80	5	0	-	-	-
Unuk	UR-1a	27/06/2010	KM/KW	10	5	75	10	0	-	-	-
Unuk	UR-1a	27/06/2010	KM/KW	5	10	80	5	0	-	-	-
Unuk	UR-1b	27/06/2010	KM/KW	70	10	10	10	0	-	-	-
Unuk	UR-1b	27/06/2010	KM/KW	15	30	50	5	0	-	-	-

M = moderate *R = riffle* *U = unstable*
L = low *P = pool* *S = stable*
G = glide *O = other* *T = trace*

Appendix 7.2-2. Detailed Habitat Characteristics from Stream Sites, Brucejack Gold Mine Project, 2010 to 2012

				Left Bank			Right Bank		
Watershed	Site	Date	Crew	Height (m)	Stability	Riparian Cover (%)	Height (m)	Stability	Riparian Cover (%)
Bowser	100	23/06/2010	LT/BS	0.12	S	-	0.12	S	-
Bowser	101	23/06/2010	LT/BS	0.23	S	-	0.17	US	-
Bowser	102	23/06/2010	LT/BS	0.20	S	-	-	-	-
Bowser	102	23/06/2010	LT/BS	0.20	S	-	0.20	S	-
Bowser	102	23/06/2010	LT/BS	0.50	S	-	0.09	S	-
Bowser	102	23/06/2010	LT/BS	0.80	S	-	0.12	S	-
Scott	103	24/06/2010	LT/BS	0.40	-	-	0.98	-	-
Scott	104	24/06/2010	LT/BS	0.60	S	-	0.40	US	-
Scott	104	24/06/2010	LT/BS	0.13	S	-	0.00	0	-
Scott	106	25/06/2010	LT/BS	0.12	S	-	0.13	S	-
Scott	106	25/06/2010	LT/BS	0.20	S	-	0.20	S	-
Todedada	107	25/06/2010	LT/BS	2.00	U	-	0.20	S	-
Todedada	108	25/06/2010	LT/BS	0.45	U	-	0.65	US	-
Todedada	109	26/06/2010	LT/BS	0.17	U	-	0.35	US	-
Todedada	109	26/06/2010	LT/BS	0.40	U	-	0.60	US	-
Todedada	109	26/06/2010	LT/BS	0.40	U	-	0.60	US	-
Todd	111	27/06/2010	LT/BS	0.20	S	-	0.40	U	-
Todd	111	27/06/2010	LT/BS	0.12	S	-	0.60	-	-
Unuk	112	27/06/2010	LT/BS	0.80	U	-	0.95	S	-
Unuk	113	27/06/2010	LT/BS	-	U	-	-	-	-
Unuk	113	27/06/2010	LT/BS	-	-	-	-	-	-
Unuk	113	27/06/2010	LT/BS	-	-	-	-	-	-
Unuk	113	27/06/2010	LT/BS	-	-	-	-	-	-
Unuk	113	27/06/2010	LT/BS	-	-	-	-	-	-
Unuk	113	27/06/2010	LT/BS	-	-	-	-	-	-
Unuk	UR-1a	27/06/2010	KM/KW	1.00	S	20	0.50	S	100
Unuk	UR-1a	27/06/2010	KM/KW	0.50	S	5	0.50	S	100
Unuk	UR-1a	27/06/2010	KM/KW	1.00	S	0	1.00	-	100
Unuk	UR-1b	27/06/2010	KM/KW	0.50	S	100	0.50	S	100
Unuk	UR-1b	27/06/2010	KM/KW	0.50	S	100	1.00	S	100

M = moderate *R = riffle* *U = unstable*
L = low *P = pool* *S = stable*
G = glide *O = other* *T = trace*

Appendix 7.2-2. Detailed Habitat Characteristics from Stream Sites, Brucejack Gold Mine Project, 2010 to 2012

Watershed	Site	Date	Crew	Instream Cover (%) Pool	Boulder	Instream Vegetation	Overhanging Vegetation	Undercut Bank	LWD	SWD	Canopy Cover (%)
Bowser	100	23/06/2010	LT/BS	80	0	20	0	0	0	0	-
Bowser	101	23/06/2010	LT/BS	0	75	0	25	0	0	0	-
Bowser	102	23/06/2010	LT/BS	50	50	0	0	0	0	0	-
Bowser	102	23/06/2010	LT/BS	5	40	0	40	0	5	5	-
Bowser	102	23/06/2010	LT/BS	85	0	0	10	0	5	0	-
Bowser	102	23/06/2010	LT/BS	40	40	0	20	0	0	0	-
Scott	103	24/06/2010	LT/BS	10	5	0	20	20	25	20	-
Scott	104	24/06/2010	LT/BS	5	70	0	5	0	10	10	-
Scott	104	24/06/2010	LT/BS	100	-	-	-	-	-	-	-
Scott	106	25/06/2010	LT/BS	20	0	5	40	5	15	15	-
Scott	106	25/06/2010	LT/BS	30	0	0	40	0	20	10	-
Todedada	107	25/06/2010	LT/BS	15	15	0	20	5	20	25	-
Todedada	108	25/06/2010	LT/BS	5	60	0	5	5	30	5	-
Todedada	109	26/06/2010	LT/BS	30	70	0	0	0	0	0	-
Todedada	109	26/06/2010	LT/BS	30	50	0	10	0	10	0	-
Todedada	109	26/06/2010	LT/BS	30	50	0	10	0	10	0	-
Todd	111	27/06/2010	LT/BS	80	10	0	10	0	0	0	-
Todd	111	27/06/2010	LT/BS	20	40	0	40	0	0	0	-
Unuk	112	27/06/2010	LT/BS	10	85	0	5	0	0	0	-
Unuk	113	27/06/2010	LT/BS	0	100	0	0	0	0	0	-
Unuk	113	27/06/2010	LT/BS	90	0	0	0	0	10	0	-
Unuk	113	27/06/2010	LT/BS	0	100	0	0	0	0	0	-
Unuk	113	27/06/2010	LT/BS	100	0	0	0	0	0	0	-
Unuk	113	27/06/2010	LT/BS	0	100	0	0	0	0	0	-
Unuk	113	27/06/2010	LT/BS	70	0	0	0	0	30	0	-
Unuk	UR-1a	27/06/2010	KM/KW	0	0	0	2	0	2	0	0
Unuk	UR-1a	27/06/2010	KM/KW	0	2	0	5	0	1	0	0
Unuk	UR-1a	27/06/2010	KM/KW	0	2	0	3	0	2	0	0
Unuk	UR-1b	27/06/2010	KM/KW	0	5	0	5	0	1	0	0
Unuk	UR-1b	27/06/2010	KM/KW	0	5	0	1	0	0	0	0

M = moderate *R = riffle* *U = unstable*
L = low *P = pool* *S = stable*
G = glide *O = other* *T = trace*

Appendix 7.2-2. Detailed Habitat Characteristics from Stream Sites, Brucejack Gold Mine Project, 2010 to 2012

				UTM Coordinates (Zone 9)				Water Quality				
Watershed	Site	Date	Crew	DS Easting	DS Northing	US Easting	US Northing	Temp (°C)	pH	Turbidity	CD (µS/cm)	Current Flow
Bell-Irving	2	26/08/2010	LT, DF	453896	6252998	-	-	7	7.4	Turbid	110	L
Bell-Irving	2	26/08/2010	LT, DF	453896	6252998	-	-	7	7.4	Turbid	110	L
Bell-Irving	2	26/08/2010	LT, DF	453896	6252998	-	-	7	7	Turbid	110	L
Unuk	203	26/08/2010	LT, DF	408387	6261597	-	-	6	7.8	Moderate	130	M
Bell-Irving	1	27/08/2010	LT, DF	-	-	451088	6251772	3.5	8.1	Turbid	60	M
Bell-Irving	209	27/08/2010	LT, DF	452937	6253083	-	-	5	7.4	Turbid	110	L
Bell-Irving	209	27/08/2010	LT, DF	452937	6253083	-	-	5	7.4	Turbid	110	L
Bell-Irving	210	27/08/2010	LT, DF	452306	6257398	452313	6257466	6	7.3	Turbid	90	-
Bell-Irving	210	27/08/2010	LT, DF	452306	6257398	452313	6257466	6	7.3	Turbid	90	-
Bell-Irving	204	28/08/2010	LT, DF	451575	6260610	-	-	4	8	Moderate	120	L
Bell-Irving	204	28/08/2010	LT, DF	451575	6260610	-	-	4	8	Moderate	120	L
Bell-Irving	205	28/08/2010	LT, DF	452477	6261738	-	-	2	8.4	Moderate	110	L
Bell-Irving	206	28/08/2010	LT, DF	452234	6267150	-	-	8	7.9	Moderate	140	L
Bell-Irving	206	28/08/2010	LT, DF	452234	6267150	-	-	8	7.9	Moderate	140	L
Bell-Irving	206	28/08/2010	LT, DF	452234	6267150	-	-	8	7.9	Moderate	140	L
Unuk	212	29/08/2010	LT, DF	407633	6262433	407750	6262495	6.1	7.7	Moderate	100	L
Unuk	213	29/08/2010	LT, DF	406785	6260056	-	-	3.5	8.7	Moderate	110	L
Unuk	213	29/08/2010	LT, DF	406786	6260133	-	-	5	7.5	Moderate	330	L
Bell-Irving	207	30/08/2010	LT, DF	450797	6247264	-	-	7.7	7.9	Moderate	90	L
Bell-Irving	208	30/08/2010	LT, DF	453468	6260718	453432	6260639	8.2	8.1	Clear	130	L
Bell-Irving	WC3	9/9/2011	KW, KJ	468367	6259244	-	-	12	7.6	Clear	20	-
Bell-Irving	WC3	9/9/2011	KW, KJ	468367	6259244	-	-	12	7.6	Clear	20	-
Bell-Irving	WC3	9/9/2011	KW, KJ	468367	6259244	-	-	12	7.6	Clear	20	-
Bell-Irving	WC3	9/9/2011	KW, KJ	468367	6259244	-	-	12	7.6	Clear	20	-
Bell-Irving	BIT1	9/9/2011	KW, KJ	469564	6262888	-	-	9	6.6	Clear	20	-
Bell-Irving	BIT1	9/9/2011	KW, KJ	469564	6262888	-	-	9	6.6	Clear	20	-
Bell-Irving	BIT1	9/9/2011	KW, KJ	469564	6262888	-	-	9	6.6	Clear	20	-
Bell-Irving	WC1	9/7/2011	KW, KJ	468336	6264206	-	-	9	8.2	Turbid	30	-
Bell-Irving	WC1	9/7/2011	KW, KJ	468336	6264206	-	-	9	8.2	Turbid	30	-
Bell-Irving	WC2	9/8/2011	KW, KJ	467314	6261775	-	-	10	7.9	Low	20	-
Bell-Irving	WC2	9/8/2011	KW, KJ	467314	6261775	-	-	10	7.9	Low	20	-
Bell-Irving	MC1	9/11/2011	KW, KJ	472737	6261147	-	-	9	7.7	Clear	30	-
Bell-Irving	MC1	9/11/2011	KW, KJ	472737	6261147	-	-	9	7.7	Clear	30	-
Bell-Irving	MC1	9/11/2011	KW, KJ	472737	6261147	-	-	9	7.7	Clear	30	-
Bell-Irving	DC1	9/11/2011	KW, KJ	466159	6266674	-	-	5	8.6	Turbid	120	-
Bell-Irving	DC1	9/11/2011	KW, KJ	466159	6266674	-	-	5	8.6	Turbid	120	-
Unuk River	UR1	9/10/2011	KW, KJ	407061	6260634	-	-	6	8.5	Turbid	160	-
Unuk River	SC1	9/10/2011	KW, KJ	407511	6261580	-	-	2.5	8.2	Turbid	170	-

M = moderate *R = riffle* *U = unstable*
L = low *P = pool* *S = stable*
G = glide *O = other* *T = trace*

Appendix 7.2-2. Detailed Habitat Characteristics from Stream Sites, Brucejack Gold Mine Project, 2010 to 2012

				Habitat Unit				Depth (m)		Width (m)	
Watershed	Site	Date	Crew	Habitat Type	Dist from Start (m)	Length (m)	Slope (%)	Wetted	Bankfull	Wetted	Bankfull
Bell-Irving	2	26/08/2010	LT, DF	R	0	100	0.5	0.27	0.40	26.0	32.0
Bell-Irving	2	26/08/2010	LT, DF	R	100	100	1.0	0.44	0.80	22.0	33.0
Bell-Irving	2	26/08/2010	LT, DF	O	120	55	0.0	0.20	0.15	16.0	17.0
Unuk	203	26/08/2010	LT, DF	R	0	100	2.0	0.45	1.00	42.0	62.0
Bell-Irving	1	27/08/2010	LT, DF	G	0	150	0.5	0.80	2.30	76.0	111.0
Bell-Irving	209	27/08/2010	LT, DF	G	0	85	3.0	0.15	1.10	15.8	24.6
Bell-Irving	209	27/08/2010	LT, DF	P	110	25	3.0	0.30	1.20	17.3	20.0
Bell-Irving	210	27/08/2010	LT, DF	R	0	85	6.0	0.50	1.50	9.5	21.0
Bell-Irving	210	27/08/2010	LT, DF	R	17	56	8.0	0.70	-	2.1	-
Bell-Irving	204	28/08/2010	LT, DF	C	0	31	1.2	0.44	0.48	15	25
Bell-Irving	204	28/08/2010	LT, DF	R	31	44	3.5	0.37	1.20	8.7	12
Bell-Irving	205	28/08/2010	LT, DF	R	0	150	2.0	0.32	1.00	9.0	19.7
Bell-Irving	206	28/08/2010	LT, DF	R	0	27	1.0	0.36	0.70	9.5	19.0
Bell-Irving	206	28/08/2010	LT, DF	P	27	15	1.0	0.24	0.95	14.0	20.0
Bell-Irving	206	28/08/2010	LT, DF	G	42	35	1.0	0.50	0.75	9.0	15.0
Unuk	212	29/08/2010	LT, DF	R	0	125	1.5	0.46	2.50	32.0	168.0
Unuk	213	29/08/2010	LT, DF	R	0	100	1.0	-	-	76.0	160.0
Unuk	213	29/08/2010	LT, DF	R	0	100	0.5	0.08	-	0.7	-
Bell-Irving	207	30/08/2010	LT, DF	R	0	125	1.5	0.44	1.20	39.0	67.0
Bell-Irving	208	30/08/2010	LT, DF	R	0	100	2.0	11.40	0.24	-	-
Bell-Irving	WC3	9/9/2011	KW, KJ	G	0	100	1.0	1.00	1.00	2.5	2.5
Bell-Irving	WC3	9/9/2011	KW, KJ	R	100	3	1.0	0.30	0.30	5.0	5.0
Bell-Irving	WC3	9/9/2011	KW, KJ	G	103	55	0.0	1.70	1.70	4.0	4.0
Bell-Irving	WC3	9/9/2011	KW, KJ	R	158	20	1.0	0.50	0.50	4.5	4.0
Bell-Irving	BIT1	9/9/2011	KW, KJ	R	0	80	3.0	0.20	0.25	2.6	3.4
Bell-Irving	BIT1	9/9/2011	KW, KJ	P	80	4	1.0	0.90	0.90	5.0	4.8
Bell-Irving	BIT1	9/9/2011	KW, KJ	R	84	20	2.0	0.15	0.20	3.8	4
Bell-Irving	WC1	9/7/2011	KW, KJ	R	0	100	1.0	-	-	30	45.0
Bell-Irving	WC1	9/7/2011	KW, KJ	P	10	20	1.0	-	-	10	-
Bell-Irving	WC2	9/8/2011	KW, KJ	R	5	60	2.0	1.00	1.00	8.0	8
Bell-Irving	WC2	9/8/2011	KW, KJ	P	0	3	1.0	1.50	1.50	8.0	8.0
Bell-Irving	MC1	9/11/2011	KW, KJ	G	0	40	1.0	0.40	0.60	10.0	10.0
Bell-Irving	MC1	9/11/2011	KW, KJ	P	40	10	0.0	0.50	0.70	20.0	21.0
Bell-Irving	MC1	9/11/2011	KW, KJ	R	50	100	1.0	0.20	0.40	5.0	6.0
Bell-Irving	DC1	9/11/2011	KW, KJ	R	0	150	1.0	1.00	1.50	15.0	40.0
Bell-Irving	DC1	9/11/2011	KW, KJ	R	30	100	1.0	0.20	0.50	1.5	2.0
Unuk River	UR1	9/10/2011	KW, KJ	R	0	200	1.0	1.00	1.50	20.0	65.0
Unuk River	SC1	9/10/2011	KW, KJ	R	0	250	1.0	1.50	2.00	40.0	90.0

M = moderate *R = riffle* *U = unstable*

L = low *P = pool* *S = stable*

G = glide *O = other* *T = trace*

Appendix 7.2-2. Detailed Habitat Characteristics from Stream Sites, Brucejack Gold Mine Project, 2010 to 2012

				Substrate					Pool		
Watershed	Site	Date	Crew	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Type	Max Depth (m)	Crest
Bell-Irving	2	26/08/2010	LT, DF	8	50	40	2	0	S	0.35	0.2
Bell-Irving	2	26/08/2010	LT, DF	10	30	40	20	0	S	0.90	0.5
Bell-Irving	2	26/08/2010	LT, DF	100	0	0	0	0	D	0.25	0.1
Unuk	203	26/08/2010	LT, DF	10	25	35	25	5	S	0.50	0.3
Bell-Irving	1	27/08/2010	LT, DF	10	30	40	20	0	S	1.20	0.6
Bell-Irving	209	27/08/2010	LT, DF	15	40	35	10	0	D	0.37	0.15
Bell-Irving	209	27/08/2010	LT, DF	15	40	35	10	0	S	0.80	125
Bell-Irving	210	27/08/2010	LT, DF	5	10	30	50	0	S	0.60	0.5
Bell-Irving	210	27/08/2010	LT, DF	10	15	25	50	0	S	0.17	0.6
Bell-Irving	204	28/08/2010	LT, DF	0	10	10	80	0	S	0.48	0.3
Bell-Irving	204	28/08/2010	LT, DF	10	15	15	60	0	S	0.70	0.3
Bell-Irving	205	28/08/2010	LT, DF	15	10	25	50	0	S	0.50	0.4
Bell-Irving	206	28/08/2010	LT, DF	20	20	55	5	0	S	0.50	0.4
Bell-Irving	206	28/08/2010	LT, DF	20	20	45	5	0	S	2.00	0.5
Bell-Irving	206	28/08/2010	LT, DF	45	20	35	0	0	S	0.80	0.3
Unuk	212	29/08/2010	LT, DF	10	65	25	0	0	S	-	0.4
Unuk	213	29/08/2010	LT, DF	25	25	48	2	0	S	-	-
Unuk	213	29/08/2010	LT, DF	80	10	5	5	0	U	0.18	0.075
Bell-Irving	207	30/08/2010	LT, DF	25	20	20	30	5	S	0.70	0.25
Bell-Irving	208	30/08/2010	LT, DF	20	40	20	20	0	S	0.36	0.9
Bell-Irving	WC3	9/9/2011	KW, KJ	100	0	0	0	0	-	-	-
Bell-Irving	WC3	9/9/2011	KW, KJ	100	0	0	0	0	-	-	-
Bell-Irving	WC3	9/9/2011	KW, KJ	100	0	0	0	0	-	-	-
Bell-Irving	WC3	9/9/2011	KW, KJ	90	10	0	0	0	-	-	-
Bell-Irving	BIT1	9/9/2011	KW, KJ	5	10	8	20	25	S	0.5	0.2
Bell-Irving	BIT1	9/9/2011	KW, KJ	60	30	10	0	0	S	0.9	0.15
Bell-Irving	BIT1	9/9/2011	KW, KJ	30	40	20	10	0	S	-	-
Bell-Irving	WC1	9/7/2011	KW, KJ	30	40	20	10	0	S	-	-
Bell-Irving	WC1	9/7/2011	KW, KJ	60	40	0	0	0	S	-	-
Bell-Irving	WC2	9/8/2011	KW, KJ	60	20	20	0	0	-	-	-
Bell-Irving	WC2	9/8/2011	KW, KJ	-	-	-	-	-	S	-	-
Bell-Irving	MC1	9/11/2011	KW, KJ	90	10	0	0	0	-	-	-
Bell-Irving	MC1	9/11/2011	KW, KJ	50	30	20	0	0	S	1.00	0.1
Bell-Irving	MC1	9/11/2011	KW, KJ	5	70	25	0	0	S	-	-
Bell-Irving	DC1	9/11/2011	KW, KJ	50	20	20	10	0	-	-	-
Bell-Irving	DC1	9/11/2011	KW, KJ	30	50	15	5	0	-	-	-
Unuk River	UR1	9/10/2011	KW, KJ	50	10	20	10	0	-	-	-
Unuk River	SC1	9/10/2011	KW, KJ	30	10	20	40	0	-	-	-

M = moderate *R = riffle* *U = unstable*
L = low *P = pool* *S = stable*
G = glide *O = other* *T = trace*

Appendix 7.2-2. Detailed Habitat Characteristics from Stream Sites, Brucejack Gold Mine Project, 2010 to 2012

				Left Bank			Right Bank		
Watershed	Site	Date	Crew	Height (m)	Stability	Riparian Cover (%)	Height (m)	Stability	Riparian Cover (%)
Bell-Irving	2	26/08/2010	LT, DF	0.15	S	-	0.20	S	-
Bell-Irving	2	26/08/2010	LT, DF	0.70	U	-	0.80	S	-
Bell-Irving	2	26/08/2010	LT, DF	0.10	U	-	0.10	U	-
Unuk	203	26/08/2010	LT, DF	0.60	S	-	0.50	S	-
Bell-Irving	1	27/08/2010	LT, DF	0.60	S	-	3.00	U	-
Bell-Irving	209	27/08/2010	LT, DF	0.5	PS	-	0.97	S	-
Bell-Irving	209	27/08/2010	LT, DF	0.5	PS	-	0.97	S	-
Bell-Irving	210	27/08/2010	LT, DF	1	U	-	1	U	-
Bell-Irving	210	27/08/2010	LT, DF	-	U	-	-	U	-
Bell-Irving	204	28/08/2010	LT, DF	1.00	S	-	1.40	U	-
Bell-Irving	204	28/08/2010	LT, DF	1.00	S	-	0.63	U	-
Bell-Irving	205	28/08/2010	LT, DF	0.90	U	5	0.30	S	10
Bell-Irving	206	28/08/2010	LT, DF	0.55	S	-	0.30	S	-
Bell-Irving	206	28/08/2010	LT, DF	0.40	S	-	0.50	U	-
Bell-Irving	206	28/08/2010	LT, DF	0.25	S	-	0.25	S	-
Unuk	212	29/08/2010	LT, DF	1.60	U	-	2.30	U	-
Unuk	213	29/08/2010	LT, DF	0.80	S	-	0.80	S	-
Unuk	213	29/08/2010	LT, DF	-	-	-	-	-	-
Bell-Irving	207	30/08/2010	LT, DF	0.90	D	-	0.60	U	-
Bell-Irving	208	30/08/2010	LT, DF	13.00	S	-	12.00	S	-
Bell-Irving	WC3	9/9/2011	KW, KJ	0.00	S	100	0.00	S	100
Bell-Irving	WC3	9/9/2011	KW, KJ	0.00	S	100	0.00	S	100
Bell-Irving	WC3	9/9/2011	KW, KJ	0.00	S	100	0.00	S	100
Bell-Irving	WC3	9/9/2011	KW, KJ	0.00	S	100	0.00	S	100
Bell-Irving	BIT1	9/9/2011	KW, KJ	0.00	S	60	0.05	S	70
Bell-Irving	BIT1	9/9/2011	KW, KJ	0.00	S	60	0	S	60
Bell-Irving	BIT1	9/9/2011	KW, KJ	0.00	S	20	0	S	50
Bell-Irving	WC1	9/7/2011	KW, KJ	0.20	U	60	0.10	S	100
Bell-Irving	WC1	9/7/2011	KW, KJ	0.10	S	60	0.10	S	100
Bell-Irving	WC2	9/8/2011	KW, KJ	0.00	S	100	0.00	S	100
Bell-Irving	WC2	9/8/2011	KW, KJ	0.00	S	100	0.00	S	100
Bell-Irving	MC1	9/11/2011	KW, KJ	0.00	S	100	0.20	S	100
Bell-Irving	MC1	9/11/2011	KW, KJ	0.30	S	100	1.20	U	80
Bell-Irving	MC1	9/11/2011	KW, KJ	0.00	S	70	0.20	S	70
Bell-Irving	DC1	9/11/2011	KW, KJ	1.00	U	80	0.80	S	10
Bell-Irving	DC1	9/11/2011	KW, KJ	0.20	S	10	0.80	S	80
Unuk River	UR1	9/10/2011	KW, KJ	0.5	U	100	0.4	S	5
Unuk River	SC1	9/10/2011	KW, KJ	1.2	U	-	1	U	-

M = moderate *R = riffle* *U = unstable*
L = low *P = pool* *S = stable*
G = glide *O = other* *T = trace*

Appendix 7.2-2. Detailed Habitat Characteristics from Stream Sites, Brucejack Gold Mine Project, 2010 to 2012

				Instream Cover (%)							
Watershed	Site	Date	Crew	Pool	Boulder	Instream Vegetation	Overhanging Vegetation	Undercut Bank	LWD	SWD	Canopy Cover (%)
Bell-Irving	2	26/08/2010	LT, DF	50	40	0	10	0	0	0	-
Bell-Irving	2	26/08/2010	LT, DF	45	45	0	10	0	0	0	-
Bell-Irving	2	26/08/2010	LT, DF	100	0	0	0	0	0	0	-
Unuk	203	26/08/2010	LT, DF	10	70	0	20	0	0	0	-
Bell-Irving	1	27/08/2010	LT, DF	20	35	0	20	10	10	5	-
Bell-Irving	209	27/08/2010	LT, DF	20	10	0	40	0	20	10	-
Bell-Irving	209	27/08/2010	LT, DF	20	10	0	5	0	55	5	-
Bell-Irving	210	27/08/2010	LT, DF	2	44	0	2	0	2	0	-
Bell-Irving	210	27/08/2010	LT, DF	30	70	0	0	0	0	0	-
Bell-Irving	204	28/08/2010	LT, DF	10	60	0	30	0	0	0	-
Bell-Irving	204	28/08/2010	LT, DF	10	60	0	30	0	0	0	-
Bell-Irving	205	28/08/2010	LT, DF	5	20	0	75	0	0	0	2
Bell-Irving	206	28/08/2010	LT, DF	10	45	0	40	0	5	0	-
Bell-Irving	206	28/08/2010	LT, DF	40	10	0	10	0	20	20	-
Bell-Irving	206	28/08/2010	LT, DF	20	10	0	70	0	0	0	-
Unuk	212	29/08/2010	LT, DF	15	5	0	10	0	70	0	-
Unuk	213	29/08/2010	LT, DF	10	5	0	5	0	60	20	-
Unuk	213	29/08/2010	LT, DF	15	5	0	80	0	0	0	-
Bell-Irving	207	30/08/2010	LT, DF	50	40	0	0	0	5	5	-
Bell-Irving	208	30/08/2010	LT, DF	20	10	5	35	5	15	10	-
Bell-Irving	WC3	9/9/2011	KW, KJ	0	0	60	10	0	0	0	1
Bell-Irving	WC3	9/9/2011	KW, KJ	0	0	40	40	0	0	0	0
Bell-Irving	WC3	9/9/2011	KW, KJ	0	0	60	10	0	0	0	0
Bell-Irving	WC3	9/9/2011	KW, KJ	0	0	70	10	0	0	0	10
Bell-Irving	BIT1	9/9/2011	KW, KJ	80	0	0	T	0	20	T	20
Bell-Irving	BIT1	9/9/2011	KW, KJ	100	0	0	0	0	0	0	20
Bell-Irving	BIT1	9/9/2011	KW, KJ	T	0	T	70	0	30	T	5
Bell-Irving	WC1	9/7/2011	KW, KJ	0	0	0	2	1	5	3	2
Bell-Irving	WC1	9/7/2011	KW, KJ	90	0	0	0	0	8	2	2
Bell-Irving	WC2	9/8/2011	KW, KJ	5	0	0	10	0	T	0	20
Bell-Irving	WC2	9/8/2011	KW, KJ	100	0	0	0	0	0	0	20
Bell-Irving	MC1	9/11/2011	KW, KJ	35	0	0	50	0	0	0	20
Bell-Irving	MC1	9/11/2011	KW, KJ	90	0	0	0	0	10	0	0
Bell-Irving	MC1	9/11/2011	KW, KJ	35	0	0	50	0	0	15	40
Bell-Irving	DC1	9/11/2011	KW, KJ	0	60	0	30	0	5	5	0
Bell-Irving	DC1	9/11/2011	KW, KJ	0	40	0	40	0	10	10	2
Unuk River	UR1	9/10/2011	KW, KJ	0	90	0	5	0	5	0	0
Unuk River	SC1	9/10/2011	KW, KJ	0	80	0	10	0	10	0	0

R = riffle *U = unstable*
P = pool *S = stable*
O = other *T = trace*

Appendix 7.2-2. Detailed Habitat Characteristics from Stream Sites, Brucejack Gold Mine Project, 2010 to 2012

				UTM Coordinates (Zone 9)				Water Quality				
Watershed	Site	Date	Crew	DS Easting	DS Northing	US Easting	US Northing	Temp (°C)	pH	Turbidity	CD (µS/cm)	Current Flow
Bowser	WC2	8/28/2012	KW, TM	467314	6261775	-	-	7	-	C	20	L
Bowser	WC2	8/28/2012	KW, TM	467314	6261775	-	-	7	-	C	20	L
Bowser	WC2	8/28/2012	KW, TM	467314	6261775	-	-	7	-	C	20	L
Bowser	WC2	8/28/2012	KW, TM	467314	6261775	-	-	7	-	C	20	L
Bowser	WC5	8/28/2012	KW, TM	466688	6262896	-	-	-	-	C	-	M
Bowser	WC5	8/28/2012	KW, TM	466688	6262896	-	-	-	-	C	-	M
Bowser	WC5	8/28/2012	KW, TM	466688	6262896	-	-	-	-	C	-	M
Bowser	WC5	8/28/2012	KW, TM	466688	6262896	-	-	-	-	C	-	M
Bowser	WC3	8/28/2012	KW, TM	468367	6259244	-	-	-	-	C	-	M
Bowser	MC1	8/30/2012	KW, TM	472737	6261147	-	-	4	-	C	-	M
Bowser	MC1	8/30/2012	KW, TM	472737	6261147	-	-	4	-	C	-	M
Bowser	MC1	8/30/2012	KW, TM	472737	6261147	-	-	4	-	C	-	M
Bowser	MC1	8/30/2012	KW, TM	472737	6261147	-	-	4	-	C	-	M
Bowser	MC1	8/30/2012	KW, TM	472737	6261147	-	-	4	-	C	-	M

M = moderate *R = riffle* *U = unstable*
L = low *P = pool* *S = stable*
G = glide *O = other* *T = trace*

Appendix 7.2-2. Detailed Habitat Characteristics from Stream Sites, Brucejack Gold Mine Project, 2010 to 2012

				Habitat Unit				Depth (m)		Width (m)	
Watershed	Site	Date	Crew	Habitat Type	Dist from Start (m)	Length (m)	Slope (%)	Wetted	Bankfull	Wetted	Bankfull
Bowser	WC2	8/28/2012	KW, TM	R	0	3	0.0	0.60	1.00	6.0	12.0
Bowser	WC2	8/28/2012	KW, TM	R	3	25	6.0	0.30	0.80	0.3	8.0
Bowser	WC2	8/28/2012	KW, TM	R	28	6	0.0	1.00	2.00	10.0	16.0
Bowser	WC2	8/28/2012	KW, TM	R	34	46	10.0	0.20	1.00	1.0	10.0
Bowser	WC5	8/28/2012	KW, TM	R	0	20	4.0	0.40	1.00	8.0	16.0
Bowser	WC5	8/28/2012	KW, TM	P	10	10	0.0	0.60	1.20	10.0	15.0
Bowser	WC5	8/28/2012	KW, TM	G	20	20	3.0	0.50	1.50	4.5	18.0
Bowser	WC5	8/28/2012	KW, TM	R	40	60	7.0	0.40	1.00	10.0	18.0
Bowser	WC3	8/28/2012	KW, TM	G	0	100	0.0	1.00	1.00	4.5	4.5
Bowser	MC1	8/30/2012	KW, TM	G	0	30	1.0	0.20	0.90	4.0	5.2
Bowser	MC1	8/30/2012	KW, TM	P	20	10	0.0	1.00	1.50	5.0	5.3
Bowser	MC1	8/30/2012	KW, TM	R	30	200	8.0	0.40	0.80	5.0	5.5
Bowser	MC1	8/30/2012	KW, TM	P	230	5	0.0	1.20	2.10	7.0	9.0
Bowser	MC1	8/30/2012	KW, TM	R	235	250	10.0	0.35	0.80	4.0	4.8

M = moderate *R = riffle* *U = unstable*
L = low *P = pool* *S = stable*
G = glide *O = other* *T = trace*

Appendix 7.2-2. Detailed Habitat Characteristics from Stream Sites, Brucejack Gold Mine Project, 2010 to 2012

				Substrate					Pool		
Watershed	Site	Date	Crew	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Type	Max Depth (m)	Crest
Bowser	WC2	8/28/2012	KW, TM	5	15	20	60	0	D	1.00	0.3
Bowser	WC2	8/28/2012	KW, TM	20	40	20	20	0	-	-	-
Bowser	WC2	8/28/2012	KW, TM	10	30	40	20	0	D	1.00	0.2
Bowser	WC2	8/28/2012	KW, TM	5	15	40	20	0	-	-	-
Bowser	WC5	8/28/2012	KW, TM	10	10	30	50	0	-	-	-
Bowser	WC5	8/28/2012	KW, TM	100	0	0	0	0	S	0.8	0
Bowser	WC5	8/28/2012	KW, TM	5	15	30	40	10	S	0.8	0.4
Bowser	WC5	8/28/2012	KW, TM	10	10	30	30	10	S	0.7	0.3
Bowser	WC3	8/28/2012	KW, TM	100	0	0	0	0	-	-	-
Bowser	MC1	8/30/2012	KW, TM	75	20	5	0	0	S	0.3	0.2
Bowser	MC1	8/30/2012	KW, TM	100	0	0	0	0	D	1.00	0.4
Bowser	MC1	8/30/2012	KW, TM	10	10	30	50	0	S	0.60	0.4
Bowser	MC1	8/30/2012	KW, TM	60	0	0	30	10	D	1.20	0.4
Bowser	MC1	8/30/2012	KW, TM	0	10	20	70	0	D	0.50	0.3

M = moderate *R = riffle* *U = unstable*
L = low *P = pool* *S = stable*
G = glide *O = other* *T = trace*

Appendix 7.2-2. Detailed Habitat Characteristics from Stream Sites, Brucejack Gold Mine Project, 2010 to 2012

				Left Bank			Right Bank		
Watershed	Site	Date	Crew	Height (m)	Stability	Riparian Cover (%)	Height (m)	Stability	Riparian Cover (%)
Bowser	WC2	8/28/2012	KW, TM	0.8	S	-	0.7	S	-
Bowser	WC2	8/28/2012	KW, TM	0.60	S	-	0.60	S	-
Bowser	WC2	8/28/2012	KW, TM	2.00	U	-	1.80	U	-
Bowser	WC2	8/28/2012	KW, TM	0.80	U	-	0.90	U	-
Bowser	WC5	8/28/2012	KW, TM	0.50	S	-	0.50	S	-
Bowser	WC5	8/28/2012	KW, TM	0.50	S	-	0.50	S	-
Bowser	WC5	8/28/2012	KW, TM	0.50	S	-	1.00	S	-
Bowser	WC5	8/28/2012	KW, TM	-	S	-	-	S	-
Bowser	WC3	8/28/2012	KW, TM	0.00	U	-	0.00	U	-
Bowser	MC1	8/30/2012	KW, TM	0.40	S	-	0.40	S	-
Bowser	MC1	8/30/2012	KW, TM	1.00	S	-	1.00	U	-
Bowser	MC1	8/30/2012	KW, TM	0.40	S	-	0.40	S	-
Bowser	MC1	8/30/2012	KW, TM	1.50	HS	-	1.50	S	-
Bowser	MC1	8/30/2012	KW, TM	1.20	S	-	1.20	S	-

M = moderate *R = riffle* *U = unstable*
L = low *P = pool* *S = stable*
G = glide *O = other* *T = trace*

Appendix 7.2-2. Detailed Habitat Characteristics from Stream Sites, Brucejack Gold Mine Project, 2010 to 2012

Watershed	Site	Date	Crew	Instream Cover (%) Pool	Boulder	Instream Vegetation	Overhanging Vegetation	Undercut Bank	LWD	SWD	Canopy Cover (%)
Bowser	WC2	8/28/2012	KW, TM	100	0	0	0	0	0	0	5
Bowser	WC2	8/28/2012	KW, TM	0	90	0	10	0	0	0	10
Bowser	WC2	8/28/2012	KW, TM	60	20	0	0	0	20	0	20
Bowser	WC2	8/28/2012	KW, TM	0	30	0	0	15	50	5	5
Bowser	WC5	8/28/2012	KW, TM	0	90	10	0	0	0	0	0
Bowser	WC5	8/28/2012	KW, TM	90	0	0	0	10	0	0	0
Bowser	WC5	8/28/2012	KW, TM	60	40	0	0	0	0	0	0
Bowser	WC5	8/28/2012	KW, TM	0	100	0	0	0	0	0	-
Bowser	WC3	8/28/2012	KW, TM	0	0	40	40	10	10	0	0
Bowser	MC1	8/30/2012	KW, TM	0	0	0	80	0	10	10	30
Bowser	MC1	8/30/2012	KW, TM	60	0	0	0	0	40	0	5
Bowser	MC1	8/30/2012	KW, TM	30	5	0	40	0	10	15	40
Bowser	MC1	8/30/2012	KW, TM	100	0	0	0	0	0	0	40
Bowser	MC1	8/30/2012	KW, TM	25	25	0	35	0	0	15	40

R = riffle *U = unstable*
P = pool *S = stable*
O = other *T = trace*

Appendix 7.2-3

Habitat Description of Sites Along Proposed Transmission Line Route, Brucejack Gold Mine Project, 2012

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Appendix 7.2-3. Habitat Description of Sites Along Proposed Transmission Line Route, Brucejack Gold Mine Project, 2012

Stream

Site	Date	UTM (Zone 9)		Width (m)				Residual Pool Depth (m)	Bankfull Depth (m)		Gradient (%)		Temperature (˚C)	Turbidity
		Easting	Northing	Channel		Wetted								
800	31/Aug/12	437339	6250967	-	-	-	-	-	-	-	1	-	-	-
705	31/Aug/12	436210	6248729	28	15	8	4	2	2.5	-	45	86	2	moderate
706	31/Aug/12	434073	6240630	20	15	6	5	-	2	1.5	3	50	-	-
707	31/Aug/12	434113	6242457	0.6	2	0.4	2	0.3	0.2	-	2	60	-	-
708	1/Sep/12	434803	6238469	10	18	11	5	-	0.5	-	70	50	-	moderate
709	1/Sep/12	434418	6238763	1	-	0.5	-	-	0.4	0.3	30	40	-	clear
710	1/Sep/12	434221	6239553	0.4	0.4	0.3	0.2	-	0.2	-	60	-	-	clear
711	1/Sep/12	434214	6240676	-	-	-	-	-	-	-	40	-	-	clear
603	31/Aug/12	435142	6237759	25	-	13	-	-	1.3	3	41	-	5	light
602	31/Aug/12	435317	6234935	16	-	6	-	0.24	1	-	23	24	2	-
601	31/Aug/12	435435	6234765	0.58	-	0.58	-	0.06	0.02	-	22	-	4	clear
600	31/Aug/12	435113	6234566	4	13	2.7	2.8	-	1.2	-	14	24	3	moderate

Cover

Site	Cover Type							Crown Closure	IV Type	Bank				
	SWD	LWD	Boulders	UB	DP	OV	IV			Shape	Texture D	Texture SD	Vegetation	Stage
800	none	T	D	none	none	T	none	0	algae	sloping	fines	boulder	none	none
705	T	none	SD	none	SD	SD	none	0	algae	vertical	rock	rock	shrubs	shrub
706	T	none	D	none	none	T	-	0	none	sloping	fines	rock	deciduous	shrub
707	SD	none	none	none	none	D	SD	21-40%	algae	sloping	rock	rock	mixed	shrub
708	none	-	D	-	-	-	-	0	none	sloping	fines	-	shrubs	shrub
709	-	-	T	-	-	D	-	0	none	sloping	fines	-	shrubs	shrub
710	-	-	T	-	-	D	-	0	none	sloping	fines	-	shrubs	shrub
711	-	-	-	-	-	T	-	-	-	-	-	-	-	-
603	-	-	-	-	-	-	-	-	-	-	-	-	-	-
602	T	T	D	none	T	SD	none	21-40%	none	sloping	cobble	boulder	coniferous	shrub
601	SD	T	T	T	none	D	T	21-40%	-	-	-	-	-	-
600	T	T	SD	T	T	D	T	1-20%	none	sloping	gravel	cobble	shrubs	shrub

D = dominant *T = trace* *LWD = large woody debris* *DP = deep pools* *IV = instream vegetation*

SD = sub-dominant *SWD = small woody debris* *UB = undercut bank* *OV = overhead vegetation* *- = not available*

Appendix 7.2-3. Habitat Description of Sites Along Proposed Transmission Line Route, Brucejack Gold Mine Project, 2012

Channel

Site	Bed Material				Channel Shape			
	Dominant	SubD	D95 (cm)	D (cm)	Morphology	Channel Pattern	Coupling	Confinement
800	boulder	Cobble	-	-	large channel	irregular	coupled	occasionally confined
705	rock	boulders	2.1	1	cascade-pool	irregular wandering	coupled	confined
706	rock	boulders	1.3	0.2	cascade-pool	irregular meanders	partially coupled	frequently confined
707	rock	fines	0.4	0.1	step-pool	irregular meanders	coupled	confined
708	fines	rock	0.9	0.8	step-pool	sinuous	partially coupled	occasionally confined
709	fines	gravels	0.4	0.4	step-pool	sinuous	coupled	frequently confined
710	fines	gravels	0.8	0.4	step-pool	straight	coupled	occasionally confined
711	-	-	-	-	-	-	-	-
603	boulder	Cobble	5	2	cascade-pool	-	-	-
602	boulder	cobble	20	70	cascade-pool	torturous meander	decoupled	occasionally confined
601	fines	boulders	20	4	step-pool	-	-	-
600	boulder	cobble	20	17	cascade-pool	irregular	decoupled	confined

Features

Site	Type	Height (m)	Length (m)	Feature UTM		Fish-Bearing?
				Easting	Northing	
800	-	-	-	-	-	Yes
705	falls	20	5	-	-	No
706	fence	30	150	434073	6242630	No
707	groundwater	2	3	434113	6242357	No
708	Fence	8	3	434803	6238469	No
709	-	-	-	-	-	No
710	-	-	-	-	-	No
711	-	-	-	-	-	No
603	-	-	-	-	-	No
602	cascade	-	17	435317	6234935	No
601	-	-	-	-	-	No
600	gradient break to 29%	-	-	435335	6237994	No

D = largest particle showing evidence of movement

D95 = Particle larger than 95% of other substrate

SD = sub-dominant

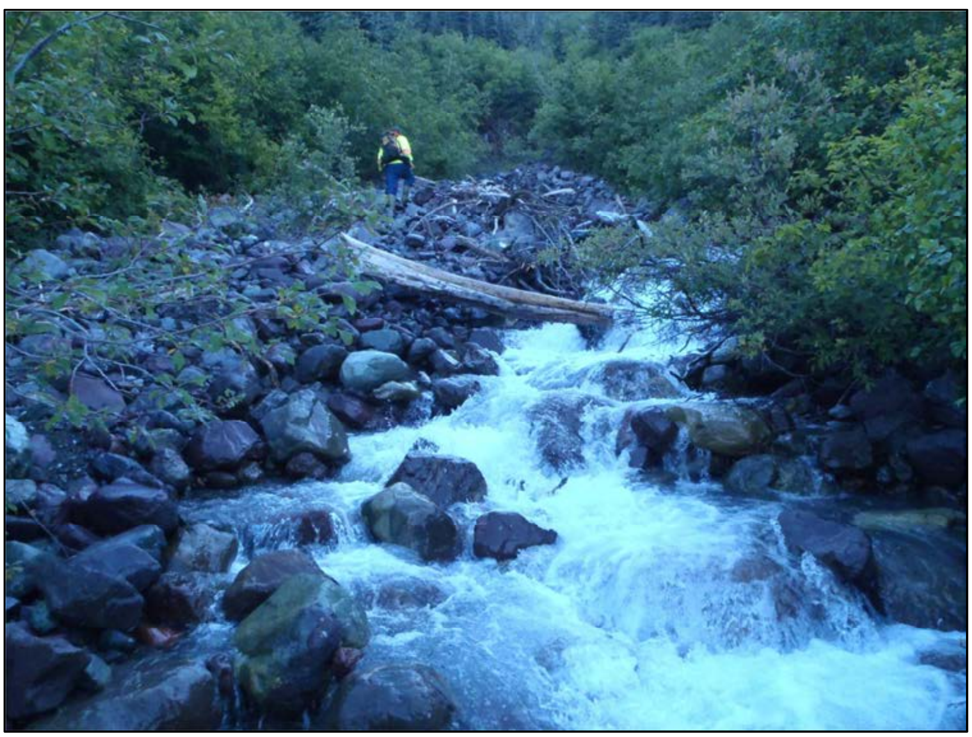
- = not available

Appendix 7.2-3. Habitat Description of Sites Along Proposed Transmission Line Route, Brucejack Gold Mine Project, 2012

Comments

Site	Description
800	Mainstem of Bowser River. Very large, previously sampled and confirmed fish-bearing
705	Steep stream with very large waterfall - non fish bearing above.
706	fish barrier, no fish habitat
707	Steep run down rock face. Very small stream. Flatter sections but interspersed with steep runs down rock. No fish.
708	Fish barrier below crossing. Photo 7000 crossing at top of photo. Crossing is on hillslope at very high gradient location above substantial waterfall. Potential fish value ~500m -700m below crossing.
709	Fish barrier 400m below crossing. Very small runoff channel through hgih gradient channel. No fish habitat.
710	Very small high gradient stream. No fish. Runoff down hillside.
711	Stream crossing located high on rock face. No fish value.
603	Drains from glacier along steep valley wall to low gradient plateau downstream. Transmission line crosses along steep section. Along low gradient section heavy erosion along both banks. Channel splits above gradient break, likely above transmission line. This card measured left branch. Right branch smaller, lower gradient, less disturbed but still steep. Not assessed directly but >20% gradient likely
602	Steep cascade - no access for fish. Steeper downstream of site (~24%)
601	Small, steep drainage, small pools, possible branch from larger. Too steep below >20%, non-fish bearing, though some step-pool suitable only for small fish and steep drops >30% over short sections
600	Site includes downstream and upstream area. Upstream area disturbed- in fan following steep gradient (~29%). Located downstream of the transmission line ~100m upstream of Bowser River. Dradient >29% downstream of the Transmission Line, no fish access

Site # 600 Photo: P8310073
Site 600 - Upstream view.



Site # 600 Photo: P8310074
Site 600 - Gradient break.

Site # 601 Photo: P8310075

Site 601 - Upstream view.

Site # N/A Photo: P8310082

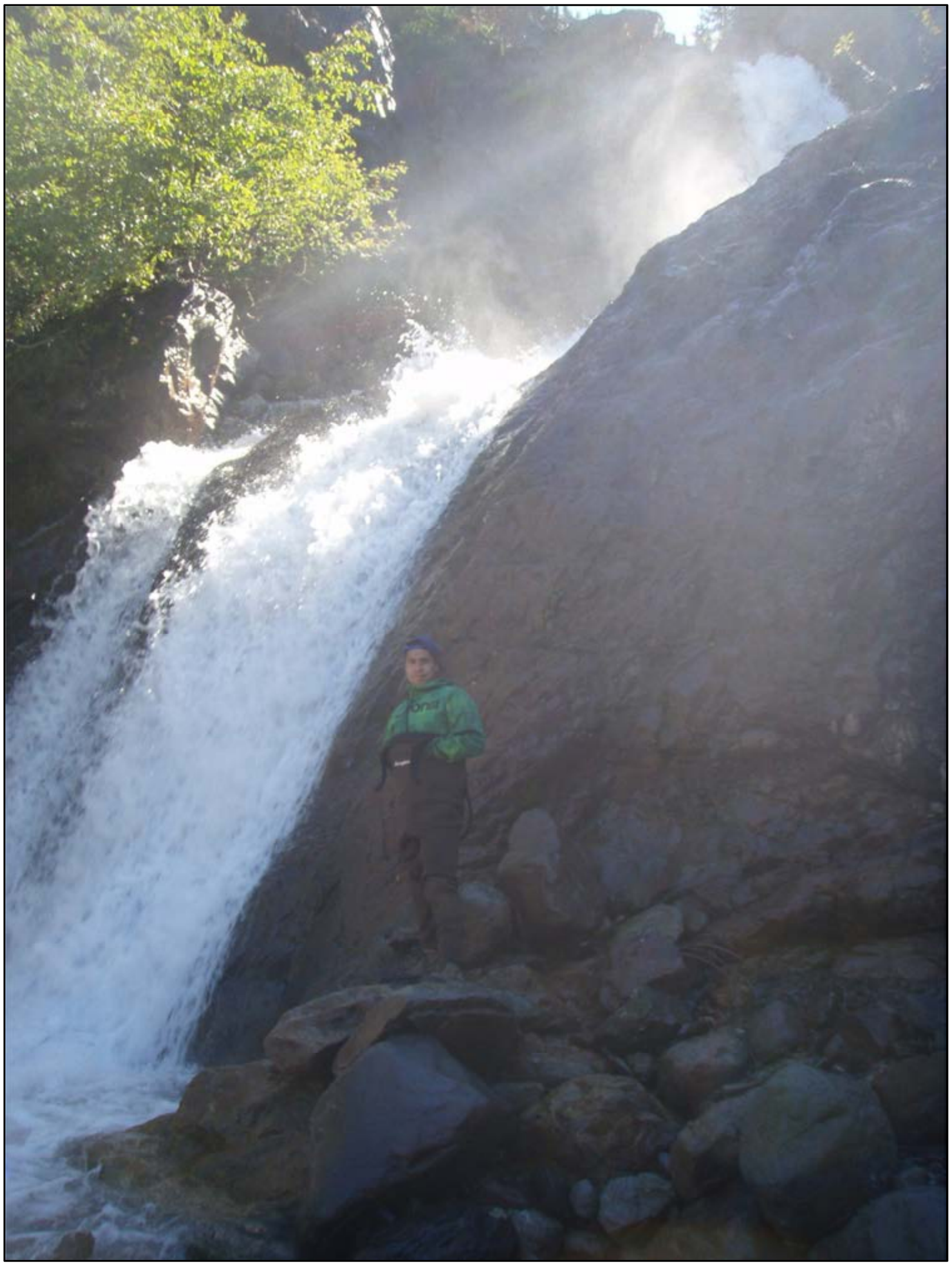
Site N/A - Fisheries sensitive zone downhill from proposed route (route located up hillslope at top of photo), along existing road with culvert.

Site # 603 Photo: P8310086

Site 603 - View of crossing taken from approx. 250 m downhill of crossing.

Site # 603 Photo: P8310092

Site 603 - View of two stream branches taken from approx. 300 m downhill of crossing (crossing located above gradient break).



Site # 705 Photo: P8316986
Site 705 - Waterfall creating fish barrier downstream of crossing.

Site # 706 Photo: P8316989
Site 706 - Gradient barrier approximately 300 m downstream of crossing.

Site # 707 Photo: P9016994
Site 707 - Steep run down rock face downstream of crossing.

Site # 707 Photo: P9016995
Site 707 - View of crossing taken from approx. 300 m downstream.

Site # 708 Photo: P9017001
Site 708 - One of several barriers to fish passage downstream of crossing.

Site # 709 Photo: P9017004
Site 709 - Waterfall downstream of crossing.

Site # 710 Photo: P9017003
Site 710 - Stream crossing at top of photo on steep rocky cliff.

Site # 711 Photo: P9017004
Site 711 - Aerial view of crossing above gradient barrier.

Site # 800 Photo: P9016980

Site 800 - Downstream of the stream crossing of the Bowser River mainstem, showing extensive riffle habitat.

Appendix 7.2-4

Lake Fish Habitat Survey Data, Snowfield and Brucejack Gold Mine Project, 2010 to 2012

Engineers and Scientists

Appendix 7.2-4. Lake Fish Habitat Survey Data, Snowfield and Brucejack Gold Mine Project, 2010 to 2012

Waterbody				Survey Dates				UTM (Zone 9)		Surface	Elevation		Biogeoclimatic	Terrain Characteristics				Shoreline Type (%)						Recreational	# Inlets	
Name	Type	ID	Watershed Code	From	To	Agency	Crew	Easting	Northing	Area (ha)	(m)	Magnitude	Zone	Setting	Hillslope Coupling	Aspect	Lake Basin Genesis	i	ii	iii	iv	v	Cover	Features	Permanent	Other
Bowser Lake	P	002LBIR	560-208600	8/30/2010	8/31/2010	C660	KM/KW/LT	474708	6249647	3455	368			VF	CO	SE	GLGS	5	15	80	0	0	S	None	137	N/A
Brucejack Lake	P	00380UNUR	960-250000-55300			C660	KW/RM	426596	6258874	N/A	1370	4	AT	VF	CO	E	GLGS	5	5	80	0	0	S	None	4	5
Todedada Lake	P	N/A	560-409900-38400-71300	8/26/2010	8/28/2010	C660	KM/KW	451645	6260323	23.5	681	8	ESSF	VW	PC	N	GLGS	80	15	0	5	0	A	None	3	5
Unnamed Lake 1	P	00198LBIR	560-368300-18300	9/14/2011	9/15/2011	C660	KW/RM	467945	6260446	N/A	675	4	ESSF	PN	DC	N	GLGS	0	0	0	60	40	A	None	4	0
Unnamed Lake 2	P	00186LBIR	560-368300-18300-30957	9/16/2011	9/17/2011	C660	KW/RM	468610	6261311	N/A	651	1	ESSF	PN	DC	NW	GLGS	0	0	0	20	80	A	None	1	0
Unnamed Lake 3	P	00269LBIR	560-208600-42900	8/28/2010	8/29/2010	C660	KM/KW	443686	6252296	20.1	762	3	ESSF	VW	CO	E	GLGS	10	10	80	0	0	M	None	3	0
Unnamed Lake 4	P	00220LBIR	560-368300-18300	8/30/2012	9/12010	C660	LT/GM	469533	6257982	N/A	675	1	ESSF	PN	DC	N	GLGS	0	0	0	50	50	A	None	2	0

Waterbody Type
P = primary lake
S = secondary lake
N/A = not applicable/available
ID = identification
Y = yes
N = no
ILP = interim locator point
Veg. = vegetation

Crew
KM = Kirsten MacKenzie
KW = Kyla Warren
LT = Lora Tryon

Biogeoclimatic Zone
ESSF = Engelman Spruce/Subalpine Fir

Lake Setting
VF = valley floor
VW = valley wall

Hillslope Coupling
CO = coupled
PC = partially coupled

Aspect
SE = southeast
N = north
E = east

Lake Basin Genesis
GLGS = Glacial (Glacial Scour)

Shoreline Type
i = sand or gravel beach
ii = low rocky shore
iii = cliffed or bluffed shore
iv = wetland shore
v = vegetated shore

Cover
S = sparse
M = moderate
A = abundant

Appendix 7.2-4. Lake Fish Habitat Survey Data, Snowfield and Brucejack Gold Mine Project, 2010 to 2012

Waterbody					Inlet Spawning	Outlet			Inlet 1			Inlet 2			Inlet 3		
Name	Type	ID	Watershed Code	# Outlets	Habitat Present?	Watershed Code	ILP	ILP Map #	Watershed Code	ILP	ILP Map #	Watershed Code	ILP	ILP Map #	Watershed Code	ILP	ILP Map #
Bowser Lake	P	002LBIR	560-208600	1	Y	560-208600	N/A	N/A	560-208600	N/A	N/A	560-208600-39300	N/A	N/A			
Brucejack Lake	P	00380UNUR	960-250000-55300	1	Y	960-250000-55300	N/A	N/A	960-250000-55300-63200	N/A	N/A	960-250000-55300	N/A	N/A	960-250000-55300-64700	N/A	N/A
Todedada Lake	P	N/A	560-409900-38400-71300	1	Y	560-409900-38400-71300	N/A	N/A	560-409900-68400-71300	N/A	N/A	560-409900-68400-71300-6050	N/A	N/A	N/A	600	104A.05
Unnamed Lake 1	P	00198LBIR	560-368300-18300	1	N	560-368300-18300	N/A	N/A	560-368300-18300	N/A	N/A	N/A	1001	1	N/A	1002	1
Unnamed Lake 2	P	00186LBIR	560-368300-18300-30957	0	N	N/A	N/A	N/A	N/A	1004	2						
Unnamed Lake 3	P	00269LBIR	560-208600-42900	1	Y	560-208600-42900	N/A	N/A	560-208600-42900-78500	N/A	N/A	560-208600-42900-76200	N/A	N/A	560-208600-42900	N/A	N/A
Unnamed Lake 4	P	00220LBIR	560-368300-18300	2	N	560-368300-18300	N/A	N/A	N/A	1005	2						

Appendix 7.2-4. Lake Fish Habitat Survey Data, Snowfield and Brucejack Gold Mine Project, 2010 to 2012

Waterbody				Inlet 4			Inlet 5			Emergent	Submergent	Floating Algae	Species List	Lake Bathymetry			Access		
Name	Type	ID	Watershed Code	Watershed Code	ILP	ILP Map #	Watershed Code	ILP	ILP Map #	Veg. (%)	Veg. (%)	present?	Attached?	Type of Survey	Littoral Area (%)	Max. Depth (m)	Survey	Off-Road	Distance (km)
Bowser Lake	P	002LBIR	560-208600							0	0	N	N	NO	1	152	H	ATV	0
Brucejack Lake	P	00380UNUR	960-250000-55300	960-250000-55300-63300	N/A	N/A				0	0	N	N	NO	1	80	H	N/A	0
Todedada Lake	P	N/A	560-409900-38400-71300	N/A	601	104A.05	N/A	602	104A.05	1	1	Y	N	NO	2	17	H	N/A	N/A
Unnamed Lake 1	P	00198LBIR	560-368300-18300	N/A	1003	1				5	2	Y	N	NO	1	5	H	N/A	N/A
Unnamed Lake 2	P	00186LBIR	560-368300-18300-30957							25	2	Y	N	NO	1	3	H	N/A	N/A
Unnamed Lake 3	P	00269LBIR	560-208600-42900							1	1	N	N	NO	1	16.5	H	N/A	N/A
Unnamed Lake 4	P	00220LBIR	560-368300-18300							20	15	Y	N	NO	1	3	H	N/A	N/A

Appendix 7.2-4. Lake Fish Habitat Survey Data, Snowfield and Brucejack Gold Mine Project, 2010 to 2012

Waterbody				Access					
Name	Type	ID	Watershed Code	Trail?	Distance (km)	Closest Community	Access Comments	Weather Comments	General Comments
Bowser Lake	P	002LBIR	560-208600	Y	0	Stewart	All roads to lake are decommissioned and impassable for 4WD vehicles from Highway 37	Heavy rain on Aug 31	Only surveyed NW corner of lake Inlet of Bowser and delta shoreline dominated by mud and gravel N & S shores rocky with some gravel/cobble beaches extremely turbid ~5cm visibility through water shoreline drops off steeply all along west shore and delta several mud/sand bottomed channels through delta Scott Cr flows directly into Bowser Lake via an old, blocked off side channel of Bowser R.
Brucejack Lake	P	00380UNUR	960-250000-55300	N/A	0	Stewart	No ground access	Windy, raining	Next to Pretivm camp High altitude, cold, turbid water High zooplankton biomass - visible to eye Deep Rocky shoreline with cliffs, sand and gravel beaches where avalanche chutes enter lake Many inlets, but most are ephemeral and almost all high gradient - no fish habitat Only inlet/outlets that provide habitat is the outlet and inlet on east side of lake No vegetation, all cover from boulders Road riprap has entered lake on south side
Todedada Lake	P	N/A	560-409900-38400-71300	N/A	N/A	Stewart	No ground access	Sunny	Nice lake, clear water, no glacial inflows Surface temp 16.5°C Lots of fish jumping Cover on shoreline dominated by LWD, especially at inlets and outlet, and submerged veg Shoreline steep in many places, with littoral zone only extending ~5m from shore Most tribs steep and unproductive except main trib (surveyed in July) that has potential spawning Possible shoreline spawning in places - observed disturbed gravel and coarse sand near inflows along NW shore Deep in middle and potentially anoxic at depth Sounder not working on first day, but 2 sets were deep and caught few fish
Unnamed Lake 1	P	00198LBIR	560-368300-18300	N/A	N/A	Stewart	Nearby decommissioned forest roads	None	Deep tea-coloured lake Water lilies in most of the shoreline Gravel/sandbar near new beaver lodge and inlet. Inlet small and slow, unlikely to cause alluvial fan as observed. Possibly previous high flow? No observed spawning areas LWD cover at edges All inlets/outlets practically stagnant Isopods observed, large and numerous Appears to be good fish habitat, but no fish Narrow littoral zone Mud substrate
Unnamed Lake 2	P	00186LBIR	560-368300-18300-30957	N/A	N/A	Stewart	Nearby decommissioned forest roads	None	Small, shallow lake NE arm is shallow, covered in water lilies Shallow bar with boulder substrate separates from rest of lake Water levels high into vegetation Evuidence of past water level rises, trees at edge of lake dead and fallen, much LWD Cutblocks in surrounding land
Unnamed Lake 3	P	00269LBIR	560-208600-42900	N/A	N/A	Stewart	No ground access	P. cloudy, windy in afternoon	Moderately deep, long lake with abundant LWD from avalanches deposits Steep-sided with most of shoreline dominated by bedrock cliffs, very narrow littoral zone in most of lake Shallow zones @ west and east margins of lake Lots of DV/BT - most larger ones in spawning colours, but not yet milting. Eating lots of terrestrial inverts & DV fry avalanche chutes on N side of lake, old burn on south side. Lots of beaver activity, mostly old. 4 large lodges along shoreline at E end Surface temp 13°C
Unnamed Lake 4	P	00220LBIR	560-368300-18300	N/A	N/A	Stewart	Nearby decommissioned forest roads	None	

Appendix 7.2-5

Shoreline Substrate Zones, Brucejack Gold Mine Project, 2010 to 2012

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Appendix 7.2-5. Shoreline Substrate Zones, Brucejack Gold Mine Project, 2010 to 2012

Lake	Zone #	% Fine	% Gravel	% Cobble	% Boulder	% Bedrock
Bowser	1	0	0	0	0	100
Bowser	2	10	90	0	0	0
Bowser	3	100	0	0	0	0
Bowser	4	90	10	0	0	0
Brucejack	1	90	10	0	0	0
Brucejack	2	0	0	80	20	0
Brucejack	3	10	0	5	75	10
Brucejack	4	50	5	40	15	0
Brucejack	5	0	0	0	0	100
Brucejack	6	40	60	0	0	0
Brucejack	7	0	0	5	0	95
Brucejack	8	0	0	5	10	85
Brucejack	9	10	20	50	0	20
Brucejack	10	0	0	10	0	90
Brucejack	11	20	20	0	0	60
Todedada	1	80	15	5	0	0
Todedada	2	90	0	0	10	0
Todedada	3	60	0	10	30	0
Todedada	4	100	0	0	0	0
Todedada	5	0	10	60	30	0
Todedada	6	0	60	40	0	0
UL 1	1	100	0	0	0	0
UL 1	2	80	20	0	0	0
UL 2	1	100	0	0	0	0
UL 2	2	80	0	0	20	0
UL 3	1	5	90	5	0	0
UL 3	2	90	10	0	0	0
UL 3	3	20	70	10	0	0
UL 3	4	20	50	0	30	0
UL 3	5	0	0	0	0	100
UL 3	6	0	0	0	80	20
UL 3	7	80	20	0	0	0
UL 3	8	20	40	40	0	0
UL4	1	90	0	0	10	0
UL4	2	80	0	10	10	0
UL4	3	70	0	20	10	0

UL = Unnamed Lake

Appendix 7.2-6

Habitat Data for Wetland Sites, Brucejack Gold Mine Project, 2010 to 2012

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Appendix 7.2-6. Habitat Data for Wetland Sites, Brucejack Gold Mine Project, 2010 to 2012

Wetland Site	Date	Crew	Trans/Pt	Location			Length (m)	Width (m)	Depth (m)	Connections			Features		Substrate	
				Zone	Easting	Northing				Inlet	Outlet	Bar	Type	UTM	Dominant	Subdominant
WL-1	26/06/2010	LT/BS	Trans	9 V	451074	6263141	50	13.6	0.60	-	-	-	-	-	Fines	-
WL-1	26/06/2010	LT/BS	Trans	9 V	451073	6263100	25	8.6	0.70	-	-	-	-	-	Fines	-
WL-1	26/06/2010	LT/BS	Trans	9 V	451083	6263078	43	15.0	0.50	-	-	-	-	-	Fines	-
WL-1	26/08/2010	LT/DF	Trans	9 V	451240	6263082	146	5.9	0.16	-	X		Outlet	9V451185 6263079	Gravel	Sand
WL-1	26/08/2010	LT/DF	Pt	9 V	451214	6263079	-	5.6	0.09	-	-	-	-	-	-	-
WL-1	26/08/2010	LT/DF	Pt	9 V	451162	6263101	-	5.4	0.13	-	-	-	-	-	-	-
WL-1	26/08/2010	LT/DF	Pt	9 V	451133	6263113	-	10.0	0.14	-	-	-	-	-	-	-

Wetland Site	Cover Type						Vegetation						Habitat Quality			
	SWD	LWD	Boulders	Deep Pools	Overhanging Vegetation	Instream Vegetation	Trees	Shrubs	Herbs	Reeds	Moss	Algae	Rearing	Overwintering	Spawning	Migrating
WL-1	T	T	N	D	S	T	-	X	-	-	-	-	Fair	Fair	Fair	Fair
WL-1	N	T	N	D	S	T	-	X	-	-	-	-	Good	Good	Good	Good
WL-1	N	N	N	N	S	D	-	X	-	-	-	-	Good	Good	Good	Good
WL-1	T	T	N	S	S	D	-	X	-	-	-	-	Good	Good	Good	Fair
WL-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WL-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WL-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Trans = transect observation

Pt = point observation

D = dominant

S = subdominant

T = trace

N = none

- = no data available

Appendix 7.3-1

Species Identification Report of Genetically Analyzed Fish, Brucejack Gold Mine Project, 2010 to 2012

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DNA Species Identification Report

Eric Taylor

UBC Zoology

etaylor@zoology.ubc.ca

Locality: Snowfields projectt

Number of samples: 30

Date: Assayed October, 2010

Methods:

1. DNA was extracted from ethanol-stored fin tissues using standard "spin-column" protocols (Qiagen Ltd). Each fish's DNA was subject to polymerase chain reaction (PCR) assays of variation at two nuclear DNA loci that are diagnostic for differences between Dolly Varden and bull trout. These loci (MTB and GH) are resolved using electrophoresis and laser detection after PCR with fluorescently-labelled primers. Differences between species are resolved as size differences between the alleles at each locus between species. These differences are reported as fragments of different size (in base pairs) after electrophoresis on a Beckman-Coulter CEQ 8000 automated genotyper. The species specific differences have been verified by assaying Dolly Varden and bull trout (up to several hundred of each) from localities ranging from Washington State, BC, and north to Alaska.

References:

1. Redenbach, Z. and E.B. Taylor 2003. Evidence for bimodal hybrid zones between two species of char (*Salvelinus*) in northwestern North America. *J. Evol. Biol.* **16(6)**: 1135-1148.

General results

1. All fish were positively identified both at MTB and GH as a mixture of Dolly Varden, *Salvelinus malma*, and bull trout, *S. confluentus*. No hybrids were observed. Four fish repeatedly failed in the analyses and could not be identified. Tissue samples of all fish were extremely small and may have contributed to failure or there may have been some problem in sample storage. Samples should be at least 5 mm x 5 mm to allow replicate extractions. See the spreadsheet accompanying this report for details.

Appendix 7.3-2

Stream Effort and Catch, Brucejack Gold Mine Project, 2010 to 2012

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Appendix 7.3-2a. Electrofishing Effort and Catch, Brucejack Gold Mine Project, 2010 to 2012

											Number of Fish Captured					
Site	Watershed	Survey Date	Time In	Time Out	EF Seconds	Length Fished (m)	Width Fished (m)	Volts (V)	Frequency (Hz)	Pulse (ms)	DV/BT	RB	MW	CO	CH	SK
100	Bowser	23/06/2010	1020	1050	371	100	4	425	40	2	6	0	1	0	0	1
101	Bowser	23/06/2010	1315	1400	520	200	1.5	425	35	2	0	0	0	0	0	1
102	Bowser	23/06/2010	1530	1610	726	233	5	425	35	2	3	0	3	0	0	0
500	Bowser	23/06/2010	1130	1150	98	40	1.5	305	50	2.7	3	0	0	0	0	0
501	Bowser	23/06/2010	1300	1330	705	200	6.5	350	30	4	3	3	0	4	0	0
502	Bowser	23/06/2010	1630	1710	274	75	2.5	450	30	4	0	0	0	0	0	0
103	Bowser	24/06/2010	820	850	437	160	3	425	40	2	3	0	2	0	0	0
104	Bowser	24/06/2010	1200	1230	397	65	4	525	37	2	0	0	0	0	0	0
105	Bowser	24/06/2010	1530	1615	703	100	4	550	37	2	0	0	0	0	0	0
503	Scott	24/06/2010	930	1000	243	75	1.5	325	45	2.7	1	0	0	0	0	0
504	Scott	24/06/2010	1330	1400	433	50	3	425	30	4	0	2	0	0	0	0
505	Scott	24/06/2010	1600	1630	311	100	4	500	30	4	1	0	0	0	0	0
506	Scott	24/06/2010	930	1000	369	100	2	400	30	4	0	0	0	0	0	0
106	Todedada	25/06/2010	915	1030	530	145	5	400	35	2	0	0	0	0	0	0
107	Scott	25/06/2010	1220	1252	521	100	3	375	37	2	6	1	0	0	0	0
108	Scott	25/06/2010	1505	1535	417	100	1	420	35	2	7	0	0	0	0	0
508	Todd	25/06/2010	1400	1430	453	100	3.5	500	30	4	0	0	0	0	0	0
509	Todd	25/06/2010	1530	1600	250	100	2	450	35	2	0	0	0	0	0	0
109	Todedada	26/06/2010	830	900	357	110	1	500	35	2	0	0	0	0	0	0
110	Todedada	26/06/2010	1215	1230	384	118	3	400	35	2	8	2	0	0	0	0
111	Todedada	26/06/2010	1515	1540	784	110	2	300	35	2	6	0	4	0	0	0
510	Todedada	26/06/2010	845	920	359	100	3	600	30	4	0	0	0	0	0	0
511	Todedada	26/06/2010	1100	1130	819	50	3	625	30	4	1	1	0	0	0	0
513	Todedada	26/06/2010	1545	1615	324	100	3	600	30	4	0	0	0	0	0	0
113	Unuk	27/06/2010	1110	1140	478	100	3	425	35	2	7	0	0	6	2	0
514	Unuk	27/06/2010	930	1000	373	30	4	710	30	4	1	1	0	0	0	0
1	Unuk	26/08/2010	1530	1620	549	150	10	690	35	2	3	1	0	0	0	0
2	Unuk	26/08/2010	1350	1450	366	150	20	500	30	2	1	0	3	0	0	0
205	Unuk	27/08/2010	1630	1700	300	150	2	350	-	-	8	0	0	0	0	0
209	Bowser	27/08/2010	1230	1300	376	100	3	450	40	2	5	0	0	0	0	0
210	Bowser	27/08/2010	1520	1600	365	65	2	500	240	2	0	0	0	0	0	0
206	Scott	28/08/2010	1340	1420	416	100	9	450	40	2	5	0	1	0	0	0
207	Todedada	28/08/2010	1645	1715	671	100	5	550	40	2	0	0	2	0	0	0
203	Todedada	29/08/2010	1525	1545	319	200	1	550	40	2	0	0	0	0	0	0
212	Todedada	29/08/2010	1000	1030	199	150	1	400	40	2	4	0	0	8	0	0
213	Todedada	29/08/2010	1250	1320	215	50	3	425	40	2	9	0	0	1	0	0
208	Wildfire	30/08/2010	1210	1240	587	100	2	420	40	2	0	0	0	0	0	0
601	Wildfire	31/08/2010	1200	1220	151	50	0.5	325	40	2	0	0	0	0	0	2
601	Wildfire	31/08/2010	1015	1035	324	340	7	375	40	2	0	0	17	0	0	1
601	Wildfire	31/08/2010	1400	1430	321	200	4	380	40	2	1	0	15	0	0	1
601	Wildfire	31/08/2010	1330	1350	200	70	2	380	40	2	1	0	1	0	0	0
WL-1	Wetland	26/08/2010	930	1000	162	146	6.5	375	30	2	38	0	0	0	0	0
1	Wildfire	9/7/2011	1000	1200	265	70	2	990	30	12	5	5	0	0	3	0
101	Wildfire	9/8/2011	0930	0958	170	60	2	990	30	12	0	0	0	0	0	0
103	Wildfire	9/8/2011	1210	1255	503	150	2	635	30	12	0	0	0	0	0	0
104	Bell-Irving	9/9/2011	1415	1450	158	60	3	635	30	12	0	0	0	0	0	0
106	Bell-Irving	9/11/2011	1400	1455	351	200	3	470	30	12	1	9	0	0	1	0
106	Unuk	9/10/2011	1230	1330	492	60	3	535	30	12	15	0	0	0	0	0
105	Unuk	9/10/2011	0925	1030	596	100	3	580	30	12	1	0	0	0	0	0
WC2	Wildfire	8/28/2012	905	930	197	100	2	990	30	12	0	0	0	0	0	0
WC3	Wildfire	8/28/2012	1200	1235	234	75	1	410	30	12	0	0	0	0	0	0
WC5	Wildfire	8/28/2012	1415	1445	133	100	1	122	30	12	0	0	0	0	0	0
WC1	Wildfire	8/29/2012	845	1350	1152	800	4	680	40	12	4	46	0	0	0	0
MC1	BI	8/29/2012	1000	1730	1052	600	2	680	40	12	6	33	0	0	0	0

EF = Electrofishing
DV/BT = Dolly Varden/bull trout
RB = rainbow trout
MW = mountain whitefish
CO = coho salmon
CH = Chinook salmon
SK = sockeye salmon

Appendix 7.3-2b. Electrofishing Catch Per Unit Effort, Brucejack Gold Mine Project, 2010 to 2012

Site	Watershed	Survey Date	EF Seconds	Length Fished (m)	Width Fished (m)	Volts (V)	Frequency (Hz)	Pulse (ms)	Catch Per Unit Effort (fish/hr) DV/BT	RB	MW	CO	CH	SK	Total
100	Bowser	23/06/2010	371	100	4.2	425	40	2	1.62	0.00	0.00	0.00	0.00	0.00	1.62
101	Bowser	23/06/2010	520	200	1.5	425	35	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
102	Bowser	23/06/2010	726	233	5	425	35	2	0.41	0.00	0.00	0.00	0.00	0.00	0.41
500	Bowser	23/06/2010	98	40	1.5	305	50	2.7	3.06	0.00	0.00	0.00	0.00	0.00	3.06
501	Bowser	23/06/2010	705	200	6.5	350	30	4	0.43	0.43	0.00	0.00	0.00	0.00	0.85
502	Bowser	23/06/2010	274	75	2.5	450	30	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
103	Bowser	24/06/2010	437	160	3	425	40	2	0.69	0.00	0.00	0.00	0.00	0.00	0.69
104	Bowser	24/06/2010	397	65	4	525	37	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
105	Bowser	24/06/2010	703	100	4	550	37	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
503	Scott	24/06/2010	243	75	1.5	325	45	2.7	0.41	0.00	0.00	0.00	0.00	0.00	0.41
504	Scott	24/06/2010	433	50	3	425	30	4	0.00	0.46	0.00	0.00	0.00	0.00	0.46
505	Scott	24/06/2010	311	100	4	500	30	4	0.32	0.00	0.00	0.00	0.00	0.00	0.32
506	Scott	24/06/2010	369	100	2	400	30	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
106	Todedada	25/06/2010	530	145	5	400	35	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
107	Scott	25/06/2010	521	100	3	375	37	2	1.15	0.19	0.00	0.00	0.00	0.00	1.34
108	Scott	25/06/2010	417	100	0.8	420	35	2	1.68	0.00	0.00	0.00	0.00	0.00	1.68
508	Todd	25/06/2010	453	100	3.5	500	30	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
509	Todd	25/06/2010	250	100	2	450	35	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
109	Todedada	26/06/2010	357	110	0.8	500	35	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
110	Todedada	26/06/2010	384	118	3	400	35	2	2.08	0.52	0.00	0.00	0.00	0.00	2.60
111	Todedada	26/06/2010	784	110	2	300	35	2	0.77	0.00	0.00	0.00	0.00	0.00	0.77
510	Todedada	26/06/2010	359	100	3	600	30	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
511	Todedada	26/06/2010	819	50	3	625	30	4	0.12	0.12	0.00	0.00	0.00	0.00	0.24
513	Todedada	26/06/2010	324	100	3	600	30	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
113	Unuk	27/06/2010	478	100	3	425	35	2	1.46	0.00	0.00	0.00	0.42	0.00	1.88
514	Unuk	27/06/2010	373	30	4	710	30	4	0.27	0.27	0.00	0.00	0.00	0.00	0.54
1	Unuk	26/08/2010	549	150	10	690	35	2	0.55	0.18	0.00	0.00	0.00	0.00	0.73
2	Unuk	26/08/2010	366	150	20	500	30	2	0.27	0.00	0.00	0.00	0.00	0.00	0.27
205	Unuk	27/08/2010	300	150	2	350	-	-	2.67	0.00	0.00	0.00	0.00	0.00	2.67
209	Bowser	27/08/2010	376	100	3	450	40	2	1.33	0.00	0.00	0.00	0.00	0.00	1.33
210	Bowser	27/08/2010	365	65	2	500	240	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
206	Scott	28/08/2010	416	100	9	450	40	2	1.20	0.00	0.00	0.00	0.00	0.00	1.20
207	Todedada	28/08/2010	671	100	5	550	40	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
203	Todedada	29/08/2010	319	200	1	550	40	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
212	Todedada	29/08/2010	199	150	1	400	40	2	2.01	0.00	0.00	0.00	0.00	0.00	2.01
213	Todedada	29/08/2010	215	50	3	425	40	2	4.19	0.00	0.00	0.00	0.00	0.00	4.19
208	Wildfire	30/08/2010	587	100	2	420	40	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
601	Wildfire	31/08/2010	151	50	0.5	325	40	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
601	Wildfire	31/08/2010	324	340	7	375	40	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
601	Wildfire	31/08/2010	321	200	4	380	40	2	0.31	0.00	0.00	0.00	0.00	0.00	0.31
601	Wildfire	31/08/2010	200	70	2	380	40	2	0.50	0.00	0.00	0.00	0.00	0.00	0.50
WL-1	Wetland	26/08/2010	162	146	6.5	375	30	2	23.46	0.00	0.00	0.00	0.00	0.00	23.46
1	Wildfire	9/7/2011	265	70	2	990	30	12	1.89	1.89	0.00	0.00	1.13	0.00	4.91
101	Wildfire	9/8/2011	170	60	2	990	30	12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
103	Wildfire	9/8/2011	503	150	2	635	30	12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
104	Bell-Irving	9/9/2011	158	60	3	635	30	12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
106	Bell-Irving	9/11/2011	351	200	3	470	30	12	0.28	2.56	0.00	0.00	0.28	0.00	3.13
106	Unuk	9/10/2011	492	60	3	535	30	12	3.05	0.00	0.00	0.00	0.00	0.00	3.05
105	Unuk	9/10/2011	596	100	3	580	30	12	0.17	0.00	0.00	0.00	0.00	0.00	0.17
WC2	Wildfire	8/28/2012	197	100	2	990	30	12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WC3	Wildfire	8/28/2012	234	75	1	410	30	12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WC5	Wildfire	8/28/2012	133	100	1	122	30	12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WC1	Wildfire	8/29/2012	1152	800	4	680	40	12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MC1	BI	8/29/2012	1052	600	2	680	40	12	0.01	0.00	0.00	0.00	0.00	0.00	0.01

EF = Electrofishing
DV/BT = Dolly Varden/bull trout
RB = rainbow trout
MW = mountain whitefish
CO = coho salmon
CH = Chinook salmon
SK = sockeye salmon

Appendix 7.3-3

Lake Effort and Catch, Brucejack Gold Mine Project, 2010 to 2012

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Appendix 7.3-3a. Minnow Trapping Effort and Catch, Brucejack Gold Mine Project, 2010 to 2012

Lake	Set	Date In	Time In	Date Out	Time Out	Soak Time (h)	Depth	UTM Easting	UTM Northing	Catch	Species	CPUE
UL 3	1	8/28/2010	11:25	8/29/2010	13:00	22.42	1.0	444413	6252105	1	DV/BT	1.07
UL 3	2	8/28/2010	11:29	8/29/2010	13:01	22.47	2.5	444465	6252053	0	-	0.00
UL 3	3	8/28/2010	11:31	8/29/2010	13:02	22.48	1.5	444518	6252050	0	-	0.00
UL 3	4	8/28/2010	11:33	8/29/2010	13:04	22.48	0.8	444649	6251997	2	DV/BT	2.13
UL 3	5	8/28/2010	11:37	8/29/2010	13:05	22.53	3.0	444749	6251899	1	DV/BT	1.07
UL 3	6	8/28/2010	11:40	8/29/2010	13:07	22.55	2.0	444638	6251915	1	DV/BT	1.06
UL 3	7	8/28/2010	11:47	8/29/2010	14:05	21.70	0.3	444473	6251932	0	-	0.00
UL 3	8	8/28/2010	12:05	8/29/2010	14:05	22.00	1.0	443801	6252051	0	-	0.00
UL 3	9	8/28/2010	12:07	8/29/2010	14:07	22.00	1.0	443783	6252098	0	-	0.00
UL 3	10	8/28/2010	12:10	8/29/2010	14:16	21.90	1.0	443726	6252149	0	-	0.00
UL 3	11	8/28/2010	12:12	8/29/2010	14:15	21.95	1.2	443703	6252193	2	DV/BT	2.19
UL 3	12	8/28/2010	12:20	8/29/2010	14:16	22.07	1.2	443341	6252203	2	DV/BT	2.18
UL 3	13	8/28/2010	12:22	8/29/2010	14:20	22.03	1.0	443309	6252180	2	DV/BT	2.18
UL 3	14	8/28/2010	12:27	8/29/2010	14:20	22.12	1.2	443239	6252243	3	DV/BT	3.26
UL 3	15	8/28/2010	12:30	8/29/2010	15:35	20.92	2.0	443295	6252250	0	-	0.00
UL 3	16	8/28/2010	12:31	8/29/2010	15:40	20.85	1.5	443301	6252318	1	DV/BT	1.15
UL 3	17	8/28/2010	12:34	8/29/2010	15:43	20.85	1.0	443431	6252337	5	DV/BT	5.76
UL 3	18	8/28/2010	12:40	8/29/2010	15:50	20.83	2.0	443617	6252305	2	DV/BT	2.30
UL 3	19	8/28/2010	12:47	8/29/2010	15:53	20.90	1.5	443997	6252197	0	-	0.00
UL 3	20	8/28/2010	12:58	8/29/2010	15:56	21.03	1.0	444369	6252171	1	DV/BT	1.14
Todedada	1	8/26/2010	11:00	8/27/2010	9:00	26.00	2.0	451670	6259688	0	-	0.00
Todedada	2	8/26/2010	11:14	8/27/2010	9:02	26.20	2.5	451628	6259804	2	DV/BT	1.83
Todedada	3	8/26/2010	11:16	8/27/2010	9:03	26.22	3.0	451596	6259880	0	-	0.00
Todedada	4	8/26/2010	11:19	8/27/2010	9:05	26.23	1.5	451555	6259945	0	-	0.00
Todedada	5	8/26/2010	11:25	8/27/2010	9:10	26.25	0.8	451509	6260158	0	-	0.00
Todedada	6	8/26/2010	11:27	8/27/2010	9:25	26.03	2.0	451522	6260311	1	DV/BT	0.92
Todedada	7	8/26/2010	11:35	8/27/2010	9:27	26.13	2.0	451653	6260344	0	-	0.00
Todedada	8	8/26/2010	11:41	8/27/2010	9:30	26.18	2.0	451683	6260206	0	-	0.00
Todedada	9	8/26/2010	11:45	8/27/2010	9:35	26.17	1.0	451743	6260049	0	-	0.00
Todedada	10	8/26/2010	11:48	8/27/2010	9:37	26.18	1.5	451844	6259978	0	-	0.00
Todedada	11	8/26/2010	11:52	8/27/2010	9:43	26.15	2.0	451926	6259800	0	-	0.00
Todedada	12	8/26/2010	11:57	8/27/2010	10:07	25.83	0.5	451705	6259585	0	-	0.00
Todedada	13	8/26/2010	11:59	8/27/2010	10:07	25.87	0.6	451704	6259585	0	-	0.00
Todedada	14	8/26/2010	12:34	8/27/2010	9:46	26.80	3.5	451897	6259623	0	-	0.00
Todedada	15	8/26/2010	12:40	8/27/2010	9:50	26.83	1.0	451911	6259497	0	-	0.00
Todedada	16	8/26/2010	12:44	8/27/2010	9:55	26.82	2.0	451921	6259366	0	-	0.00
Todedada	17	8/26/2010	12:46	8/27/2010	9:57	26.82	1.5	451919	6259278	1	DV/BT	0.89
Todedada	18	8/26/2010	12:51	8/27/2010	10:00	26.85	1.0	451774	6259381	0	-	0.00
Todedada	19	8/26/2010	12:54	8/27/2010	10:05	26.82	2.0	451729	6259427	0	-	0.00
Todedada	20	8/26/2010	12:56	8/27/2010	10:05	26.85	0.8	451693	6259479	0	-	0.00
Bowser	1	8/30/2010	12:01	8/31/2010	15:43	20.30	1.1	455706	6254026	0	-	0.00

UL = Unnamed Lake

Appendix 7.3-3a. Minnow Trapping Effort and Catch, Brucejack Gold Mine Project, 2010 to 2012

Lake	Set	Date In	Time In	Date Out	Time Out	Soak Time (h)	Depth	UTM Easting	UTM Northing	Catch	Species	CPUE
Bowser	2	8/30/2010	12:05	8/31/2010	15:45	20.33	0.5	455620	6254009	0	-	0.00
Bowser	3	8/30/2010	12:07	8/31/2010	15:52	20.25	0.5	455617	6253971	0	-	0.00
Bowser	4	8/30/2010	12:20	8/31/2010	15:55	20.42	0.3	455580	6253868	0	-	0.00
Bowser	5	8/30/2010	12:25	8/31/2010	15:50	20.58	0.5	455571	6253738	0	-	0.00
Bowser	6	8/30/2010	12:29	8/31/2010	15:45	20.73	0.4	455500	6253684	0	-	0.00
Bowser	7	8/30/2010	12:33	8/31/2010	15:45	20.80	0.3	455355	6253684	0	-	0.00
Bowser	8	8/30/2010	12:59	8/31/2010	15:37	21.37	0.3	455644	6253575	0	-	0.00
Bowser	9	8/30/2010	13:07	8/31/2010	15:30	21.62	0.3	455501	6253481	0	-	0.00
Bowser	10	8/30/2010	13:15	8/31/2010	15:15	22.00	0.3	455670	6253384	0	-	0.00
Bowser	11	8/30/2010	13:45	8/31/2010	16:45	21.00	0.4	456530	6252628	0	-	0.00
Bowser	12	8/30/2010	13:50	8/31/2010	16:50	21.00	0.4	456448	6252572	0	-	0.00
Bowser	13	8/30/2010	14:00	8/31/2010	16:55	21.08	0.4	456481	6252653	0	-	0.00
Bowser	14	8/30/2010	14:03	8/31/2010	16:55	21.13	0.3	456458	6252641	0	-	0.00
Bowser	15	8/30/2010	14:05	8/31/2010	16:59	21.10	0.3	456437	6252604	0	-	0.00
Bowser	16	8/30/2010	14:10	8/31/2010	16:59	21.18	0.3	456365	6252621	0	-	0.00
Bowser	17	8/30/2010	14:15	8/31/2010	17:05	21.17	0.3	456355	6252645	0	-	0.00
Bowser	18	8/30/2010	14:17	8/31/2010	17:05	21.20	0.4	456355	6252645	0	-	0.00
Brucejack	1	9/13/2011	13:45	9/14/2011	9:45	28.00	-	427194	6258768	0	-	0.00
Brucejack	2	9/13/2011	13:47	9/14/2011	9:35	28.20	-	427263	6258722	0	-	0.00
Brucejack	3	9/13/2011	13:48	9/14/2011	9:30	28.30	-	427311	6258693	0	-	0.00
Brucejack	4	9/13/2011	13:50	9/14/2011	9:29	28.35	-	427435	6258586	0	-	0.00
Brucejack	5	9/13/2011	13:52	9/14/2011	9:26	28.43	-	427648	6258784	0	-	0.00
Brucejack	6	9/13/2011	13:55	9/14/2011	9:25	28.50	-	428098	6258759	0	-	0.00
Brucejack	7	9/13/2011	13:58	9/14/2011	9:23	28.58	-	428398	6259003	0	-	0.00
Brucejack	8	9/13/2011	13:59	9/14/2011	9:20	28.65	-	428284	6259139	0	-	0.00
Brucejack	9	9/13/2011	14:03	9/14/2011	9:18	28.75	-	427458	6259343	0	-	0.00
Brucejack	10	9/13/2011	14:11	9/14/2011	9:15	28.93	-	427173	6258913	0	-	0.00
UL 1	1	9/14/2011	15:13	9/15/2011	9:02	30.18	-	467945	6260446	0	-	0.00
UL 1	2	9/14/2011	15:15	9/15/2011	9:04	30.18	-	468051	6260351	0	-	0.00
UL 1	3	9/14/2011	15:18	9/15/2011	9:05	30.22	-	468165	6260124	0	-	0.00
UL 1	4	9/14/2011	15:21	9/15/2011	9:09	30.20	-	468169	6260087	0	-	0.00
UL 1	5	9/14/2011	15:25	9/15/2011	9:12	30.22	-	468015	6260141	0	-	0.00
UL 1	6	9/14/2011	15:29	9/15/2011	9:14	30.25	-	467912	6260152	0	-	0.00
UL 1	7	9/14/2011	15:35	9/15/2011	9:18	30.28	-	467792	6260188	0	-	0.00
UL 1	8	9/14/2011	15:43	9/15/2011	9:23	30.33	-	470618	6266790	0	-	0.00
UL 1	9	9/14/2011	15:47	9/15/2011	9:25	30.37	-	468131	6260636	0	-	0.00
UL 2	1	9/15/2011	13:51	9/16/2011	9:11	28.67	-	468818	6261233	0	-	0.00
UL 2	2	9/15/2011	13:55	9/16/2011	9:15	28.67	-	468527	6261288	0	-	0.00
UL 2	3	9/15/2011	13:58	9/16/2011	9:18	28.67	-	468394	6261494	0	-	0.00
UL 2	4	9/15/2011	14:01	9/16/2011	9:20	28.68	-	468400	6261736	0	-	0.00
UL 2	5	9/15/2011	14:06	9/16/2011	9:23	28.72	-	468506	6261589	0	-	0.00

UL = Unnamed Lake

Appendix 7.3-3a. Minnow Trapping Effort and Catch, Brucejack Gold Mine Project, 2010 to 2012

Lake	Set	Date In	Time In	Date Out	Time Out	Soak Time (h)	Depth	UTM Easting	UTM Northing	Catch	Species	CPUE
UL 2	6	9/15/2011	14:09	9/16/2011	9:25	28.73	-	468553	6261642	0	-	0.00
UL 2	7	9/15/2011	14:30	9/16/2011	9:27	29.05	-	468615	6261622	0	-	0.00
UL 2	8	9/15/2011	14:34	9/16/2011	9:31	29.05	-	468690	6261475	0	-	0.00
UL1	1	28/08/12	9:55	29/08/12	8:20	22.42	1.00	467825	6260560	0	-	0.00
UL1	2	28/08/12	10:00	29/08/12	8:22	22.37	0.60	467857	6260539	0	-	0.00
UL1	3	28/08/12	10:04	29/08/12	8:23	22.32	1.00	467990	6260416	0	-	0.00
UL1	4	28/08/12	10:06	29/08/12	8:24	22.30	1.00	468010	6260400	0	-	0.00
UL1	5	28/08/12	10:09	29/08/12	8:26	22.28	0.50	468168	6260120	0	-	0.00
UL1	6	28/08/12	10:10	29/08/12	8:29	22.32	1.00	468165	6260116	0	-	0.00
UL1	7	28/08/12	10:13	29/08/12	8:30	22.28	2.00	468038	6260096	0	-	0.00
UL1	8	28/08/12	10:15	29/08/12	8:36	22.35	1.50	468042	6260082	0	-	0.00
UL1	9	28/08/12	10:17	29/08/12	8:38	22.35	1.00	467882	6260178	0	-	0.00
UL1	10	28/08/12	10:19	29/08/12	8:39	22.33	1.50	467865	6260164	0	-	0.00
UL1	11	28/08/12	10:22	29/08/12	8:42	22.33	1.50	467724	6260235	0	-	0.00
UL1	12	28/08/12	10:23	29/08/12	8:43	22.33	1.00	467703	6260252	0	-	0.00
UL1	13	28/08/12	10:27	29/08/12	8:45	22.30	1.00	467658	6260386	0	-	0.00
UL2	1	29/08/12	10:19	30/18/12	8:30	22.18	1.00	468429	6261388	0	-	0.00
UL2	2	29/08/12	10:20	30/08/12	8:33	22.22	2.00	468425	6261417	0	-	0.00
UL2	3	29/08/12	10:27	30/08/12	8:35	22.13	1.00	468358	6261728	0	-	0.00
UL2	4	29/08/12	10:28	30/08/12	8:40	22.20	1.00	468398	6261733	0	-	0.00
UL2	5	29/08/12	10:31	30/08/12	8:17	21.77	1.50	468713	6261520	0	-	0.00
UL2	6	29/08/12	10:32	30/08/12	8:19	21.78	1.50	468715	6261491	0	-	0.00
UL2	7	29/08/12	10:38	30/08/12	8:20	21.70	1.20	468822	6261247	0	-	0.00
UL2	8	29/08/12	10:41	30/08/12	8:23	21.70	1.00	468794	6261218	0	-	0.00
UL2	9	29/08/12	10:46	30/08/12	8:24	21.63	2.50	468580	6261295	0	-	0.00
UL2	10	29/08/12	10:48	30/08/12	8:27	21.65	1.00	468547	6261299	0	-	0.00
UL2	11	29/08/12	10:57	30/08/12	8:10	21.22	1.50	468766	6261830	0	-	0.00
UL2	12	29/08/12	10:59	30/08/12	8:12	21.22	1.80	468826	6261879	0	-	0.00
UL2	13	29/08/12	11:00	30/08/12	8:15	21.25	0.90	468834	6261919	0	-	0.00
UL4	1	30/08/12	10:32	31/08/12	7:30	20.97	1.20	469363	6258214	0	-	0.00
UL4	2	30/08/12	-	-	-	-	0.50	469338	6258235	-	-	-
UL4	3	30/08/12	10:38	31/08/12	7:40	21.03	0.30	439206	6258205	0	-	0.00
UL4	4	30/08/12	10:40	31/08/12	7:42	21.03	1.00	469194	6258202	0	-	0.00
UL4	5	30/08/12	10:44	31/08/12	7:44	21.00	0.40	469370	6258113	0	-	0.00
UL4	6	30/08/12	10:50	31/08/12	7:46	20.93	0.40	469364	6258070	0	-	0.00
UL4	7	30/08/12	10:52	31/08/12	7:48	20.93	0.60	469355	6258000	0	-	0.00
UL4	8	30/08/12	10:54	31/08/12	7:50	20.93	0.90	469369	6257985	0	-	0.00
UL4	9	30/08/12	10:57	31/08/12	7:52	20.92	1.00	469548	6257976	0	-	0.00
UL4	10	30/08/12	10:59	31/08/12	7:54	20.92	1.30	469545	6258008	0	-	0.00
UL4	11	30/08/12	11:09	31/08/12	7:56	20.78	0.90	469464	6258108	0	-	0.00
UL4	12	30/08/12	11:11	31/08/12	7:58	20.78	0.50	469478	6258207	0	-	0.00
UL4	13	30/08/12	11:13	31/08/12	8:00	20.78	0.3	469426	6258200	0	-	0.00

UL = Unnamed Lake

Appendix 7.3-3b. Gillnetting Effort and Catch, Brucejack Gold Mine Project, 2010 to 2012

								Net Dimensions							Number of Fish				
Lake	Easting	Northing	Set	Date	Time In	Time Out	Soak Time/100m^2	Type	Length (m)	Depth (m)	Set Depth (m)	Mesh Size	Setting	Habitat	DV/BT	RB	MW	CO	CH
UL 3	443730	6252204	1	8/28/2010	14:10	14:40	0.45	Sinking	90	1.83	7.7	ST	BT	PL	13	0	0	0	0
UL 3	444341	6252029	2	8/28/2010	15:40	16:30	0.75	Sinking	90	1.83	11.2	ST	BT	PL	24	0	0	0	0
UL 3	444487	6251979	3	8/28/2010	09:20	09:50	0.45	Sinking	90	1.83	7.4	ST	BT	PL	2	0	0	0	0
UL 3	444234	6252220	4	8/28/2010	10:05	10:35	0.45	Sinking	90	1.83	8.5	ST	BT	PL	7	0	0	0	0
UL 3	443743	6252143	5	8/28/2010	11:05	11:45	0.60	Sinking	90	1.83	12.6	ST	BT	PL	9	0	0	0	0
UL 3	444368	6251972	6	8/28/2010	12:55	13:40	0.68	Floating	90	1.83	8.5	ST	SU	PL	0	0	0	0	0
UL 3	444216	6252206	7	8/28/2010	13:50	14:45	0.82	Floating	90	1.83	14.5	ST	SU	PL	4	0	0	0	0
UL 3	443618	6252208	8	8/28/2010	15:05	16:45	1.50	Floating	90	1.83	5.5	ST	SU	PL	3	0	0	0	0
Todedada	451748	6259541	1	8/26/2010	10:20	11:00	0.60	Sinking	90	1.83	7.0	ST	BT	PL	1	0	0	0	0
Todedada	451870	6259760	2	8/26/2010	11:10	12:45	1.43	Sinking	90	1.83	12.0	ST	BT	PL	0	0	0	0	0
Todedada	451705	6260071	3	8/26/2010	12:20	13:30	1.05	Sinking	90	1.83	10.0	ST	BT	PL	8	0	0	0	0
Todedada	451628	6259978	4	8/26/2010	13:40	14:35	0.83	Sinking	90	1.83	10.0	ST	BT	PL	14	5	0	0	0
Todedada	451734	6259451	5	8/26/2010	14:00	14:40	0.60	Floating	90	1.83	12.3	ST	BT	PL	0	0	0	0	0
Todedada	451900	6259789	6	8/26/2010	15:05	15:45	0.60	Floating	90	1.83	12.8	ST	BT	PL	0	0	0	0	0
Todedada	451634	6259938	7	8/26/2010	16:05	16:55	0.75	Floating	90	1.83	11.7	ST	BT	PL	0	0	0	0	0
Todedada	451601	6260054	8	8/26/2010	17:05	17:45	0.60	Floating	90	1.83	9.3	ST	BT	PL	2	0	0	0	0
Bowser	455696	6254002	1	8/30/2010	15:15	15:50	0.52	Sinking	90	1.83	11.3	ST	BT	P	0	0	0	0	0
Bowser	455633	6253863	2	8/30/2010	16:00	17:00	0.90	Sinking	90	1.83	8.7	ST	BT	P	0	0	2	0	0
Bowser	455931	6254009	3	8/30/2010	09:55	10:45	0.75	Sinking	90	1.83	14.3	ST	BT	P	0	0	0	0	0
Bowser	455662	6253745	4	8/30/2010	10:07	11:45	1.47	Floating	90	1.83	10.1	ST	SU	P	0	0	0	0	0
Bowser	455907	6253264	5	8/30/2010	11:35	12:45	1.05	Sinking	90	1.83	16.0	ST	BT	P	0	0	0	0	0
Bowser	455665	6253945	6	8/30/2010	11:55	13:30	1.43	Floating	90	1.83	12.0	ST	SU	P	1	0	0	0	0
Bowser	456138	6253988	7	8/30/2010	13:45	15:10	1.28	Floating	90	1.83	12.0	ST	SU	P	2	0	0	0	0
Bowser	456291	6254132	8	8/30/2010	15:30	16:00	0.45	Floating	90	1.83	12.5	ST	SU	P	0	0	0	0	0
Brucejack	427309	6259331	1	13/09/2011	11:00	8:46	21.99	Floating	90	1.83	-	ST	SU	PL	0	0	0	0	0
Brucejack	427209	6258936	2	13/09/2011	11:30	9:05	21.83	Sinking	90	1.83	-	ST	BT	PL	0	0	0	0	0
UL1	468062	6260245	1	14/09/2011	14:55	15:40	0.68	Floating	90	1.83	-	ST	SU	PL	0	0	0	0	0
UL1	467783	6260476	2	14/09/2011	15:05	16:10	0.98	Sinking	90	1.83	-	ST	BT	PL	0	0	0	0	0
UL1	467780	6260293	3	14/09/2011	16:00	10:02	18.63	Floating	90	1.83	-	ST	SU	PL	0	0	0	0	0
UL1	468035	6260144	4	14/09/2011	16:20	9:46	18.09	Sinking	90	1.83	-	ST	BT	PL	0	0	0	0	0
UL2	468398	6261690	1	15/09/2011	13:23	14:22	0.89	Sinking	90	1.83	-	ST	BT	PL	0	0	0	0	0
UL2	468567	6261358	2	15/09/2011	13:37	14:40	0.94	Floating	90	1.83	-	ST	SU	PL	0	0	0	0	0
UL2	468570	6261515	3	15/09/2011	14:34	9:46	19.68	Sinking	90	1.83	-	ST	BT	PL	0	0	0	0	0
UL2	468769	6261317	4	15/09/2011	14:55	10:00	19.58	Floating	90	1.83	-	ST	SU	PL	0	0	0	0	0
UL1	468095	6260062	1	28/08/2012	9:30	4:20	6.15	Sinking	90	1.83	-	ST	BT	PL	0	0	0	0	0
UL1	468032	6260232	2	28/08/2012	9:40	4:30	6.15	Floating	90	1.83	-	ST	SU	PL	0	0	0	0	0
UL2	468726	6261285	1	29/08/2012	10:00	13:45	3.38	Sinking	90	1.83	11.0	ST	BT	PL	0	0	0	0	0
UL2	468556	6261331	2	29/08/2012	10:05	16:00	5.33	Floating	90	1.83	1.0	ST	SU	PL	0	0	0	0	0

ST = standard gang of 1.27, 2.54, 3.81, 5.08, 6.35, 7.62, and 8.89 cm mesh size nets
BT = lake bottom
SU = lake surface
RB = rainbow trout
MW = mountain whitefish
CO = coho salmon
CH = chinook salmon
PL = pelagic/littoral
P = pelagic
DV/BT = Dolly Varden/bull trout
SK = sockeye salmon
LSU = longnose sucker
UL = Unnamed Lake

Appendix 7.3-3b. Gillnetting Effort and Catch, Brucejack Gold Mine Project, 2010 to 2012

								Number of Fish			Catch Per Unit Effort							
Lake	Easting	Northing	Set	Date	Time In	Time Out	Soak Time/100m^2	SK	LSU	Total	DV/BT	RB	MW	CO	CH	SK	LSU	Total
UL 3	443730	6252204	1	8/28/2010	14:10	14:40	0.45	0	0	40432	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.24
UL 3	444341	6252029	2	8/28/2010	15:40	16:30	0.75	0	0	40445	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.75
UL 3	444487	6251979	3	8/28/2010	09:20	09:50	0.45	0	0	40423	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.04
UL 3	444234	6252220	4	8/28/2010	10:05	10:35	0.45	0	0	40429	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.13
UL 3	443743	6252143	5	8/28/2010	11:05	11:45	0.60	0	0	40433	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.23
UL 3	444368	6251972	6	8/28/2010	12:55	13:40	0.68	0	0	40425	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
UL 3	444216	6252206	7	8/28/2010	13:50	14:45	0.82	0	0	40430	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.14
UL 3	443618	6252208	8	8/28/2010	15:05	16:45	1.50	0	0	40431	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.19
Todedada	451748	6259541	1	8/26/2010	10:20	11:00	0.60	0	0	40419	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.03
Todedada	451870	6259760	2	8/26/2010	11:10	12:45	1.43	0	0	40419	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Todedada	451705	6260071	3	8/26/2010	12:20	13:30	1.05	0	0	40428	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.35
Todedada	451628	6259978	4	8/26/2010	13:40	14:35	0.83	0	0	40440	0.48	0.17	0.00	0.00	0.00	0.00	0.00	0.65
Todedada	451734	6259451	5	8/26/2010	14:00	14:40	0.60	0	0	40422	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Todedada	451900	6259789	6	8/26/2010	15:05	15:45	0.60	0	0	40423	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Todedada	451634	6259938	7	8/26/2010	16:05	16:55	0.75	0	0	40424	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Todedada	451601	6260054	8	8/26/2010	17:05	17:45	0.60	0	0	40427	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.05
Bowser	455696	6254002	1	8/30/2010	15:15	15:50	0.52	0	1	40423	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02
Bowser	455633	6253863	2	8/30/2010	16:00	17:00	0.90	0	11	40436	0.00	0.00	0.08	0.00	0.00	0.00	0.41	0.49
Bowser	455931	6254009	3	8/30/2010	09:55	10:45	0.75	0	0	40424	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bowser	455662	6253745	4	8/30/2010	10:07	11:45	1.47	0	0	40425	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bowser	455907	6253264	5	8/30/2010	11:35	12:45	1.05	0	2	40428	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.09
Bowser	455665	6253945	6	8/30/2010	11:55	13:30	1.43	4	0	40432	0.06	0.00	0.00	0.00	0.00	0.24	0.00	0.30
Bowser	456138	6253988	7	8/30/2010	13:45	15:10	1.28	2	2	40434	0.11	0.00	0.00	0.00	0.00	0.11	0.11	0.32
Bowser	456291	6254132	8	8/30/2010	15:30	16:00	0.45	1	0	40429	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.02
Brucejack	427309	6259331	1	13/09/2011	11:00	8:46	21.99	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Brucejack	427209	6258936	2	13/09/2011	11:30	9:05	21.83	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
UL1	468062	6260245	1	14/09/2011	14:55	15:40	0.68	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
UL1	467783	6260476	2	14/09/2011	15:05	16:10	0.98	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
UL1	467780	6260293	3	14/09/2011	16:00	10:02	18.63	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
UL1	468035	6260144	4	14/09/2011	16:20	9:46	18.09	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
UL2	468398	6261690	1	15/09/2011	13:23	14:22	0.89	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
UL2	468567	6261358	2	15/09/2011	13:37	14:40	0.94	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
UL2	468570	6261515	3	15/09/2011	14:34	9:46	19.68	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
UL2	468769	6261317	4	15/09/2011	14:55	10:00	19.58	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
UL1	468095	6260062	1	28/08/2012	9:30	4:20	6.15	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
UL1	468032	6260232	2	28/08/2012	9:40	4:30	6.15	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
UL2	468726	6261285	1	29/08/2012	10:00	13:45	3.38	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
UL2	468556	6261331	2	29/08/2012	10:05	16:00	5.33	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ST = standard gang of 1.27, 2.54, 3.81, 5.08, 6.35, 7.62, and 8.89 cm mesh size nets
BT = lake bottom
SU = lake surface
RB = rainbow trout
MW = mountain whitefish
CO = coho salmon
CH = chinook salmon
PL = pelagic/littoral
P = pelagic
DV/BT = Dolly Varden/bull trout
SK = sockeye salmon
LSU = longnose sucker
UL = Unnamed Lake

Appendix 7.3-4

Sockeye Spawning Survey Observations, Brucejack Gold Mine Project, 2010 to 2012

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Appendix 7.3-4a. Sockeye Salmon Spawning Survey Data, Todedada Creek, Brucejack Gold Mine Project, 2010 to 2012

Date:	22-Sep-10	**Survey Start Time:**	13:30
Stream Name:	Todedada Creek	**Survey Start Location:**	9 V 451313 6265374
Turbidity:		**Survey End Time:**	16:30
Weather:		**Survey End Location:**	9 V 451378 6264768

Waypoint/UTM	Species	Adults	Redds	Behaviour	Habitat	Comments
9 V 451353 6265576	SK	14	-	Holding	1-1.2 m deep, gravel and sand (20-40 mm) substrate, open, large channel morphology	Small disturbances in the gravel downstream, but no fish seen
9 V 451363 6264948	SK	1	1	Holding over redd	20-50 mm gravel, coarse sand	Large redd with adult observed 8 m upstream
9 V 451380 6264770	-	-	-	-	-	Impassable (?) beaver dam

Appendix 7.3-4b. Sockeye Salmon Spawning Survey Data, Scott Creek and Bowser Inlets, Brucejack Gold Mine Project, 2010 to 2012

Date:	22-Sep-10 and 23-Sep-10	**Survey Start Time:**	10:30
Stream Name:	Scott Creek/Bowser Lake Inlets	**Survey Start Location:**	9 V 426989 6258428
Turbidity:		**Survey End Time:**	-
Weather:		**Survey End Location:**	At the bridge

Waypoint/UTM	Species	Adults	Redds	Behaviour	Habitat	Comments
9 V 454856 6253152	SK	12	1	Bright red, chasing, fighting, paired	Pool ~2 m deep, 40 m x 10 m, very low water, gravel/sand substrate	Groundwater channel headed by lots of beaver ponds Channels connecting pools DS and US are <10 cm deep
9 V 454671 6253068	SK	4	2	Holding over redds	Very shallow pool (0.4 m), 40 m x 12 m	Very shallow channel connecting to DS pool, possible barrier to large fish?

Notes: *Surveyed Bowser Lake inlets on Sept 22, 2010 before walking up Scott Creek Sept 23, 2010. Survey Start Location and time refers to start of Scott Creek survey. Scott Creek was riffle-pool morphology, moderately turbid, with 4ºC water. There were few sidechannels. Substrate was 85% gravel, 5% fines, and 10 % cobble in the riffles. The larger substrate was moderately embedded but the finer gravel less so. There was fair to good spawning habitat throughout the stream. The upstream end of the stream was mostly cobble with some large gravel and occasional boulders. Low temperature may keep spawning fish out of the mainstem.*

Appendix 7.3-4c. Sockeye Salmon Spawning Survey Data, Bowser Lake Shoreline, Brucejack Gold Mine Project, 2010 to 2012

Date:	23-Sep-10	**Survey Start Time:**	10:30
Stream Name:	Bowser Lake shoreline	**Survey Start Location:**	9 V 426989 6258428
Turbidity:		**Survey End Time:**	-
Weather:		**Survey End Location:**	At the bridge

Waypoint/UTM	Species	Adults	Redds	Behaviour	Habitat	Comments
9 V 455579 6253053	-	-	-	-	Fine gravel and sand with thin layer of fines overtop	Possible test digs (20cm x 40 cm)

Notes: *Walked along the shoreline of Bowser Lake and up inlets, including the Scott Creek outflow. Water temperature was 6ºC. Shoreline is 80% small gravel (10-30 mm) and 20% fines. Scott Creek outflow substrate was fine gravel and sand with a thin layer of fines over top.*

Appendix 7.3-5

Coho Spawning Survey Locations, Brucejack Gold Mine Project, 2010 to 2012

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Appendix 7.3-5a. Coho Salmon Spawning Survey Data, Todedada Creek, Brucejack Gold Mine Project, 2010 to 2012

Date:	19-Oct-10	**Survey Start Time:**	13:30
Stream Name:	Todedada (mainstem)	**Survey Start Location:**	9 V 451053 6263185
Turbidity:	Moderate	**Survey End Time:**	15:45
Weather:	Snow	**Survey End Location:**	-

Waypoint	Species	Adults	Redds	Behaviour	Habitat	Comments
9 V 451053 6263185	CO	3	1	Holding on redd	Run with OV, loose gravel 20-60 cm	-
9 V 451050 6263215	CO	1	2	Holding?	Run with OV, large gravel/sand	Redds in tail of pool
9 V 451159 6263083	CO	1	0	Dead	Overland sidechannel	
9 V 451244 6263080	-	0	0	-	Gravel glide	4 test digs
9 V 451228 6263204	CO	1	0	Migrating	Shallow riffle	Just downstream of deep pool with overhead cover

Notes: *Walked from corner where stream meets hill slope up along the channel until it changed to become sandy-bottom and ran overland through willow thickets (waypoints 277-280), then crossed to mainstem and walked the braids on the gravel floodplain. The gravel was more compacted along this stretch with very few deep pools or cover. Waypoint 281 was taken in this section immediately downstream of a deeper pool with small amounts of overhead cover.*

Appendix 7.3-5b. Coho Salmon Spawning Survey Data, Scott Creek, Brucejack Gold Mine Project, 2010 to 2012

Date:	19-Oct-10	**Survey Start Time:**	8:30
Stream Name:	Scott Creek/Bowser Lake inlets	**Survey Start Location:**	Bridge
Turbidity:	Clear	**Survey End Time:**	16:00
Weather:	Cloudy	**Survey End Location:**	Bowser Lake

Waypoint/UTM	Species	Adults	Redds	Behaviour	Habitat	Comments
9 V 455092 6253191	CO	1	0	Digging	1 m deep pool, sandy/cobble	
9 V 454854 6253157	SK	11	6 to 8	Holding over redds	Pool, cobble substrate	Same as last time, 2-3 dead
9 V 454669 6253066	SK	9	5	Holding over redds	Pool, cobble substrate	Same as last time, plus 5 more, no dead
9 V 454960 6253159	-	0	1	-	10-20 cm gravel glide	
None, inlet to Bowser Lak	SK	3	0	Holding	Patch of gravel	
9 V 455671 6252838	SK	1	0	Holding	Scour pool in sidechannel, very slow, under woody debris	
9 V 455658 6252807	-	0	1	-	Shallow pool, loose gravel	Fish carcass with eggs, may not have spawned

Notes: *Walked along Scott Creek from the bridge to Bowser Lake, following all tributaries and sidechannels up to the end of channel or to beaver dams. Once at the lake, we walked up and down all inlets to Bowser on the Scott Creek side. Sockeye were found in the 2 pools they were found in during sockeye spawning survey, plus another along the lakeshore in the clear Scott Creek water and remains along the shore suggest additional shore spawning.*

Appendix 7.3-5c. Coho Salmon Spawning Survey Data, Scott Creek, Brucejack Gold Mine Project, 2010 to 2012

Date:	20-Oct-10	**Survey Start Time:**	10:45
Stream Name:	Bowser River tributaries	**Survey Start Location:**	-
Turbidity:	Light	**Survey End Time:**	12:00
Weather:	Rain	**Survey End Location:**	-

Waypoint	Species	Adults	Redds	Behaviour	Habitat	Comments
9 V 443572 6250876	SK	15	-	Holding on redds, some digging	Tailout of large, deep pool with loose gravel	Paired up, fairly active. May be more in deeper parts of pool

Notes: *A deep pool immediately downswtream of a beaver dam against the hillslope. Many fish were holding in the pool and the tailout over a number of redds. No fish seen upstream of the area to the beaver dam and helicopter surveys in the beaver pond and below found nothing.*

Appendix 7.3-5d. Coho Salmon Spawning Survey Data, Todedada Creek, Brucejack Gold Mine Project, 2010 to 2012

Date:	20-Oct-10	**Survey Start Time:**	15:00
Stream Name:	Todedada Creek (East branch)	**Survey Start Location:**	9 V 451354 6264922
Turbidity:	Light/moderate	**Survey End Time:**	16:00
Weather:	Snowing	**Survey End Location:**	-

Waypoint	Species	Adults	Redds	Behaviour	Habitat	Comments
9 V 451354 6264922	CO	17	4 or 5	Holding in pairs	Deep pool	
9 V 451370 6264950	CO	1	0	Holding	Run under overhead cover	
9 V 451359 6264966	-	0	4			
9 V 451373 6264791	CO	2	5	Holding	pool and run D/S of beaver dam	

Notes: *Walked from corner with deep pool (Waypoint 282) downstream below where stream turns to a slow, muddly slough, then returned upstream to the beaver dam at 285. Visibility was low due to weather, but we were able to identify redds and fish.*

Appendix 7.3-5e. Coho Salmon Spawning Survey Data, Todedada Creek, Brucejack Gold Mine Project, 2010 to 2012

Date:	21-Oct-10	**Survey Start Time:**	9:30
Stream Name:	Todedada Creek (East branch)	**Survey Start Location:**	-
Turbidity:	-	**Survey End Time:**	14:30
Weather:	-	**Survey End Location:**	9 V 453001 6262459

Waypoint	Species	Adults	Redds	Behaviour	Habitat	Comments
9 V 451315 6263660	CO	4	5	Holding on redd	Riffle below confluence of two streams, gravel	
9 V 451344 6263632	CO	1	2	Holding on redd	Riffle, shallow, gravel/sand	
9 V 451372 6263625	CO	2	2	Holding on redd	Glide with OV, gravel/cobble	
9 V 451401 6263666	CO	6	2	Holding on redd	Glide with OV, gravel	
9 V 451348 6263630	-	0	1?	-	Shallow riffle	Possible redd
9 V 451466 6263572	CO	2	0	-	Glide, gravel/cobble	
9 V 451558 6263459	-	0	1	-	Glide, compact gravel	Redd or test dig
9 V 451558 6263459	CO	3	2	Holding, paired	Deepish glide, gravel	
9 V 451601 6263387	-	0	1	-	Glide, OV, cobble	
9 V 451702 6263371	-	0	1	-	Shallow riffle, gravel	
9 V 451730 6263395	CO	4	3	-	Riffle/run, loose gravel	
9 V 451969 6263322	CO	-	2	Holding	Deep pool, woody debris, gravel/sand	1 redd in sand
-	-	-	1	-	Run with OV, WD, gravel/cobble	
-	CO	1	2	Holding on redd	Run, gravel	
-	CO	1	2	Holding on redd	Riffle, gravel	
9 V 451969 6263322	CO	3	0	Holding	Riffle, gravel	
9 V 451978 6263324	CO	4	2	Holding	Riffle, gravel	
-	-	6	2	Holding	Riffle, gravel/cobble	
9 V 451993 6263327	CO	0	1	-	Riffle, gravel/cobble	
9 V 452009 6263332	CO	1	2	Holding on redd	Shallow (30 cm) riffle, gravel/cobble	
9 V 452018 6263329	CO	3	5	Holding	Shallow (30 cm) riffle, gravel/cobble	
9 V 452034 6263329	CO	3	3	Holding	Run, 30 cm depth, large boulder	
9 V 452054 6263336	CO	1	0	Holding	Scour pool, OV	
9 V 452111 6263325	CO	4	1	Holding on redd	Shallow riffle, gravel/cobble	
9 V 452123 6263327	CO	7	5	Holding on redd	Shallow glide, gravel	
	CO	6	5	Holding on redd	Tail out of pool, OV, gravel	
9 V 452156 6263344	CO	5	4	Holding	Pool of old beaver dam, gravel OV	
9 V 453013 6262681	CO	2	2	-	Riffle/run below pool, gravel	

Appendix 7.3-5e. Coho Salmon Spawning Survey Data, Todedada Creek, Brucejack Gold Mine Project, 2010 to 2012

Date:	21-Oct-10	**Survey Start Time:**	9:30
Stream Name:	Todedada Creek (East branch)	**Survey Start Location:**	-
Turbidity:	-	**Survey End Time:**	14:30
Weather:	-	**Survey End Location:**	9 V 453001 6262459

Waypoint	Species	Adults	Redds	Behaviour	Habitat	Comments
9 V 453017 6262656	CO	2	1	Holding on redd	Riffle with shallow, angular, moderately compacted gravel	
9 V 453028 6262639	CO	7	4	Holding on redd	Glide, shallow, angular, compact gravel and small cobble	
9 V 453038 6262607	CO	1	1	Holding on redd	Glide, shallow, angular, compact gravel and small cobble	
9 V 453036 6262599	-	0	1	Holding on redd	Glide, shallow, angular, compact gravel and small cobble	

Notes: *Walked along Scott Creek from the bridge to Bowser Lake, following all tributaries and sidechannels up to the end of channel or to beaver dams. Once at the lake, we walked up and down all inlets to Bowser on the Scott Creek side. Sockeye were found* in the 2 pools they were found in during sockeye spawning survey, plus another along the lakeshore in the clear Scott Creek water and remains along the shore suggest additional shore spawning.

Appendix 7.3-5f. Coho Salmon Spawning Survey Data, Scott Creek and Bowser Lake Inlets, Brucejack Gold Mine Project, 2010 to 2012

Date:	22-Oct-10	**Survey Start Time:**	8:30
Stream Name:	Scott Creek/Bowser Lake inlets	**Survey Start Location:**	-
Turbidity:	Clear	**Survey End Time:**	9:30
Weather:	Cloudy	**Survey End Location:**	-

Waypoint/UTM	Species	Adults	Redds	Behaviour	Habitat	Comments
9 V 455092 6253191	-	-	-	-	-	CO found in this spot in previous survey, but not there now
9 V 454960 6253159	-	-	1	-	-	Found previously
9 V 454898 6253174	-	-	1	-	-	New redd
9 V 454854 6253157	SK	11	-	Holding on redds	-	Same SK as last survey
9 V 454669 6253066	SK	9	-	Holding on redds	-	Same SK as last survey
9 V 453496 6252577	SK	1	1	-	Shallow run, gravel	Possible redd, new

Notes: *We did spot surveys of areas where fish were observed in earlier surveys to look for incoming coho spawners. The sockeye observed last survey were still in the same places, but the coho observed last time had disappeared and two new redds were found*

Appendix 7.4-1

Biological Characteristics of Fish, Brucejack Gold Mine Project, 2010 to 2012

Engineers and Scientists

Appendix 7.4-1a. Biological Characteristics of Fish Captured in Streams, Brucejack Gold Mine Project, 2010 to 2012

Site	Watershed	Year	Identified Species	Genetic Species	Length (mm)	Weight (g)	Condition (g/mm^3)	Age (yr)	Sex	Sexual Maturity	Aging Structure	Age Sample #	Genetic Sample #
100	Bowser	2010	DV/BT	BT	75	-	-	1	U	U	FR	3	4
100	Bowser	2010	DV/BT	BT	112	-	-	1	U	U	FR	1	2
100	Bowser	2010	DV/BT	DV	62	-	-	-	U	U	FR	5	6
100	Bowser	2010	DV/BT	-	68	-	-	-	U	U	FR	13	14
100	Bowser	2010	DV/BT	-	89	-	-	-	U	U	FR	7	8
100	Bowser	2010	DV/BT	-	115	-	-	-	U	U	FR	11	12
100	Bowser	2010	MW	-	178	-	-	-	U	U	-	-	-
100	Bowser	2010	SK	-	79	-	-	1	U	U	SC	9	10
101	Bowser	2010	SK	-	100	-	-	1	U	U	SC	15	16
102	Bowser	2010	DV/BT	BT	78	5.3	1.12	0	U	U	FR	17	18
102	Bowser	2010	DV/BT	-	117	11.9	0.74	1	U	U	FR	21	22
102	Bowser	2010	DV/BT	-	117	15.8	0.99	1	U	U	FR	19	20
102	Bowser	2010	DV/BT	-	77	5	1.10	-	U	U	FR	23	24
102	Bowser	2010	MW	-	93	8.5	1.06	-	U	U	-	-	-
102	Bowser	2010	MW	-	207	115	1.30	-	U	U	-	-	-
103	Scott	2010	DV/BT	BT	101	14.9	1.45	0	U	U	FR	1	2
103	Scott	2010	DV/BT	-	66	3.3	1.15	-	U	U	FR	5	-
103	Scott	2010	DV/BT	BT	117	19.5	1.22	-	U	U	FR	3	4
103	Scott	2010	MW	-	176	74.5	1.37	-	U	U	-	-	-
103	Scott	2010	MW	-	185	77.4	1.22	-	U	U	-	-	-
107	Todedada	2010	DV/BT	-	50	1.7	1.36	-	U	U	FR	8	-
107	Todedada	2010	DV/BT	DV	57	1.6	0.86	-	U	U	FR	3	4
107	Todedada	2010	DV/BT	-	60	2.5	1.16	-	U	U	FR	9	-
107	Todedada	2010	DV/BT	-	62	2.8	1.17	-	U	U	FR	7	-
107	Todedada	2010	DV/BT	DV	64	3.5	1.34	-	U	U	FR	1	2
107	Todedada	2010	DV/BT	-	88	8	1.17	-	U	U	FR	6	-
107	Todedada	2010	RB	-	117	20.4	1.27	0	U	U	SC	5	-
108	Todedada	2010	DV/BT	DV	57	2.3	1.24	-	U	U	FR	12	13
108	Todedada	2010	DV/BT	-	60	2.5	1.16	-	U	U	FR	17	-
108	Todedada	2010	DV/BT	-	62	2.7	1.13	-	U	U	FR	18	-
108	Todedada	2010	DV/BT	DV	82	7	1.27	-	U	U	FR	10	11
108	Todedada	2010	DV/BT	-	102	12.3	1.16	-	U	U	FR	15	-
108	Todedada	2010	DV/BT	-	108	13	1.03	-	U	U	FR	16	-
108	Todedada	2010	DV/BT	-	109	14.7	1.14	-	U	U	FR	14	-
109	Todedada	2010	DV/BT	-	50	1.7	1.36	-	U	U	FR	8	-
109	Todedada	2010	DV/BT	-	57	1.6	0.86	-	U	U	FR	3	4
109	Todedada	2010	DV/BT	-	60	2.5	1.16	-	U	U	FR	9	-
109	Todedada	2010	DV/BT	-	62	2.8	1.17	-	U	U	FR	7	-
109	Todedada	2010	DV/BT	DV	64	3.5	1.34	-	U	U	FR	1	2
109	Todedada	2010	DV/BT	-	88	8	1.17	-	U	U	FR	6	-
109	Todedada	2010	RB	-	117	20.3	1.27	-	U	U	SC	5	-
110	Todedada	2010	DV/BT	-	59	1.8	0.88	-	U	U	FR	11	-
110	Todedada	2010	DV/BT	BT	110	14.3	1.07	-	U	U	FR	2	3
110	Todedada	2010	DV/BT	-	121	21.7	1.22	-	U	U	FR	8	-
110	Todedada	2010	DV/BT	-	130	25.6	1.17	-	U	U	FR	7	-
110	Todedada	2010	DV/BT	-	143	32.3	1.10	-	U	U	FR	10	-
110	Todedada	2010	DV/BT	-	143	33.9	1.16	-	U	U	FR	12	-
110	Todedada	2010	DV/BT	-	150	35	1.04	-	U	U	FR	9	-
110	Todedada	2010	DV/BT	DV	170	50.2	1.02	-	U	U	FR	4	5
110	Todedada	2010	RB	-	112	14.3	1.02	-	U	U	SC	6	-
110	Todedada	2010	RB	-	127	24.3	1.19	-	U	U	SC	1	-

Species: BT = bull trout, CH = chinook salmon, CO = coho salmon, DV = Dolly Varden, DV/BT = Dolly Varden/bull trout, MW = mountain whitefish, RB = rainbow trout

IMM = immature, M = male, MT = mature, U = unknown,

FR = fin ray, SC = scale

Dashes (-) indicate that data was not collected

Appendix 7.4-1a. Biological Characteristics of Fish Captured in Streams, Brucejack Gold Mine Project, 2010 to 2012

Site	Watershed	Year	Identified Species	Genetic Species	Length (mm)	Weight (g)	Condition (g/mm^3)	Age (yr)	Sex	Sexual Maturity	Aging Structure	Age Sample #	Genetic Sample #
111	Todd	2010	DV/BT	-	130	25.8	1.17	0	U	U	FR	18	19
111	Todd	2010	DV/BT	BT	200	92.7	1.16	1	U	U	FR	15	16
111	Todd	2010	DV/BT	BT	160	50.7	1.24	2	U	U	FR	13	14
111	Todd	2010	DV/BT	-	142	41.1	1.44	-	U	U	FR	21	-
111	Todd	2010	DV/BT	-	154	43.5	1.19	-	U	U	FR	17	-
111	Todd	2010	DV/BT	-	175	60.1	1.12	-	U	U	FR	20	-
111	Todd	2010	MW	-	162	52.8	1.24	-	U	U	-	-	-
111	Todd	2010	MW	-	174	61	1.16	-	U	U	-	-	-
111	Todd	2010	MW	-	247	-	-	-	U	U	-	-	-
111	Todd	2010	MW	-	267	-	-	-	U	U	-	-	-
113	Unuk	2010	CH	-	53	1.8	1.21	0	U	IM	SC	15	16
113	Unuk	2010	CH	-	56	2.1	1.20	0	U	IM	SC	12	13
113	Unuk	2010	CO	-	68	4.3	1.37	1	U	IM	SC	8	-
113	Unuk	2010	CO	-	71	4.1	1.15	1	U	IM	SC	1	-
113	Unuk	2010	CO	-	31	0.5	1.68	-	U	IM	-	-	-
113	Unuk	2010	CO	-	32	0.4	1.22	-	U	IM	-	-	-
113	Unuk	2010	CO	-	32	0.5	1.53	-	U	IM	-	-	-
113	Unuk	2010	CO	-	52	1.6	1.14	-	U	IM	-	-	-
113	Unuk	2010	DV/BT	-	92	10.6	1.36	1	U	IM	FR	4	5
113	Unuk	2010	DV/BT	-	119	18.9	1.12	1	U	IM	FR	6	7
113	Unuk	2010	DV/BT	-	66	2.7	0.94	-	U	IM	FR	14	-
113	Unuk	2010	DV/BT	-	73	3.8	0.98	-	U	IM	FR	9	-
113	Unuk	2010	DV/BT	-	81	5	0.94	-	U	IM	FR	11	-
113	Unuk	2010	DV/BT	-	82	7.4	1.34	-	U	IM	FR	10	-
113	Unuk	2010	DV/BT	DV	94	11	1.32	-	U	IM	FR	2	3
201	Bowser	2010	MW	-	125	17.6	0.90	-	U	U	-	-	-
201	Bowser	2010	MW	-	164	22.1	0.50	-	U	U	-	-	-
201	Bowser	2010	MW	-	190	20.7	0.30	-	U	U	-	-	-
201	Bowser	2010	RB	-	134	21	0.87	-	U	U	-	-	-
202	Bowser	2010	DV/BT		82	5.3	0.96	1	U	U	FR	11	12
202	Bowser	2010	DV/BT	-	34	-	-	-	U	U	-	-	-
202	Bowser	2010	DV/BT	-	36	-	-	-	U	U	-	-	-
202	Bowser	2010	DV/BT	-	46	-	-	-	U	U	-	-	-
202	Bowser	2010	DV/BT	-	50	-	-	-	U	U	-	-	-
202	Bowser	2010	DV/BT	-	55	-	-	-	U	U	-	-	-
202	Bowser	2010	DV/BT	DV	75	-	-	-	U	U	FR	13	14
202	Bowser	2010	DV/BT	-	78	-	-	-	U	U	-	-	-
202	Bowser	2010	DV/BT	-	80	-	-	-	U	U	FR	9	10
202	Bowser	2010	DV/BT	-	90	6	0.82	-	U	U	-	-	-
202	Bowser	2010	MW	-	92	-	-	-	U	U	-	-	-
202	Bowser	2010	MW	-	105	13.3	1.15	-	U	U	-	-	-
202	Bowser	2010	MW	-	115	13.7	0.90	-	U	U	-	-	-
205	Todedada	2010	DV/BT	-	73	3.3	0.85	1	U	U	FR	13	-
205	Todedada	2010	DV/BT	-	70	3.2	0.93	-	U	U	-	-	-
205	Todedada	2010	DV/BT	-	70	3.2	0.93	-	U	U	-	-	-
205	Todedada	2010	DV/BT	-	73	3.4	0.87	-	U	U	-	-	-
205	Todedada	2010	DV/BT	-	115	14	0.92	-	U	U	FR	9	-
205	Todedada	2010	DV/BT	BT	125	23.5	1.20	-	U	U	FR	7	BT
205	Todedada	2010	DV/BT	-	142	33.2	1.16	-	U	U	FR	11	-
205	Todedada	2010	DV/BT	-	147	27.8	0.88	-	U	U	-	-	-
206	Todedada	2010	DV/BT	BT	66	3.1	1.08	0	U	U	FR	2	2

Species: BT = bull trout, CH = chinook salmon, CO = coho salmon, DV = Dolly Varden, DV/BT = Dolly Varden/bull trout, MW = mountain whitefish, RB = rainbow trout

IMM = immature, M = male, MT = mature, U = unknown,

FR = fin ray, SC = scale

Dashes (-) indicate that data was not collected

Appendix 7.4-1a. Biological Characteristics of Fish Captured in Streams, Brucejack Gold Mine Project, 2010 to 2012

Site	Watershed	Year	Identified Species	Genetic Species	Length (mm)	Weight (g)	Condition (g/mm^3)	Age (yr)	Sex	Sexual Maturity	Aging Structure	Age Sample #	Genetic Sample #
206	Todedada	2010	DV/BT	-	110	11.7	0.88	1	U	U	FR	1	-
206	Todedada	2010	DV/BT	-	36	0.3	0.64	-	U	U	-	-	-
206	Todedada	2010	DV/BT	-	43	0.9	1.13	-	U	U	-	-	-
206	Todedada	2010	DV/BT	-	53	1.7	1.14	-	U	U	-	-	-
206	Todedada	2010	MW	-	151	37.2	1.08	-	U	U	-	-	-
207	Todd	2010	MW	-	22	-	-	-	U	U	-	-	-
207	Todd	2010	MW	-	29	-	-	-	U	U	-	-	-
209	Scott	2010	DV/BT	-	112	11.2	0.80	1	U	U	FR	5	6
209	Scott	2010	DV/BT	BT	126	8.9	0.44	1	U	U	FR	3	4
209	Scott	2010	DV/BT	-	45	-	-	-	U	U	-	-	-
209	Scott	2010	DV/BT	-	51	1.1	0.83	-	U	U	FR	1	2
209	Scott	2010	DV/BT	-	54	1.5	0.95	-	U	U	-	-	-
212	Unuk	2010	CO	-	45	1.1	1.21	-	U	U	-	-	-
212	Unuk	2010	CO	-	47	1.2	1.16	-	U	U	-	-	-
212	Unuk	2010	CO	-	48	1.2	1.09	-	U	U	-	-	-
212	Unuk	2010	CO	-	49	1.1	0.93	-	U	U	-	-	-
212	Unuk	2010	CO	-	49	1.1	0.93	-	U	U	-	-	-
212	Unuk	2010	CO	-	51	1.2	0.90	-	U	U	-	-	-
212	Unuk	2010	CO	-	58	2	1.03	-	U	U	-	-	-
212	Unuk	2010	CO	-	62	2.4	1.01	-	U	U	-	-	-
212	Unuk	2010	DV/BT	DV	81	4.7	0.88	0	U	U	FR	1	2
212	Unuk	2010	DV/BT	DV	106	12.2	1.02	0	U	U	FR	3	4
212	Unuk	2010	DV/BT	-	36	0.3	0.64	-	U	U	-	-	-
212	Unuk	2010	DV/BT	-	43	0.7	0.88	-	U	U	-	-	-
213	Unuk	2010	CO	-	54	2.2	1.40	-	U	U	-	-	-
213	Unuk	2010	DV/BT	-	83	6.3	1.10	1	U	U	FR	7	-
213	Unuk	2010	DV/BT	-	136	23	0.91	1	U	U	FR	6	-
213	Unuk	2010	DV/BT	-	39	0.3	0.51	-	U	U	-	-	-
213	Unuk	2010	DV/BT	-	46	-	-	-	U	U	-	-	-
213	Unuk	2010	DV/BT	-	47	-	-	-	U	U	FR	5	-
213	Unuk	2010	DV/BT	-	49	-	-	-	U	U	-	-	-
213	Unuk	2010	DV/BT	-	77	4.1	0.90	-	U	U	-	-	-
213	Unuk	2010	DV/BT	-	83	5.1	0.89	-	U	U	-	-	-
213	Unuk	2010	DV/BT	-	90	7.2	0.99	-	U	U	FR	8	-
500	Bowser	2010	DV/BT	-	23	-	-	-	U	IM	-	-	-
500	Bowser	2010	DV/BT	-	24	-	-	-	U	IM	-	-	-
500	Bowser	2010	DV/BT	-	29	-	-	-	U	IM	-	-	-
501	Bowser	2010	CO	-	31	-	-	-	U	U	-	-	-
501	Bowser	2010	CO	-	35	-	-	-	U	U	-	-	-
501	Bowser	2010	CO	-	38	-	-	-	U	U	-	-	-
501	Bowser	2010	CO	-	44	-	-	-	U	U	-	-	-
501	Bowser	2010	DV/BT	-	77	3.9	0.85	1	U	U	FR	6	7
501	Bowser	2010	DV/BT	DV	114	14.3	0.97	1	U	U	FR	3	4
501	Bowser	2010	DV/BT	-	35	-	-	-	U	U	-	-	-
501	Bowser	2010	RB	-	88	7.4	1.09	1	U	U	SC	5	-
501	Bowser	2010	RB	-	112	17.7	1.26	2	U	U	SC	2	-
501	Bowser	2010	RB	-	136	26.9	1.07	2	U	U	SC	1	-
503	Todedada	2010	DV/BT	-	75	6.9	1.64	0	U	U	FR	1	1
504	Todedada	2010	RB	-	88	6.8	1.00	1	U	U	SC	2	-
504	Todedada	2010	RB	-	110	15.6	1.17	1	U	U	SC	1	-
505	Todedada	2010	DV/BT	-	58	2.3	1.18	0	U	IM	FR	1	-

Species: BT = bull trout, CH = chinook salmon, CO = coho salmon, DV = Dolly Varden, DV/BT = Dolly Varden/bull trout, MW = mountain whitefish, RB = rainbow trout

IMM = immature, M = male, MT = mature, U = unknown,

FR = fin ray, SC = scale

Dashes (-) indicate that data was not collected

Appendix 7.4-1a. Biological Characteristics of Fish Captured in Streams, Brucejack Gold Mine Project, 2010 to 2012

Site	Watershed	Year	Identified Species	Genetic Species	Length (mm)	Weight (g)	Condition (g/mm^3)	Age (yr)	Sex	Sexual Maturity	Aging Structure	Age Sample #	Genetic Sample #
514	Unuk	2010	DV/BT	-	81	9.8	1.84	0	U	U	FR	3	3
514	Unuk	2010	DV/BT	-	100	12.4	1.24	2	U	U	FR	1	1
514	Unuk	2010	DV/BT	-	58	3.9	2.00	-	U	U	-	-	-
514	Unuk	2010	DV/BT	-	59	3.5	1.70	-	U	U	-	-	-
514	Unuk	2010	DV/BT	-	60	3.8	1.76	-	U	U	-	-	-
514	Unuk	2010	DV/BT	-	65	4.1	1.49	-	U	U	-	-	-
514	Unuk	2010	DV/BT	-	69	2.3	0.70	-	U	U	-	-	-
514	Unuk	2010	DV/BT	-	70	4.2	1.22	-	U	U	FR	5	-
514	Unuk	2010	DV/BT	-	70	4.7	1.37	-	U	U	-	-	-
514	Unuk	2010	DV/BT	-	76	5.2	1.18	-	U	U	-	-	-
514	Unuk	2010	DV/BT	-	80	6.9	1.35	-	U	U	-	-	-
514	Unuk	2010	DV/BT	-	84	7.2	1.21	-	U	U	-	-	-
514	Unuk	2010	DV/BT	-	86	9.8	1.54	-	U	U	FR	2	2
514	Unuk	2010	DV/BT	-	87	7.3	1.11	-	U	U	-	-	-
514	Unuk	2010	DV/BT	-	89	9.3	1.32	-	U	U	-	-	-
514	Unuk	2010	DV/BT	-	91	12.5	1.66	-	U	U	FR	4	-
514	Unuk	2010	DV/BT	-	92	10.2	1.31	-	U	U	-	-	-
514	Unuk	2010	DV/BT	-	124	21.6	1.13	-	U	U	-	-	-
514	Unuk	2010	RB	-	230	-	-	-	U	U	-	-	-
MC1	Bell Irving	2011	CH	-	67	4.5	1.50	0	U	IM	FR	3	-
MC1	Bell Irving	2011	DV/BT	-	40	0.7	1.09	0	U	IM	FR	1	-
MC1	Bell Irving	2011	RB	-	39	0.8	1.35	0	U	IM	-	-	-
MC1	Bell Irving	2011	RB	-	108	19.3	1.53	2	U	IM	FR	2	-
MC1	Bell Irving	2011	RB	-	45	1	1.10	0	U	IM	-	-	-
MC1	Bell Irving	2011	RB	-	44	0.9	1.06	0	U	IM	-	-	-
MC1	Bell Irving	2011	RB	-	31	0.3	1.01	0	U	IM	-	-	-
MC1	Bell Irving	2011	RB	-	36	0.5	1.07	0	U	IM	-	-	-
MC1	Bell Irving	2011	RB	-	33	0.3	0.83	0	U	IM	-	-	-
MC1	Bell Irving	2011	RB	-	42	0.7	0.94	0	U	IM	-	-	-
MC1	Bell Irving	2011	RB	-	34	0.5	1.27	0	U	IM	-	-	-
SC1	Unuk	2011	DV/BT	-	112	17.6	1.25	2	U	IM	FR	1	-
UR1	Unuk	2011	DV/BT	-	109	13.6	1.05	1	U	IM	FR	1	-
UR1	Unuk	2011	DV/BT	-	125	20.6	1.05	2	U	IM	FR	3	-
UR1	Unuk	2011	DV/BT	-	66	3.6	1.25	1	U	IM	FR	5	-
UR1	Unuk	2011	DV/BT	-	71	3.9	1.09	1	U	IM	FR	6	-
UR1	Unuk	2011	DV/BT	-	70	3.9	1.14	1	U	IM	FR	7	-
UR1	Unuk	2011	DV/BT	-	65	2.7	0.98	1	U	IM	FR	8	-
UR1	Unuk	2011	DV/BT	-	72	3.8	1.02	1	U	IM	FR	9	-
UR1	Unuk	2011	DV/BT	-	58	2.4	1.23	1	U	IM	FR	10	-
UR1	Unuk	2011	DV/BT	-	66	2.7	0.94	1	U	IM	FR	11	-
UR1	Unuk	2011	DV/BT	-	64	2.9	1.11	1	U	IM	FR	12	-
UR1	Unuk	2011	DV/BT	-	106	12.6	1.06	2	U	IM	FR	13	-
UR1	Unuk	2011	DV/BT	-	96	9.6	1.09	2	U	IM	FR	14	-
UR1	Unuk	2011	DV/BT	-	109	14.8	1.14	1	U	IM	FR	15	-
UR1	Unuk	2011	DV/BT	-	84	5.5	0.93	-	U	IM	-	-	-
UR1	Unuk	2011	DV/BT	-	70	4	1.17	-	U	IM	-	-	-
WC1	Wildfire	2010	DV/BT	-	86	6.6	1.04	0	U	U	FR	10	-
WC1	Wildfire	2010	DV/BT	-	102	11.2	1.06	1	U	U	FR	9	-
WC1	Wildfire	2010	DV/BT	-	116	15.6	1.00	1	U	U	FR	5	-
WC1	Wildfire	2010	DV/BT	BT	122	21.8	1.20	2	U	U	FR	1	2
WC1	Wildfire	2010	DV/BT	-	51	1.6	1.21	-	U	U	-	-	-

Species: BT = bull trout, CH = chinook salmon, CO = coho salmon, DV = Dolly Varden, DV/BT = Dolly Varden/bull trout, MW = mountain whitefish, RB = rainbow trout

IMM = immature, M = male, MT = mature, U = unknown,

FR = fin ray, SC = scale

Dashes (-) indicate that data was not collected

Appendix 7.4-1a. Biological Characteristics of Fish Captured in Streams, Brucejack Gold Mine Project, 2010 to 2012

Site	Watershed	Year	Identified Species	Genetic Species	Length (mm)	Weight (g)	Condition (g/mm^3)	Age (yr)	Sex	Sexual Maturity	Aging Structure	Age Sample #	Genetic Sample #
WC1	Wildfire	2010	DV/BT	-	57	1.6	0.86	-	U	U	-	-	-
WC1	Wildfire	2010	DV/BT	BT	105	13.3	1.15	-	U	U	FR	6	7
WC1	Wildfire	2010	DV/BT	-	113	15.9	1.10	-	U	U	-	-	-
WC1	Wildfire	2010	DV/BT	-	117	17.5	1.09	-	U	U	FR	8	-
WC1	Wildfire	2010	RB	-	107	15.8	1.29	1	U	U	SC	3	-
WC1	Wildfire	2010	RB	-	133	26.2	1.11	2	U	U	SC	4	-
WC1	Wildfire	2011	CH	-	73	4.9	1.26	2	U	IM	FR	4	-
WC1	Wildfire	2011	CH	-	67	3.8	1.26	1	U	IM	FR	7	-
WC1	Wildfire	2011	CH	-	69	4.4	1.34	1	U	IM	FR	8	-
WC1	Wildfire	2011	DV/BT	-	97	9.6	1.05	2	U	IM	FR	11	-
WC1	Wildfire	2011	DV/BT	-	84	6.5	1.10	1	U	IM	FR	12	-
WC1	Wildfire	2011	DV/BT	-	73	3.6	0.93	1	U	IM	FR	13	-
WC1	Wildfire	2011	DV/BT	-	69	3.2	0.97	-	U	IM	FR	14	-
WC1	Wildfire	2011	DV/BT	-	136	30.8	1.22	3	M	MT	FR	15	-
WC1	Wildfire	2011	RB	-	112	17.9	1.27	2	U	IM	FR	1	-
WC1	Wildfire	2011	RB	-	68	4	1.27	-	U	IM	FR	2	-
WC1	Wildfire	2011	RB	-	94	9.7	1.17	1	U	IM	FR	3	-
WC1	Wildfire	2011	RB	-	64	3	1.14	0	U	IM	FR	5	-
WC1	Wildfire	2011	RB	-	120	20.3	1.17	1	U	IM	FR	6	-
WC1	Wildfire	2011	RB	-	66	4.2	1.46	-	U	IM	FR	9	-
WC1	Wildfire	2011	RB	-	96	10.4	1.18	0	U	IM	FR	10	-
WC1	Wildfire	2012	DV/BT	-	195	76.8	1.04	-	U	U	-	-	-
WC1	Wildfire	2012	DV/BT	-	77	3.52	0.77	-	U	U	-	-	-
WC1	Wildfire	2012	DV/BT	-	165	39.55	0.88	-	U	U	-	-	-
WC1	Wildfire	2012	DV/BT	-	103	12.14	1.11	-	U	U	-	-	-
WC1	Wildfire	2012	DV/BT	-	134	22.5	0.94	-	U	U	-	-	-
WC1	Wildfire	2012	DV/BT	-	68	3.64	1.16	-	U	U	-	-	-
MC1	Bell Irving	2012	DV/BT	-	88	6.1	0.90	-	U	U	-	-	-
MC1	Bell Irving	2012	DV/BT	-	85	5.76	0.94	-	U	U	-	-	-
MC1	Bell Irving	2012	DV/BT	-	88	6.95	1.02	-	U	U	-	-	-
MC1	Bell Irving	2012	DV/BT	-	83	5.32	0.93	-	U	U	-	-	-
MC1	Bell Irving	2012	DV/BT	-	73	3.95	1.02	-	U	U	-	-	-
MC1	Bell Irving	2012	DV/BT	-	91	7.21	0.96	-	U	U	-	-	-
MC1	Bell Irving	2012	DV/BT	-	86	6.56	1.03	-	U	U	-	-	-
MC1	Bell Irving	2012	DV/BT	-	102	9.97	0.94	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	81	5.18	0.97	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	73	4.56	1.17	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	147	40.52	1.28	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	128	20.57	0.98	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	84	5.6	0.94	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	80	6	1.17	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	117	13.82	0.86	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	77	4.93	1.08	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	85	7.94	1.29	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	91	7.71	1.02	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	74	4.49	1.11	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	74	4.79	1.18	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	80	5.91	1.15	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	74	4.64	1.15	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	70	4.14	1.21	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	78	4.89	1.03	-	U	U	-	-	-

Species: BT = bull trout, CH = chinook salmon, CO = coho salmon, DV = Dolly Varden, DV/BT = Dolly Varden/bull trout, MW = mountain whitefish, RB = rainbow trout

IMM = immature, M = male, MT = mature, U = unknown,

FR = fin ray, SC = scale

Dashes (-) indicate that data was not collected

Appendix 7.4-1a. Biological Characteristics of Fish Captured in Streams, Brucejack Gold Mine Project, 2010 to 2012

Site	Watershed	Year	Identified Species	Genetic Species	Length (mm)	Weight (g)	Condition (g/mm^3)	Age (yr)	Sex	Sexual Maturity	Aging Structure	Age Sample #	Genetic Sample #
MC1	Bell Irving	2012	RB	-	46	1.09	1.12	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	87	7.23	1.10	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	69	4.07	1.24	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	48	1.39	1.26	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	66	3.06	1.06	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	39	0.57	0.96	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	70	3.53	1.03	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	97	7.78	0.85	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	84	6.37	1.07	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	36	0.53	1.14	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	85	6.98	1.14	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	125	17.54	0.90	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	74	8.41	2.08	-	U	U	-	-	-
MC1	Bell Irving	2012	RB	-	44	1.24	1.46	-	U	U	-	-	-

Species: BT = bull trout, CH = chinook salmon, CO = coho salmon, DV = Dolly Varden, DV/BT = Dolly Varden/bull trout, MW = mountain whitefish, RB = rainbow trout

IMM = immature, M = male, MT = mature, U = unknown,

FR = fin ray, SC = scale

Dashes (-) indicate that data was not collected

Appendix 7.4-1b. Biological Characteristics of Fish Captured in Lakes, Brucejack Gold Mine Project, 2010 to 2012

Lake	Capture Method	Year	Identified Species	Length (mm)	Weight (g)	Condition (g/mm^3)	Age (yr)	Sex	Sexual Maturity	Aging Structure	Age Sample #
Todedada	MT	2010	DV/BT	91	7.8	1.04	0	U	U	FR	32
Bowser	EF	2010	DV/BT	83	6.3	1.10	1	U	U	FR	4
Bowser	EF	2010	DV/BT	85	7	1.14	1	U	U	FR	5
Unnamed	GN	2010	DV/BT	133	-	-	1	U	U	FR	2
Bowser	EF	2010	DV/BT	151	31.9	0.93	2	U	U	FR	2
Todedada	GN	2010	DV/BT	402	-	-	3	M	M	OT	24
Unnamed	GN	2010	DV/BT	205	-	-	3	U	U	FR	1
Unnamed	GN	2010	DV/BT	212	-	-	3	F	SP	OT	27
Unnamed	GN	2010	DV/BT	219	-	-	3	M	IM	OT	28
Bowser	GN	2010	DV/BT	257	145	0.85	4	U	U	FR	6
Todedada	GN	2010	DV/BT	333	-	-	4	F	M	OT	7
Todedada	GN	2010	DV/BT	360	-	-	4	F	SP	OT	28
Unnamed	GN	2010	DV/BT	207	-	-	4	M	MT	OT	29
Unnamed	GN	2010	DV/BT	214	90.1	0.92	4	M	MT	OT	30
Bowser	GN	2010	DV/BT	380	-	-	6	U	U	FR	7
Bowser	GN	2010	DV/BT	498	-	-	11	F	SP	OT	5
Bowser	EF	2010	DV/BT	37	0.5	0.99	-	U	U	-	-
Bowser	EF	2010	DV/BT	87	6.3	0.96	-	U	U	FR	6
Todedada	MT	2010	DV/BT	67	3.1	1.03	-	U	U	FR	34
Todedada	GN	2010	DV/BT	310	-	-	-	U	U	FR	6
Todedada	GN	2010	DV/BT	323	-	-	-	F	M	OT	8
Todedada	GN	2010	DV/BT	338	-	-	-	F	M	OT	26
Todedada	GN	2010	DV/BT	345	-	-	-	M	IM	OT	19
Todedada	GN	2010	DV/BT	345	-	-	-	M	IM	OT	20
Todedada	GN	2010	DV/BT	350	-	-	-	M	IM	OT	16
Todedada	GN	2010	DV/BT	353	-	-	-	U	U	FR	2
Todedada	GN	2010	DV/BT	355	-	-	-	M	IM	FR	17
Todedada	GN	2010	DV/BT	359	-	-	-	U	U	FR	10
Todedada	GN	2010	DV/BT	365	-	-	-	M	U	OT	9
Todedada	GN	2010	DV/BT	370	-	-	-	U	U	FR	4
Todedada	GN	2010	DV/BT	370	-	-	-	F	SP	OT	27
Todedada	GN	2010	DV/BT	371	-	-	-	U	U	FR	5
Todedada	GN	2010	DV/BT	373	-	-	-	F	M	OT	18
Todedada	GN	2010	DV/BT	376	-	-	-	M	M	OT	25
Todedada	GN	2010	DV/BT	380	-	-	-	U	U	SC	3
Todedada	GN	2010	DV/BT	384	-	-	-	U	U	FR	15
Todedada	GN	2010	DV/BT	388	-	-	-	M	M	OT	21
Todedada	GN	2010	DV/BT	388	-	-	-	U	U	FR	12
Unnamed	MT	2010	DV/BT	42	1.2	1.62	-	U	U	-	-
Unnamed	MT	2010	DV/BT	50	1.3	1.04	-	U	U	-	-
Unnamed	MT	2010	DV/BT	53	1.2	0.81	-	U	U	-	-
Unnamed	MT	2010	DV/BT	71	3.2	0.89	-	U	U	-	-
Unnamed	MT	2010	DV/BT	87	9.5	1.44	-	U	U	-	-
Unnamed	MT	2010	DV/BT	90	9.5	1.30	-	U	U	-	-

Species: DV/BT = Dolly Varden/bull trout, LSU = longnose sucker MW = mountain whitefish, RB = rainbow trout, SK = sockeye salmon

IMM = immature, M = male, MT = mature, U = unknown,

FR = fin ray, SC = scale

Dashes (-) indicate that data was not collected

Method: EF = electrofishing, GN = gillnet, MT = minnowtrap

Appendix 7.4-1b. Biological Characteristics of Fish Captured in Lakes, Brucejack Gold Mine Project, 2010 to 2012

Lake	Capture Method	Year	Identified Species	Length (mm)	Weight (g)	Condition (g/mm^3)	Age (yr)	Sex	Sexual Maturity	Aging Structure	Age Sample #
Unnamed	MT	2010	DV/BT	92	10.3	1.32	-	U	U	-	-
Unnamed	MT	2010	DV/BT	95	8.4	0.98	-	U	U	-	-
Unnamed	MT	2010	DV/BT	102	10.7	1.01	-	U	U	-	-
Unnamed	MT	2010	DV/BT	112	14.3	1.02	-	U	U	-	-
Unnamed	MT	2010	DV/BT	115	16.2	1.07	-	U	U	-	-
Unnamed	GN	2010	DV/BT	115	19.4	1.28	-	U	U	-	-
Unnamed	GN	2010	DV/BT	116	22.7	1.45	-	U	U	-	-
Unnamed	GN	2010	DV/BT	118	190.1	11.57	-	U	U	-	-
Unnamed	MT	2010	DV/BT	121	21.3	1.20	-	U	U	-	-
Unnamed	GN	2010	DV/BT	122	20.9	1.15	-	U	U	-	-
Unnamed	MT	2010	DV/BT	124	20.7	1.09	-	U	U	-	-
Unnamed	MT	2010	DV/BT	128	18.7	0.89	-	U	U	-	-
Unnamed	MT	2010	DV/BT	130	20.7	0.94	-	U	U	-	-
Unnamed	GN	2010	DV/BT	131	23.2	1.03	-	U	U	-	-
Unnamed	MT	2010	DV/BT	148	34.1	1.05	-	U	U	-	-
Unnamed	MT	2010	DV/BT	149	39.5	1.19	-	U	U	-	-
Unnamed	GN	2010	DV/BT	149	37.6	1.14	-	U	U	-	-
Unnamed	GN	2010	DV/BT	151	37.5	1.09	-	U	U	-	-
Unnamed	GN	2010	DV/BT	157	46.4	1.20	-	U	U	-	-
Unnamed	GN	2010	DV/BT	164	-	-	-	U	U	-	-
Unnamed	GN	2010	DV/BT	165	51.1	1.14	-	U	U	-	-
Unnamed	GN	2010	DV/BT	165	-	-	-	U	U	FR	9
Unnamed	GN	2010	DV/BT	166	-	-	-	U	U	-	-
Unnamed	MT	2010	DV/BT	168	48.9	1.03	-	U	U	-	-
Unnamed	GN	2010	DV/BT	169	52.4	1.09	-	U	U	-	-
Unnamed	GN	2010	DV/BT	170	-	-	-	U	U	-	-
Unnamed	GN	2010	DV/BT	171	-	-	-	U	U	FR	17
Unnamed	GN	2010	DV/BT	172	-	-	-	U	U	FR	16
Unnamed	GN	2010	DV/BT	176	-	-	-	U	U	FR	12
Unnamed	GN	2010	DV/BT	179	-	-	-	U	U	-	-
Unnamed	GN	2010	DV/BT	180	-	-	-	U	U	FR	4
Unnamed	GN	2010	DV/BT	180	-	-	-	U	U	FR	19
Unnamed	GN	2010	DV/BT	184	-	-	-	U	U	FR	23
Unnamed	GN	2010	DV/BT	185	63.4	1.00	-	U	U	-	-
Unnamed	MT	2010	DV/BT	189	70.2	1.04	-	U	U	-	-
Unnamed	MT	2010	DV/BT	190	70.1	1.02	-	U	U	-	-
Unnamed	MT	2010	DV/BT	190	70.1	1.02	-	U	U	-	-
Unnamed	GN	2010	DV/BT	190	-	-	-	U	U	FR	11
Unnamed	MT	2010	DV/BT	192	75.8	1.07	-	U	U	-	-
Unnamed	GN	2010	DV/BT	192	-	-	-	U	U	FR	18
Unnamed	MT	2010	DV/BT	193	71.3	0.99	-	U	U	-	-
Unnamed	GN	2010	DV/BT	198	82.4	1.06	-	U	U	-	-
Unnamed	GN	2010	DV/BT	203	-	-	-	U	U	-	-
Unnamed	GN	2010	DV/BT	205	85.7	0.99	-	U	U	-	-

Species: DV/BT = Dolly Varden/bull trout, LSU = longnose sucker MW = mountain whitefish, RB = rainbow trout, SK = sockeye salmon

IMM = immature, M = male, MT = mature, U = unknown,

FR = fin ray, SC = scale

Dashes (-) indicate that data was not collected

Method: EF = electrofishing, GN = gillnet, MT = minnowtrap

Appendix 7.4-1b. Biological Characteristics of Fish Captured in Lakes, Brucejack Gold Mine Project, 2010 to 2012

Lake	Capture Method	Year	Identified Species	Length (mm)	Weight (g)	Condition (g/mm^3)	Age (yr)	Sex	Sexual Maturity	Aging Structure	Age Sample #
Unnamed	GN	2010	DV/BT	205	83.3	0.97	-	U	U	-	-
Unnamed	GN	2010	DV/BT	205	83.1	0.96	-	U	U	-	-
Unnamed	MT	2010	DV/BT	206	82.2	0.94	-	U	U	-	-
Unnamed	GN	2010	DV/BT	206	-	-	-	U	U	FR	8
Unnamed	GN	2010	DV/BT	208	-	-	-	U	U	FR	21
Unnamed	GN	2010	DV/BT	209	-	-	-	U	U	FR	10
Unnamed	GN	2010	DV/BT	210	87.5	0.94	-	U	U	-	-
Unnamed	GN	2010	DV/BT	210	-	-	-	U	U	FR	25
Unnamed	GN	2010	DV/BT	211	-	-	-	U	U	FR	3
Unnamed	GN	2010	DV/BT	211	-	-	-	U	U	-	-
Unnamed	GN	2010	DV/BT	212	-	-	-	U	U	FR	14
Unnamed	GN	2010	DV/BT	212	-	-	-	U	U	FR	15
Unnamed	GN	2010	DV/BT	213	-	-	-	U	U	FR	20
Unnamed	GN	2010	DV/BT	214	84.4	0.86	-	U	U	-	-
Unnamed	GN	2010	DV/BT	214	-	-	-	U	U	FR	7
Unnamed	GN	2010	DV/BT	214	-	-	-	U	U	FR	26
Unnamed	GN	2010	DV/BT	215	-	-	-	U	U	-	-
Unnamed	GN	2010	DV/BT	216	100.4	1.00	-	U	U	-	-
Unnamed	GN	2010	DV/BT	216	-	-	-	U	U	-	-
Unnamed	GN	2010	DV/BT	219	104.2	0.99	-	U	U	-	-
Unnamed	GN	2010	DV/BT	219	-	-	-	U	U	-	-
Unnamed	GN	2010	DV/BT	219	-	-	-	U	U	FR	22
Unnamed	GN	2010	DV/BT	220	-	-	-	U	U	FR	13
Unnamed	GN	2010	DV/BT	221	-	-	-	U	U	FR	5
Unnamed	MT	2010	DV/BT	222	96.5	0.88	-	U	U	-	-
Unnamed	GN	2010	DV/BT	222	-	-	-	U	U	FR	6
Unnamed	GN	2010	DV/BT	224	113.5	1.01	-	U	U	-	-
Unnamed	GN	2010	DV/BT	224	116.3	1.03	-	U	U	-	-
Unnamed	GN	2010	DV/BT	228	111.6	0.94	-	U	U	-	-
Unnamed	GN	2010	DV/BT	233	125.1	0.99	-	U	U	-	-
Unnamed	GN	2010	DV/BT	237	-	-	-	U	U	FR	24
Bowser	MT	2010	LSU	67	3.6	1.20	-	U	U	-	-
Bowser	GN	2010	LSU	108	16.5	1.31	-	U	U	-	-
Bowser	GN	2010	LSU	175	-	-	-	U	U	-	-
Bowser	GN	2010	LSU	214	121	1.23	-	U	U	-	-
Bowser	GN	2010	LSU	222	130	1.19	-	U	U	-	-
Bowser	GN	2010	LSU	225	146	1.28	-	U	U	-	-
Bowser	GN	2010	LSU	234	152	1.19	-	U	U	-	-
Bowser	GN	2010	LSU	236	153	1.16	-	U	U	-	-
Bowser	GN	2010	LSU	244	177	1.22	-	U	U	-	-
Bowser	GN	2010	LSU	245	193	1.31	-	U	U	-	-
Bowser	GN	2010	LSU	257	-	-	-	U	U	-	-
Bowser	GN	2010	LSU	265	-	-	-	U	U	-	-
Bowser	GN	2010	LSU	273	-	-	-	U	U	-	-

Species: DV/BT = Dolly Varden/bull trout, LSU = longnose sucker MW = mountain whitefish, RB = rainbow trout,
SK = sockeye salmon

IMM = immature, M = male, MT = mature, U = unknown,

FR = fin ray, SC = scale

Dashes (-) indicate that data was not collected

Method: EF = electrofishing, GN = gillnet, MT = minnowtrap

Appendix 7.4-1b. Biological Characteristics of Fish Captured in Lakes, Brucejack Gold Mine Project, 2010 to 2012

Lake	Capture Method	Year	Identified Species	Length (mm)	Weight (g)	Condition (g/mm^3)	Age (yr)	Sex	Sexual Maturity	Aging Structure	Age Sample #
Bowser	GN	2010	LSU	282	-	-	-	U	U	-	-
Bowser	GN	2010	LSU	286	-	-	-	U	U	-	-
Bowser	GN	2010	LSU	295	-	-	-	U	U	-	-
Bowser	GN	2010	LSU	310	-	-	-	U	U	-	-
Bowser	EF	2010	MW	40	0.6	0.94	-	U	U	-	-
Bowser	EF	2010	MW	41	0.5	0.73	-	U	U	-	-
Bowser	EF	2010	MW	50	1.1	0.88	-	U	U	-	-
Bowser	EF	2010	MW	51	1.3	0.98	-	U	U	-	-
Bowser	EF	2010	MW	55	1.6	0.96	-	U	U	-	-
Bowser	EF	2010	MW	55	1.4	0.84	-	U	U	-	-
Bowser	EF	2010	MW	56	2	1.14	-	U	U	-	-
Bowser	EF	2010	MW	56	1.2	0.68	-	U	U	-	-
Bowser	EF	2010	MW	61	1.8	0.79	-	U	U	-	-
Bowser	EF	2010	MW	62	2.2	0.92	-	U	U	-	-
Bowser	EF	2010	MW	80	5	0.98	-	U	U	-	-
Bowser	EF	2010	MW	82	5.7	1.03	-	U	U	-	-
Bowser	EF	2010	MW	84	5.4	0.91	-	U	U	-	-
Bowser	EF	2010	MW	84	5.5	0.93	-	U	U	-	-
Bowser	EF	2010	MW	85	6.4	1.04	-	U	U	-	-
Bowser	EF	2010	MW	87	6.2	0.94	-	U	U	-	-
Bowser	EF	2010	MW	89	6.3	0.89	-	U	U	-	-
Bowser	EF	2010	MW	95	8.2	0.96	-	U	U	-	-
Bowser	EF	2010	MW	97	8.1	0.89	-	U	U	-	-
Bowser	EF	2010	MW	100	10.4	1.04	-	U	U	-	-
Bowser	EF	2010	MW	100	9.4	0.94	-	U	U	-	-
Bowser	EF	2010	MW	100	10.6	1.06	-	U	U	-	-
Bowser	EF	2010	MW	101	10.6	1.03	-	U	U	-	-
Bowser	EF	2010	MW	101	9.8	0.95	-	U	U	-	-
Bowser	EF	2010	MW	102	11.8	1.11	-	U	U	-	-
Bowser	EF	2010	MW	103	10.8	0.99	-	U	U	-	-
Bowser	EF	2010	MW	118	18.8	1.14	-	U	U	-	-
Bowser	EF	2010	MW	125	24.9	1.27	-	U	U	-	-
Bowser	EF	2010	MW	130	26	1.18	-	U	U	-	-
Bowser	EF	2010	MW	131	21.8	0.97	-	U	U	-	-
Bowser	EF	2010	MW	131	24	1.07	-	U	U	-	-
Bowser	EF	2010	MW	135	26.2	1.06	-	U	U	-	-
Bowser	EF	2010	MW	168	51.8	1.09	-	U	U	-	-
Bowser	EF	2010	MW	186	44.7	0.69	-	U	U	-	-
Bowser	GN	2010	MW	210	101.2	1.09	-	U	U	-	-
Bowser	GN	2010	MW	286	-	-	-	U	U	-	-
Todedada	MT	2010	RB	77	5.9	1.29	0	U	U	FR	33
Todedada	GN	2010	RB	353	-	-	3	M	M	OT	23
Todedada	GN	2010	RB	350	-	-	4	U	U	FR	14
Todedada	GN	2010	RB	370	-	-	4	M	M	OT	22

Species: DV/BT = Dolly Varden/bull trout, LSU = longnose sucker MW = mountain whitefish, RB = rainbow trout, SK = sockeye salmon

IMM = immature, M = male, MT = mature, U = unknown,

FR = fin ray, SC = scale

Dashes (-) indicate that data was not collected

Method: EF = electrofishing, GN = gillnet, MT = minnowtrap

Appendix 7.4-1b. Biological Characteristics of Fish Captured in Lakes, Brucejack Gold Mine Project, 2010 to 2012

Lake	Capture Method	Year	Identified Species	Length (mm)	Weight (g)	Condition (g/mm^3)	Age (yr)	Sex	Sexual Maturity	Aging Structure	Age Sample #
Todedada	GN	2010	RB	390	-	-	4	U	U	FR	11
Todedada	GN	2010	RB	258	-	-	-	U	U	FR	30
Todedada	GN	2010	RB	295	-	-	-	U	U	FR	1
Todedada	GN	2010	RB	324	-	-	-	U	U	FR	29
Todedada	GN	2010	RB	408	-	-	-	U	U	FR	13
Bowser	GN	2010	SK	118	17.7	1.08	1	U	U	FR	4
Bowser	GN	2010	SK	106	13.2	1.11	2	U	U	FR	3
Bowser	GN	2010	SK	114	17	1.15	2	U	U	FR	2
Bowser	GN	2010	SK	129	27.5	1.28	3	U	U	FR	1
Bowser	EF	2010	SK	33	0.4	1.11	-	U	U	-	-
Bowser	EF	2010	SK	37	0.5	0.99	-	U	U	-	-
Bowser	EF	2010	SK	41	0.5	0.73	-	U	U	-	-
Bowser	EF	2010	SK	48	0.9	0.81	-	U	U	-	-
Bowser	EF	2010	SK	52	1.2	0.85	-	U	U	-	-
Bowser	GN	2010	SK	120	19.3	1.12	-	U	U	-	-
Bowser	GN	2010	SK	124	18.6	0.98	-	U	U	SC	8
Bowser	GN	2010	SK	131	24.3	1.08	-	F	M	-	-

Species: DV/BT = Dolly Varden/bull trout, LSU = longnose sucker MW = mountain whitefish, RB = rainbow trout, SK = sockeye salmon

IMM = immature, M = male, MT = mature, U = unknown,

FR = fin ray, SC = scale

Dashes (-) indicate that data was not collected

Method: EF = electrofishing, GN = gillnet, MT = minnowtrap

Appendix 7.5-1

Biological Metal Mining Effluent Regulations Data, Brucejack Gold Mine Project, 2010 to 2012

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Appendix 7.5-1. Biological Metal Mining Effluent Regulations Data, Brucejack Gold Mine Project, 2010 to 2012

Location	Date	Sample Method	Sample #	Species	Sex	Maturity	Fork Length (mm)	Total Weight (g)	Eviscerated Weight (g)	Gonad Weight (g)	Liver Weight (g)	Stomach Weight (g)	Aging Structure	Eggs Taken (Y/N)	Adipose Taken (Y/N)
SC1	10-Sep-11	EF	1	DV	U	IM	112	17.58	14.69	0.03	0.25	1.96	FR/O	N	Y
UC1	10-Sep-11	EF	1	DV	U	IM	109	13.63	11.76	-	0.14	0.85	FR	N	Y
UC1	10-Sep-11	EF	2	DV	F	IM	125	20.59	17.69	0.02	0.18	1.31	FR/O	N	Y
UC1	10-Sep-11	EF	13	DV	U	IM	106	12.61	10.55	-	0.16	1.55	FR/O	N	N
UC1	10-Sep-11	EF	14	DV	U	IM	96	9.56	-	0.05	0.06	1.25	FR/O	N	N
UC1	10-Sep-11	EF	15	DV	U	IM	109	14.85	-	-	0.19	2.07	FR/O	N	N
WC1	12-Sep-11	EF	11	DV/BT	U	IM	97	9.58	8.21	-	0.12	1.02	FR/O	N	Y
WC1	12-Sep-11	EF	12	DV/BT	M	IM	84	6.54	5.52	0.01	0.05	0.68	FR/O	N	Y
WC1	12-Sep-11	EF	13	DV/BT	U	IM	73	3.65	3.15	-	0.01	0.29	FR/O	N	Y
WC1	12-Sep-11	EF	14	DV/BT	U	IM	69	3.21	2.68	-	0.05	0.28	FR/O	N	Y
WC1	12-Sep-11	EF	15	DV/BT	M	MT	136	30.83	26.95	1.45	0.25	1.22	FR/O	N	Y
WC1	29-Sep-12	EF	1	DV/BT	F	IM	195	76.8	71.53	0.13	0.85	3.7	-	N	N
WC1	29-Sep-12	EF	2	DV/BT	U	IM	77	3.52	3.09	0.32	0.03	0.01	-	N	N
MC1	30-Sep-12	EF	1	DV/BT	U	IM	88	6.1	5.47	0.01	0.05	0.49	-	N	N
MC1	30-Sep-12	EF	2	DV/BT	U	IM	85	5.76	-	-	0.04	0.42	-	N	N
MC1	30-Sep-12	EF	3	DV/BT	U	IM	88	6.95	6.02	0.01	0.08	0.68	-	N	N
MC1	30-Sep-12	EF	4	DV/BT	U	IM	83	5.32	4.83	0.01	0.05	0.43	-	N	N
MC1	30-Sep-12	EF	5	DV/BT	U	IM	73	3.95	3.4	0.06	0.06	0.41	-	N	N
MC1	30-Sep-12	EF	6	DV/BT	U	IM	91	7.21	6.28	0	0.08	0.68	-	N	N
MC1	30-Sep-12	EF	7	DV/BT	U	IM	86	6.56	5.73	0	0.1	0.54	-	N	N
MC1	30-Sep-12	EF	8	DV/BT	U	IM	102	9.97	9.35	0.01	0.14	0.39	-	N	N
WC1	1-Oct-12	EF	3	DV/BT	M	MTC	165	39.55	4.36	0.95	0.19	1.87	-	N	N
WC1	1-Oct-12	EF	4	DV/BT	U	IM	103	12.14	1.83	0.01	0.1	0.62	-	N	N
WC1	1-Oct-12	EF	5	DV/BT	M	MTC	134	22.5	2.5	1.02	0.17	1.2	-	N	N
WC1	1-Oct-12	EF	6	DV/BT	U	IM	68	3.64	0.37	-	0	0.26	-	N	N

Species: BT = bull trout, DV = Dolly Varden, DV/BT Dolly Varden/bull trout

F = female, IM = immature, M = male, MT = mature, U = unknown

Dashes (-) indicate that data was not collected

Appendix 7.5-2

Reports of Tissue Metal Concentrations, Brucejack Gold Mine Project, 2010 to 2012

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RESCAN ENVIRONMENTAL SERVICES
ATTN: Kyla Warren
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 26-JAN-12
Report Date: 02-FEB-12 16:00 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: **L1108056**

Project P.O. #: NOT SUBMITTED
Job Reference: 1042-008-09
C of C Numbers: 10-171182
Legal Site Desc:

Amber Springer
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1108056-2	L1108056-3	L1108056-4	L1108056-5	L1108056-6
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	10-OCT-11	10-OCT-11	10-OCT-11	10-OCT-11	10-OCT-11
	Sampled Time					
	Client ID	URI #4	URI #2	URI #13	URI #14	URI #15
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	77.2	77.2	75.6	73.9	77.6
Metals	Aluminum (Al)-Total (mg/kg wwt)	32.6	22.9	19.3	99.0	62.0
	Antimony (Sb)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	0.013	<0.010
	Arsenic (As)-Total (mg/kg wwt)	0.077	0.168	0.077	0.287	0.176
	Barium (Ba)-Total (mg/kg wwt)	0.462	0.463	0.422	2.26	1.39
	Beryllium (Be)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Bismuth (Bi)-Total (mg/kg wwt)	<0.030	<0.030	<0.030	<0.030	<0.030
	Cadmium (Cd)-Total (mg/kg wwt)	0.0058	0.0149	0.0074	0.0096	0.0091
	Calcium (Ca)-Total (mg/kg wwt)	129	153	195	246	225
	Chromium (Cr)-Total (mg/kg wwt)	0.12	<0.10	<0.10	0.23	0.14
	Cobalt (Co)-Total (mg/kg wwt)	0.047	0.097	0.056	0.097	0.066
	Copper (Cu)-Total (mg/kg wwt)	0.505	0.682	0.459	2.33	0.657
	Lead (Pb)-Total (mg/kg wwt)	0.024	0.023	<0.020	0.064	0.040
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	293	337	314	355	297
	Manganese (Mn)-Total (mg/kg wwt)	1.18	0.967	0.835	3.35	2.32
	Mercury (Hg)-Total (mg/kg wwt)	0.0130	0.0261	0.0213	0.0277	0.0330
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	0.018	0.013
	Nickel (Ni)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	0.14	<0.10
	Selenium (Se)-Total (mg/kg wwt)	0.67	0.89	0.74	0.86	0.79
	Strontium (Sr)-Total (mg/kg wwt)	0.291	0.193	0.218	0.612	0.444
	Thallium (Tl)-Total (mg/kg wwt)	<0.010	0.014	0.011	0.017	0.010
	Tin (Sn)-Total (mg/kg wwt)	<0.050	<0.050	<0.050	<0.050	<0.050
	Uranium (U)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0028	<0.0020
	Vanadium (V)-Total (mg/kg wwt)	0.15	0.11	0.12	0.54	0.34
	Zinc (Zn)-Total (mg/kg wwt)	7.27	9.15	6.85	8.42	6.68

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1108056-7	L1108056-8	L1108056-9	L1108056-10	L1108056-11
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	12-OCT-11	12-OCT-11	12-OCT-11	12-OCT-11	12-OCT-11
	Sampled Time					
	Client ID	WCI #11	WCI #12	WCI #13	WCI #14	WCI #15
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	76.7	78.9	76.6	77.7	76.0
Metals	Aluminum (Al)-Total (mg/kg wwt)	19.7	79.9	5.6	<2.0	<2.0
	Antimony (Sb)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	<0.010	<0.010
	Arsenic (As)-Total (mg/kg wwt)	0.028	0.036	0.016	0.012	0.045
	Barium (Ba)-Total (mg/kg wwt)	0.890	1.33	0.092	0.161	0.030
	Beryllium (Be)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Bismuth (Bi)-Total (mg/kg wwt)	<0.030	<0.030	<0.030	<0.030	<0.030
	Cadmium (Cd)-Total (mg/kg wwt)	<0.0050	0.0060	0.0057	0.0072	<0.0050
	Calcium (Ca)-Total (mg/kg wwt)	341	637	124	548	120
	Chromium (Cr)-Total (mg/kg wwt)	0.59	0.27	<0.10	<0.10	<0.10
	Cobalt (Co)-Total (mg/kg wwt)	0.054	0.081	0.055	0.047	0.089
	Copper (Cu)-Total (mg/kg wwt)	0.321	0.411	0.535	0.330	0.604
	Lead (Pb)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	293	330	294	281	283
	Manganese (Mn)-Total (mg/kg wwt)	0.686	1.15	0.346	0.439	0.253
	Mercury (Hg)-Total (mg/kg wwt)	0.0193	0.0180	0.0281	0.0191	0.0156
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	<0.010	<0.010
	Nickel (Ni)-Total (mg/kg wwt)	<0.10	0.14	<0.10	<0.10	<0.10
	Selenium (Se)-Total (mg/kg wwt)	0.75	0.91	0.74	0.98	0.86
	Strontium (Sr)-Total (mg/kg wwt)	0.676	1.14	0.085	0.896	0.085
	Thallium (Tl)-Total (mg/kg wwt)	<0.010	<0.010	0.024	<0.010	<0.010
	Tin (Sn)-Total (mg/kg wwt)	<0.050	<0.050	<0.050	<0.050	<0.050
	Uranium (U)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Vanadium (V)-Total (mg/kg wwt)	<0.10	0.27	<0.10	<0.10	<0.10
	Zinc (Zn)-Total (mg/kg wwt)	6.62	7.02	6.64	5.83	5.88

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
HG-WET-CVAFS-VA	Tissue	Mercury in Tissue by CVAFS (WET)	EPA 200.3, EPA 245.7

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry, adapted from US EPA Method 245.7. This digestion procedure was implemented on October 5, 2009.

ALS Test Code	Matrix	Test Description	Method Reference**
MET-WET-MS-VA	Tissue	Metals in Tissue by ICPMS (WET)	EPA 200.3, EPA 6020A

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by Inductively Coupled Plasma - Mass Spectrometry, adapted from US EPA Method 6020A. This digestion procedure was implemented on October 5, 2009

ALS Test Code	Matrix	Test Description	Method Reference**
MOISTURE-TISS-VA	Tissue	% Moisture in Tissues	ASTM D2974-00 Method A

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BC, CANADA

Chain of Custody Numbers:

10-171182

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

10-171182

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page 1 of 1

Report To
Company: RESCAN
Contact: KYLA WARREN
Address: 3790 ALFRED AVE
SMITHERS, BC
Phone: 250-877-7838 Fax:

Report Format / Distribution
Standard: ✓ Other (specify):
Select: PDF ✓ Excel ✓ Digital Fax
Email 1: kwarren@rescan.com
Email 2:

Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
- ~~X~~ Regular (Standard Turnaround Times - Business Days)
- X Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
- Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
- Same Day or Weekend Emergency - Contact ALS to confirm TAT

Invoice To Same as Report ? (circle) Yes or No (if No, provide details)
Copy of Invoice with Report? (circle) Yes or No
Company:
Contact:
Address:
Phone: Fax:

Client / Project Information
Job #: 1042.008.09
PO / AFE:
LSD:
Quote #:

Lab Work Order # (lab use only) L1108056

ALS Contact: Amber Springer
Sampler: Kyla Warren

Analysis Request (Indicate Filtered or Preserved, F/P)

RUSH
Priority processing

Sample #	Sample Identification (This description will ap[pear on the report])	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	*tissue metals	Number of Containers
	SC1 #1	10-10-11		tissue	X	1
	UR1 #1	↓		↓	X	1
	UR1 #2				X	1
	UR1 #13				X	1
	UR1 #14				X	1
	UR1 #15				X	1
	WC1 #11	12-10-11			X	1
	WC1 #12	↓			X	1
	WC1 #13				X	1
	WC1 #14				X	1
	WC1 #15				X	1

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

*routine ICPMS scan plus Mercury

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by: BP	Date: Jan. 26	Time: 16:35	Temperature: 8 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

RESCAN ENVIRONMENTAL SERVICES
ATTN: Kyla Warren
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 07-SEP-12
Report Date: 10-OCT-12 16:07 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: **L1206180**
Project P.O. #: NOT SUBMITTED
Job Reference: 1042-008-09
C of C Numbers: 10-171183, 10-207157
Legal Site Desc:

Amber Springer
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1206180-1	L1206180-2	L1206180-3	L1206180-4	L1206180-5
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	29-AUG-12	29-AUG-12	29-AUG-12	01-SEP-12	01-SEP-12
	Sampled Time					
	Client ID	WC1 #1	WC1 #2	WC1 #3	WC1 #4	WC1 #5
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	79.5	82.9	79.0	77.3	77.9
Metals	Aluminum (Al)-Total (mg/kg wwt)	<2.0	3.0	5.6	4.0	7.8
	Antimony (Sb)-Total (mg/kg wwt)	<0.010	<0.010	0.017	<0.010	0.015
	Arsenic (As)-Total (mg/kg wwt)	0.021	0.013	0.029	0.020	0.021
	Barium (Ba)-Total (mg/kg wwt)	0.011	0.112	0.095	0.125	0.124
	Beryllium (Be)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Bismuth (Bi)-Total (mg/kg wwt)	<0.030	<0.030	<0.030	<0.030	<0.030
	Cadmium (Cd)-Total (mg/kg wwt)	<0.0050	<0.0050	0.0070	<0.0050	<0.0050
	Calcium (Ca)-Total (mg/kg wwt)	99.9	401	105	291	95.2
	Chromium (Cr)-Total (mg/kg wwt)	<0.10	<0.10	0.47	<0.10	<0.10
	Cobalt (Co)-Total (mg/kg wwt)	0.034	0.103	0.102	0.079	0.081
	Copper (Cu)-Total (mg/kg wwt)	0.333	0.322	1.25	0.726	1.12
	Lead (Pb)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	305	247	283	317	309
	Manganese (Mn)-Total (mg/kg wwt)	0.154	0.316	0.422	0.353	0.427
	Mercury (Hg)-Total (mg/kg wwt)	0.0305	0.0205	0.0353	0.0385	0.0288
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	<0.010	<0.010
	Nickel (Ni)-Total (mg/kg wwt)	<0.10	<0.10	0.14	<0.10	<0.10
	Selenium (Se)-Total (mg/kg wwt)	0.52	0.92	0.70	0.93	1.04
	Silver (Ag)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	<0.010	<0.010
	Strontium (Sr)-Total (mg/kg wwt)	0.078	0.731	0.087	0.465	0.107
	Thallium (Tl)-Total (mg/kg wwt)	<0.010	<0.010	0.021	0.010	0.014
	Tin (Sn)-Total (mg/kg wwt)	<0.050	0.066	<0.050	<0.050	<0.050
	Uranium (U)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Vanadium (V)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Zinc (Zn)-Total (mg/kg wwt)	5.06	5.99	10.3	8.76	10.8

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1206180-6	L1206180-7	L1206180-8	L1206180-9	L1206180-10
	Description	TISSUE	TISSUE	TISSUE	TISSUE	TISSUE
	Sampled Date	01-SEP-12	30-AUG-12	30-AUG-12	30-AUG-12	30-AUG-12
	Sampled Time					
	Client ID	WC1 #6	MC1 #1	MC1 #2	MC1 #3	MC1 #4
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	80.4	79.8	79.1	78.7	80.8
Metals	Aluminum (Al)-Total (mg/kg wwt)	2.8	90.7	13.2	8.3	9.3
	Antimony (Sb)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	<0.010	<0.010
	Arsenic (As)-Total (mg/kg wwt)	<0.010	0.049	0.014	0.011	0.011
	Barium (Ba)-Total (mg/kg wwt)	0.063	1.39	0.263	0.343	0.157
	Beryllium (Be)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Bismuth (Bi)-Total (mg/kg wwt)	<0.030	<0.030	<0.030	<0.030	<0.030
	Cadmium (Cd)-Total (mg/kg wwt)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Calcium (Ca)-Total (mg/kg wwt)	161	628	458	242	154
	Chromium (Cr)-Total (mg/kg wwt)	<0.10	0.32	<0.10	0.37	<0.10
	Cobalt (Co)-Total (mg/kg wwt)	0.059	0.100	0.068	0.069	0.202
	Copper (Cu)-Total (mg/kg wwt)	0.441	0.654	0.578	0.449	0.481
	Lead (Pb)-Total (mg/kg wwt)	<0.020	0.026	<0.020	<0.020	<0.020
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	276	321	349	347	317
	Manganese (Mn)-Total (mg/kg wwt)	0.353	2.41	0.591	0.451	0.441
	Mercury (Hg)-Total (mg/kg wwt)	0.0125	0.0229	0.0220	0.0240	0.0226
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.010	0.022	<0.010	<0.010	<0.010
	Nickel (Ni)-Total (mg/kg wwt)	<0.10	0.28	<0.10	<0.10	<0.10
	Selenium (Se)-Total (mg/kg wwt)	0.78	0.43	0.43	0.41	0.41
	Silver (Ag)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	<0.010	<0.010
	Strontium (Sr)-Total (mg/kg wwt)	0.258	1.38	0.896	0.391	0.231
	Thallium (Tl)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	<0.010	<0.010
	Tin (Sn)-Total (mg/kg wwt)	0.109	0.110	0.058	<0.050	<0.050
	Uranium (U)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Vanadium (V)-Total (mg/kg wwt)	<0.10	0.30	<0.10	<0.10	<0.10
	Zinc (Zn)-Total (mg/kg wwt)	7.42	6.50	6.33	4.95	5.26

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1206180-11 TISSUE 30-AUG-12 MC1 #5	L1206180-12 TISSUE 30-AUG-12 MC1 #6	L1206180-13 TISSUE 30-AUG-12 MC1 #7	L1206180-14 TISSUE 30-AUG-12 MC1 #8	
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)	77.8	79.1	77.5	81.5	
Metals	Aluminum (Al)-Total (mg/kg wwt)	50.2	9.2	6.9	5.3	
	Antimony (Sb)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	<0.010	
	Arsenic (As)-Total (mg/kg wwt)	0.020	0.015	<0.010	0.016	
	Barium (Ba)-Total (mg/kg wwt)	0.584	0.300	0.121	0.107	
	Beryllium (Be)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	
	Bismuth (Bi)-Total (mg/kg wwt)	<0.030	<0.030	<0.030	<0.030	
	Cadmium (Cd)-Total (mg/kg wwt)	<0.0050	<0.0050	<0.0050	0.0163	
	Calcium (Ca)-Total (mg/kg wwt)	341	645	383	264	
	Chromium (Cr)-Total (mg/kg wwt)	0.17	<0.10	<0.10	<0.10	
	Cobalt (Co)-Total (mg/kg wwt)	0.087	0.053	0.086	<0.020	
	Copper (Cu)-Total (mg/kg wwt)	0.420	0.517	0.591	0.365	
	Lead (Pb)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	
	Magnesium (Mg)-Total (mg/kg wwt)	358	339	376	322	
	Manganese (Mn)-Total (mg/kg wwt)	1.72	0.482	0.494	0.389	
	Mercury (Hg)-Total (mg/kg wwt)	0.0292	0.0246	0.0246	0.0156	
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	<0.010	
	Nickel (Ni)-Total (mg/kg wwt)	0.13	<0.10	<0.10	0.12	
	Selenium (Se)-Total (mg/kg wwt)	0.58	0.39	0.54	0.51	
	Silver (Ag)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	<0.010	
	Strontium (Sr)-Total (mg/kg wwt)	0.610	1.30	0.679	0.388	
	Thallium (Tl)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	<0.010	
	Tin (Sn)-Total (mg/kg wwt)	<0.050	<0.050	<0.050	<0.050	
	Uranium (U)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	
	Vanadium (V)-Total (mg/kg wwt)	0.19	<0.10	<0.10	<0.10	
	Zinc (Zn)-Total (mg/kg wwt)	5.33	6.50	6.38	3.77	

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Chromium (Cr)-Total	DUP-H	L1206180-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9
Method Blank	Copper (Cu)-Total	MB-LOR	L1206180-1, -10, -11, -12, -13, -14, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.
MB-LOR	Method Blank exceeds ALS DQO. LORs adjusted for samples with positive hits below 5 times blank level. Please contact ALS if re-analysis is required.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
AG-WET-MS-VA	Tissue	Silver in Tissue by ICPMS (WET)	EPA 200.3, EPA 6020A

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by Inductively Coupled Plasma - Mass Spectrometry, adapted from US EPA Method 6020A. This digestion procedure was implemented on October 5, 2009.

HG-WET-CVAFS-VA	Tissue	Mercury in Tissue by CVAFS (WET)	EPA 200.3, EPA 245.7

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry, adapted from US EPA Method 245.7. This digestion procedure was implemented on October 5, 2009.

MET-WET-MS-VA	Tissue	Metals in Tissue by ICPMS (WET)	EPA 200.3, EPA 6020A

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by Inductively Coupled Plasma - Mass Spectrometry, adapted from US EPA Method 6020A. This digestion procedure was implemented on October 5, 2009

MOISTURE-TISS-VA	Tissue	% Moisture in Tissues	ASTM D2974-00 Method A

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

10-171183   10-207157

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

10-171183

ALS En...

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page 1 of 2

Report To		Report Format / Distribution	
Company: RESCAN		Standard: ✓ Other (specify):	
Contact: KYLA WARREN		Select: PDF ✓ Excel ✓ Digital Fax	
Address: 3790 ALFRED AVE SMITHERS BC		Email 1: kwarren@rescan.com	
Phone: 250 877 7838	Fax: 250-877-7833	Email 2:	
Invoice To: Same as Report ? (circle) Yes or No (if No, provide details)		Client / Project Information	
Copy of Invoice with Report? (circle) Yes or No		Job #: 1042-008-09	
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #:	
Lab Work Order # (lab use only)	L1206180	ALS Contact: AMBER SPRINGER	Sampler: Kyla Warren

Service Request: (Rush subject to availability - Contact ALS to confirm TAT)

- ✓ Regular (Standard Turnaround Times - Business Days)
- Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
- Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
- Same Day or Weekend Emergency - Contact ALS to confirm TAT

Analysis Request (Indicate Filtered or Preserved, F/P)

Short Holding Time
Rush Processing

Sample #	Sample Identification (This description wi... ...t)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	METALS	Number of Containers
1	WC1 #1	29-08-12		tissue	✓	1
2	WC1 #2	29-08-12		↓	✓	1
3	WC1 #3	29-08 12			✓	1
4	WC1 #4	01-09-12			✓	1
5	WC1 #5	01-09-12			✓	1
6	WC1 #6	01-09-12			✓	1
7	MC1 #1	30-08-12			✓	1
8	MC1 #2	30-08-12			✓	1
9	MC1 #3	30 08-12			✓	1
10	MC1 #4	30-08-12			✓	1
11	MC1 #5	30-08-12			✓	1
12	MC1 #6	30-08-12			✓	1

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

PLEASE USE ROUTINE ICPMS SCAN PLUS MERCURY AS IN WORK ORDER L1208056 plus SILVER

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: KWarren	Date: Sept 6 '12	Time:	Received by: BB	Date: Sept. 7	Time: 12:45	Temperature: 9.7 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

10- 207157

ALS En

WL1206180-COFC

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page 2 of 2

Report To		Report Format / Distribution	Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company: RESCAN		Standard: ✓ Other (specify):	✓ Regular (Standard Turnaround Times - Business Days)
Contact: KYLA WARREN		Select: PDF ✓ Excel ✓ Digital Fax	Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: 3790 ALFRED AVE		Email 1: kwarren@rescan.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
		Email 2:	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone: 250-877-7838	Fax: 250-877-7833		Analysis Request
Invoice To: Same as Report ? (circle) Yes or No (if No, provide details)		Client / Project Information	(Indicate Filtered or Preserved, F/P)
Copy of Invoice with Report? (circle) Yes or No		Job #: 1042-008-09	
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #:	
Lab Work Order # (lab use only)		ALS Contact: AMBER SPRINGER / Sampler: KYLA WARREN	

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	METALS												Number of Containers
13	MCI #7	30-08-12		tissue	✓												1
14	MCI #8	30-08-12		tissue	✓												1

Rush Processing

Short Holding Time

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

ROUTINE ICPMS SCAN PLUS MERCURY AND SILVER

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: KWarren	Date: 09/06/12	Time:	Received by: BP	Date: Sept. 7	Time: 12:45	Temperature: 9.7 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Appendix 7.6-1

Stomach Content Analysis of Dolly Varden/Bull Trout, Brucejack Gold Mine Project, 2010 to 2012

Rescan™
Engineers and Scientists

Appendix 7.6-1a. Stomach Contents of Dolly Varden/Bull Trout by Number, Brucejack Gold Mine Project, 2011

Location and Number			WC1-11	WC1-13	WC1-13	WC1-14	WC1-15	UR1-14	SC1-01	UR1-13	UR1-04	UR1-15	UR1-02	
Date			12-Sep-11	12-Sep-11	12-Sep-11	12-Sep-11	13-Sep-11	13-Sep-11	13-Sep-11	13-Sep-11	13-Sep-11	13-Sep-11	13-Sep-11	
Sample No.			110506	110507	110508	110509	110510	110511	110512	110513	110514	110515	110516	
Fullness (%)			100	100	90	75	10	100	100	100	90	100	75	
Digestion (%)			10	50	90	90	90	50	25	50	75	25	90	
Actual Weight (mg)			511	308	22	31	39	559	840	717	305	1182	227	
Comments				in whirlpak	in vial									
Species/Group	Stage	Origin												
NEMATODA														0
Panagrolaimus		B	-	-	-	1	-	-	-	-	-	-	-	1
OLIGOCHAETA														
Unidentified Oligochaeta		B	-	-	-	-	-	1	-	-	-	2	-	3
Lumbricidae	A	B	-	-	-	-	-	-	1	-	-	-	-	1
OSTRACODA														
Candona		D	-	1	-	-	-	-	-	-	-	-	-	1
CHILOPODA														
Unidentified centipede		D	-	-	-	-	-	1	-	-	1	-	-	2
ARACHNIDA			-	-	-	-	-	-	-	-	-	-	-	0
Aranea		D	-	-	-	-	-	-	-	-	1	-	-	1
INSECTA														
Unidentified Insecta		B	-	-	-	-	1	-	-	-	-	-	-	1
EPHEMEROPTERA														
Ameletidae	N	B	-	-	-	-	1	-	-	-	-	-	-	1
Baetidae	N	B	-	-	-	-	-	6	1	5	-	1	-	13
Ephemerellidae			-	-	-	-	-	-	-	-	-	-	-	0
Ephemerella doddsi	N	B	1	-	-	-	-	-	-	-	-	-	-	1
Heptageneiidae	N	B	-	19	2	-	2	19	-	11	2	4	3	62
Cinygmula	N	B	-	1	-	-	-	-	-	-	-	-	-	1
Epeorus	N	B	7	30	-	-	-	3	-	-	-	1	-	41
Heptagenia	N	B	12	3	-	-	-	3	-	-	-	1	-	19
PLECOPTERA														
Unidentified Plecoptera	N	B	-	-	-	-	1	22	-	5	-	-	-	28
Capnidae	N	B	-	51	2	-	-	5	-	4	-	-	-	62
Chloroperlidae	N	B	-	-	-	-	-	7	-	4	1	4	-	16
Leuctridae	N	B	-	5	-	-	-	1	-	3	-	-	-	9
Nemouridae	N	B	21	21	2	1	-	16	7	4	2	39	5	118
Perlodidae	N	B	13	2	-	1	2	11	3	16	2	2	-	52
TRICHOPTERA														
Unidentified Trichoptera	L	B	-	-	-	-	-	-	-	-	1	-	-	1
Hydropsychidae			-	-	-	-	-	-	-	-	-	-	-	0
Unidentified Hydropsychidae	L	B	-	1	-	1	-	-	-	-	-	-	-	2
Arctopsyche	L	B	-	-	-	-	-	-	1	-	-	-	-	1
Parapsyche	L	B	1	1	-	-	-	2	2	4	-	8	3	21
Rhyacophilidae			-	-	-	-	-	-	-	-	-	-	-	0
Rhyacophila	L	B	2	1	-	-	-	10	11	4	6	11	4	49

Appendix 7.6-1a. Stomach Contents of Dolly Varden/Bull Trout by Number, Brucejack Gold Mine Project, 2011

Location and Number			WC1-11	WC1-13	WC1-13	WC1-14	WC1-15	UR1-14	SC1-01	UR1-13	UR1-04	UR1-15	UR1-02	
Date			12-Sep-11	12-Sep-11	12-Sep-11	12-Sep-11	13-Sep-11	13-Sep-11	13-Sep-11	13-Sep-11	13-Sep-11	13-Sep-11	13-Sep-11	
Sample No.			110506	110507	110508	110509	110510	110511	110512	110513	110514	110515	110516	
Fullness (%)			100	100	90	75	10	100	100	100	90	100	75	
Digestion (%)			10	50	90	90	90	50	25	50	75	25	90	
Actual Weight (mg)			511	308	22	31	39	559	840	717	305	1182	227	
Comments				in whirlpak	in vial									
Species/Group	Stage	Origin												
LEPIDOPTERA														
Unidentified Lepidoptera	L	D	-	-	-	2	-	1	1	-	-	-	-	4
COLEOPTERA														
Carabidae	A	D	-	-	-	1	-	-	1	-	-	-	-	2
Staphylinidae	A	D	-	-	-	-	-	-	1	-	-	-	-	1
HYMENOPTERA														
Formicidae	A	D	-	-	-	-	-	1	1	1	-	-	1	4
DIPTERA														
Diptera	L	B	-	-	-	-	-	-	-	-	1	-	-	1
Diptera	P	B	-	-	-	-	-	-	-	-	1	-	-	1
Diptera	A	D	-	-	-	-	-	1	-	-	-	-	-	1
<u>Empididae</u>			-	-	-	-	-	-	-	-	-	-	-	0
Unidentified Empididae	L	B	-	-	-	-	-	2	-	-	-	-	-	2
Oreogoton	L	B	-	-	-	-	-	-	-	1	-	-	-	1
<u>Ephydridae</u>	L	B	-	-	-	1	-	-	-	-	-	-	-	1
<u>Tipulidae</u>			-	-	-	-	-	-	-	-	-	-	-	0
Unidentified Tipulidae	L	B	-	-	-	1	1	-	-	-	-	-	-	2
Dicranota	L	B	-	1	-	-	-	-	-	-	-	-	-	1
Rhabdomastix	L	B	-	-	-	-	-	1	-	-	1	-	-	2
Tipula	L	B	-	-	-	-	-	-	-	-	-	1	-	1
<u>Chironomidae</u>			-	-	-	-	-	-	-	-	-	-	-	0
Unidentified Chironomidae	A	D	-	-	-	-	-	-	-	1	-	-	-	1
Tanypodinae	L	B	-	-	-	-	-	-	-	-	-	-	-	0
Thienemannimyia	L	B	-	1	-	-	-	-	-	-	-	-	-	1
Tanytarsini	L	B	-	-	-	-	-	-	1	-	-	1	-	2
Orthocladiinae	L	B	-	2	-	-	-	-	-	1	1	-	-	4
Brillia	L	B	-	1	-	-	-	2	1	-	-	-	-	4
Diamesinae			-	-	-	-	-	-	-	2	-	-	-	2
Diamesa	L	B	-	-	-	-	-	17	9	-	3	9	-	38
FISH														
Unidentified fish	L	C	-	-	-	-	-	-	-	-	1	-	-	1
NON-FOOD ITEMS														
Case materials			-	-	-	-	-	X	-	-	-	X	-	0
Plant			-	X	-	-	-	-	X	X	X	X	X	0
Pebble			-	-	-	-	X	-	-	-	-	X	-	0
TOTAL			57	141	6	9	8	132	41	66	24	84	16	584

Appendix 7.6-1b. Stomach Contents of Dolly Varden/Bull Trout by Weight, Brucejack Gold Mine Project, 2011

Location and Number			WC1-11	WC1-13	WC1-13	WC1-14	WC1-15	UR1-14	SC1-01	UR1-13	UR1-04	UR1-15	UR1-02	
Date			12-Sep-11	12-Sep-11	12-Sep-11	12-Sep-11	13-Sep-11	13-Sep-11	13-Sep-11	13-Sep-11	13-Sep-11	13-Sep-11	13-Sep-11	
Sample No.			110506	110507	110508	110509	110510	110511	110512	110513	110514	110515	110516	
Fullness (%)			100	100	90	75	10	100	100	100	90	100	75	
Digestion (%)			10	50	90	90	90	50	25	50	75	25	90	
Actual Weight (mg)			511	308	22	31	39	559	840	717	305	1182	227	
Comments				in whirlpak	in vial									
Species/Group	Stage	Origin												
NEMATODA														
Panagrolaimus		B	-	-	-	0.1	-	-	-	-	-	-	-	0.1
OLIGOCHAETA														
Unidentified Oligochaeta		B	-	-	-	-	-	24	-	-	-	47	-	71
Lumbricidae	A	B	-	-	-	-	-	-	164	-	-	-	-	164
OSTRACODA														
Candona		D	-	0.1	-	-	-	-	-	-	-	-	-	0.1
CHILOPODA														
Unidentified centipede		D	-	-	-	-	-	1	-	-	7	-	-	8
ARACHNIDA														
Aranea		D	-	-	-	-	-	-	-	-	1	-	-	1
INSECTA														
Unidentified Insecta		B	-	-	-	-	5	-	-	-	-	-	-	5
EPHEMEROPTERA	N													
Ameletidae	N	B	-	-	-	-	0.5	-	-	-	-	-	-	0.5
Baetidae	N	B	-	-	-	-	-	8	2	15	-	2	-	27
Ephemerellidae		-	-	-	-	-	-	-	-	-	-	-	-	0
Ephemerella doddsi	N	B	7	-	-	-	-	-	-	-	-	-	-	7
Heptageneiidae	N	B	-	30	17	-	4	37	-	68	5	17	15	193
Cinygmula	N	B	-	7	-	-	-	-	-	-	-	-	-	7
Epeorus	N	B	27	119	-	-	-	6	-	-	-	5	-	157
Heptagenia	N	B	69	12	-	-	-	17	-	-	-	5	-	103
PLECOPTERA														
Unidentified Plecoptera	N	B	-	-	-	-	0.3	6	-	3	-	-	-	9.3
Capnidae	N	B	-	25	1	-	-	3	-	1	-	-	-	30
Chloroperlidae	N	B	-	-	-	-	-	15	-	38	6	62	-	121
Leuctridae	N	B	-	7	-	-	-	1	-	7	-	-	-	15
Nemouridae	N	B	63	42	4	2	-	35	15	7	8	112	20	308
Perlodidae	N	B	284	30	-	10	27	80	12	153	10	23	-	629
TRICHOPTERA	L													
Unidentified Trichoptera	L	B	-	-	-	-	-	-	-	-	5	-	-	5
Hydropsychidae		-	-	-	-	-	-	-	-	-	-	-	-	0
Unidentified Hydropsychidae	L	B	-	0.5	-	1	-	-	-	-	-	-	-	1.5
Arctopsyche	L	B	-	-	-	-	-	-	8	-	-	-	-	8
Parapsyche	L	B	40	23	-	-	-	156	124	282	-	652	200	1477
Rhyacophilidae		-	-	-	-	-	-	-	-	-	-	-	-	0
Rhyacophila	L	B	21	9	-	-	-	127	427	66	86	158	60	954

Appendix 7.6-1b. Stomach Contents of Dolly Varden/Bull Trout by Weight, Brucejack Gold Mine Project, 2011

Location and Number			**WC1-11**	**WC1-13**	**WC1-13**	**WC1-14**	**WC1-15**	**UR1-14**	**SC1-01**	**UR1-13**	**UR1-04**	**UR1-15**	**UR1-02**	
Date			**12-Sep-11**	**12-Sep-11**	**12-Sep-11**	**12-Sep-11**	**13-Sep-11**	**13-Sep-11**	**13-Sep-11**	**13-Sep-11**	**13-Sep-11**	**13-Sep-11**	**13-Sep-11**	
Sample No.			**110506**	**110507**	**110508**	**110509**	**110510**	**110511**	**110512**	**110513**	**110514**	**110515**	**110516**	
Fullness (%)			**100**	**100**	**90**	**75**	**10**	**100**	**100**	**100**	**90**	**100**	**75**	
Digestion (%)			**10**	**50**	**90**	**90**	**90**	**50**	**25**	**50**	**75**	**25**	**90**	
Actual Weight (mg)			**511**	**308**	**22**	**31**	**39**	**559**	**840**	**717**	**305**	**1182**	**227**	
Comments				**in whirlpak**	**in vial**									
Species/Group	**Stage**	**Origin**												
LEPIDOPTERA														
Unidentified Lepidoptera	L	D	-	-	-	10	-	1	8	-	-	-	-	19
COLEOPTERA	A													
Carabidae	A	D	-	-	-	0.9	-	-	5	-	-	-	-	5.9
Staphylinidae	A	D	-	-	-	-	-	-	16	-	-	-	-	16
HYMENOPTERA														
Formicidae	A	D	-	-	-	-	-	5	5	5	-	-	12	27
DIPTERA		-	-	-	-	-	-	-	-	-	-	-	-	0
Diptera	L	B	-	-	-	-	-	-	-	-	1	-	-	1
Diptera	P	B	-	-	-	-	-	-	-	-	11	-	-	11
Diptera	A	D	-	-	-	-	-	8	-	-	-	-	-	8
Empididae	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Unidentified Empididae	L	B	-	-	-	-	-	2	-	-	-	-	-	2
Oreogoton	L	B	-	-	-	-	-	-	-	2	-	-	-	2
Ephydridae	L	B	-	-	-	4	-	-	-	-	-	-	-	4
Tipulidae		-	-	-	-	-	-	-	-	-	-	-	-	0
Unidentified Tipulidae	L	B	-	-	-	5	0.2	-	-	-	-	-	-	5.2
Dicranota	L	B	-	0.5	-	-	-	-	-	-	-	-	-	0.5
Rhabdomastix	L	B	-	-	-	-	-	1	-	-	4	-	-	5
Tipula	L	B	-	-	-	-	-	-	-	-	-	52	-	52
Chironomidae		-	-	-	-	-	-	-	-	-	-	-	-	0
Unidentified Chironomidae	A	D	-	-	-	-	-	-	-	1	-	-	-	1
Tanypodinae	L	B	-	-	-	-	-	-	-	-	-	-	-	0
Thienemannimyia	L	B	-	0.4	-	-	-	-	-	-	-	-	-	0.4
Tanytarsini	L	B	-	-	-	-	-	-	1	-	-	1	-	2
Orthocladiinae	L	B	-	0.5	-	-	-	-	-	1	1	-	-	2.5
Brillia	L	B	-	1	-	-	-	5	1	-	-	-	-	7
Diamesinae		-	-	-	-	-	-	-	-	1	-	-	-	1
Diamesa	L	B	-	-	-	-	-	12	6	-	1	5	-	24
FISH														
Unidentified fish	L	C	-	-	-	-	-	-	-	-	119	-	-	119
NON-FOOD ITEMS														
Case materials		-	-	-	-	-	-	9	-	-	-	9	-	18
Plant		-	-	1	-	-	-	-	46	86	40	30	41	244
Pebble		-	-	-	-	-	2	-	-	-	-	2	-	4
TOTAL			511	308	22	33	39	559	840	736	305	1182	348	4883

Appendix 7.6-1c. Stomach Contents of Dolly Varden/Bull Trout by Number, Brucejack Gold Mine Project, 2012

Location and Number			WC1-1	WC1-2	WC1-3	WC1-4	WC1-5	WC1-6	MC1-1	MC1-2	MC1-3	MC1-4	MC1-5	MC1-6	MC1-7	MC1-8
Date			28-Aug-12	28-Aug-12	1-Sep-12	1-Sep-12	1-Sep-12	1-Sep-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12
Sample No.			120100	120101	120102	120103	120104	120105	120106	120107	120108	120109	120110	120111	120112	120113
Fullness (%)			25	90	75	90	100	75	90	5	90	50	50	100	90	1
Digestion (%)			50	50	50	75	75	90	25	95	25	25	95	25	50	0
Actual Weight (mg)			318	78	423	159	246	51	24	2	89	39	27	233	100	1
Comments																
Species/Group	Stage	Origin														
ARACHNIDA																
Hydracarina		B	-	-	-	3	-	-	-	-	-	-	-	-	-	-
INSECTA			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unidentified Insecta	parts	B	-	-	-	-	-	P	-	-	-	-	P	-	-	-
EPHEMEROPTERA																
Unidentified Ephemeroptera	N	B	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Ameletidae			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ameletus	N	B	-	-	-	-	-	-	-	-	3	-	-	21	5	-
Baetidae			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baetis	N	B	-	-	5	-	3	1	-	-	2	2	-	-	3	-
Ephemerellidae	N*	B	-	-	-	-	-	-	-	-	1	-	1	-	1	-
Ephemerella coloradensis	N	B	-	-	4	1	1	-	-	-	-	-	-	-	-	-
Ephemerella doddsi	N	B	-	-	-	-	-	-	-	-	-	-	-	2	-	-
Heptageneiidae	N*	B	2	-	-	5	5	-	-	-	-	-	-	-	-	-
Cinygmula	N	B	-	-	13	-	9	-	2	-	1	1	-	3	1	-
Epeorus	N	B	7	4	11	1	6	-	-	-	-	-	-	-	-	-
Heptagenia	N	B	-	-	1	-	-	-	-	-	-	-	-	-	-	-
PLECOPTERA																
Unidentified Plecoptera	N	B	2	1	-	3	-	3	-	-	-	-	-	-	-	-
Chloroperlidae	N*	B	-	1	2	3	-	-	-	-	-	-	-	-	1	-
Nemouridae			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nemoura	N	B	-	-	-	-	-	-	-	-	-	-	-	-	-	1
PSOCOPTERA																
Unidentified Psocoptera	A	D	-	-	-	-	-	2	-	-	-	-	-	-	-	-
TRICHOPTERA																
Trichoptera	L*	B	-	-	-	-	-	3	-	-	-	-	-	1	-	-
Rhyacophilidae			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhyacophila	L	B	-	-	-	-	-	-	1	1	1	1	-	1	1	-
LEPIDOPTERA																
Unidentified Lepidoptera	L	D	1	-	-	-	-	-	-	-	-	-	-	-	-	-
COLEOPTERA			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Staphylinidae	A	D	-	-	-	-	-	-	-	-	-	1	-	-	-	-
HYMENOPTERA																
Unidentified Hymenoptera	A	D	20	1	1	-	-	1	-	-	1	-	-	-	-	-
Formicidae	A	D	-	-	-	-	-	-	1	-	-	-	-	-	-	-
DIPTERA			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Empididae	A	D	-	-	-	-	-	1	-	-	-	-	-	-	-	-

Appendix 7.6-1c. Stomach Contents of Dolly Varden/Bull Trout by Number, Brucejack Gold Mine Project, 2012

Location and Number			**WC1-1**	**WC1-2**	**WC1-3**	**WC1-4**	**WC1-5**	**WC1-6**	**MC1-1**	**MC1-2**	**MC1-3**	**MC1-4**	**MC1-5**	**MC1-6**	**MC1-7**	**MC1-8**
Date			**28-Aug-12**	**28-Aug-12**	**1-Sep-12**	**1-Sep-12**	**1-Sep-12**	**1-Sep-12**	**29-Aug-12**	**29-Aug-12**	**29-Aug-12**	**29-Aug-12**	**29-Aug-12**	**29-Aug-12**	**29-Aug-12**	**29-Aug-12**
Sample No.			**120100**	**120101**	**120102**	**120103**	**120104**	**120105**	**120106**	**120107**	**120108**	**120109**	**120110**	**120111**	**120112**	**120113**
Fullness (%)			**25**	**90**	**75**	**90**	**100**	**75**	**90**	**5**	**90**	**50**	**50**	**100**	**90**	**1**
Digestion (%)			**50**	**50**	**50**	**75**	**75**	**90**	**25**	**95**	**25**	**25**	**95**	**25**	**50**	**0**
Actual Weight (mg)			**318**	**78**	**423**	**159**	**246**	**51**	**24**	**2**	**89**	**39**	**27**	**233**	**100**	**1**
Comments																
Species/Group	**Stage**	**Origin**														
Chironomidae																
Chironomidae damaged	P	B	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Orthocladinae	L	B	-	-	-	-	-	-	-	-	5	-	2	7	1	-
Orthocladinae	P	B	-	-	-	-	-	-	-	-	1	-	-	2	-	-
Orthocladius	L	B	-	-	10	-	-	-	-	-	-	-	-	-	-	-
Psectrocladius	P	B	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Diamesinae	L	B	-	2	1	-	-	-	-	-	-	-	-	-	-	-
Brachycera	L	D	-	-	-	-	-	-	-	-	-	-	1	1	-	-
NON-FOOD ITEMS																
Case materials			-	-	-	-	-	P	-	-	-	-	-	P	-	-
Pebble			P	P	P	P	P	-	-	-	-	-	-	-	-	-
TOTAL			33	10	48	16	24	11	5	1	15	5	4	38	13	1

Appendix 7.6-1d. Stomach Contents of Dolly Varden/Bull Trout by Weight, Brucejack Gold Mine Project, 2012

Stomach Number			WC1-1	WC1-2	WC1-3	WC1-4	WC1-5	WC1-6	MC1-1	MC1-2	MC1-3	MC1-4	MC1-5	MC1-6	MC1-7	MC1-8
Date			28-Aug-12	28-Aug-12	1-Sep-12	1-Sep-12	1-Sep-12	1-Sep-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12
Sample No.			120100	120101	120102	120103	120104	120105	120106	120107	120108	120109	120110	120111	120112	120113
Fullness (%)			25	90	75	90	100	75	90	5	90	50	50	100	90	1
Digestion (%)			50	50	50	75	75	90	25	95	25	25	95	25	50	0
Actual Weight (mg)			318	78	423	159	246	51	24	2	89	39	27	233	100	1
Comments																
Species/Group	Stage	Origin														
ARACHNIDA																
Hydracarina		B	-	-	-	1	-	-	-	-	-	-	-	-	-	-
INSECTA																
Unidentified Insecta	parts	B	-	-	-	-	-	29	-	-	-	-	15	-	-	-
EPHEMEROPTERA																
Unidentified Ephemeroptera	N	B	-	5	-	-	-	-	-	-	-	-	-	-	-	-
Ameletidae																
Ameletus	N	B	-	-	-	-	-	-	-	-	50	-	-	161	63	-
Baetidae			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Baetis	N	B	-	-	10	-	3	1	-	-	2	8	-	-	9	-
Ephemerellidae	N*	B	-	-	-	-	-	-	-	-	1	-	2	-	1	-
Ephemerella coloradensis	N	B	-	-	132	31	30	-	-	-	-	-	-	-	-	-
Ephemerella doddsi	N	B	-	-	-	-	-	-	-	-	-	-	-	8	-	-
Heptageneiidae	N*	B	53	-	-	95	50	-	-	-	-	-	-	-	-	-
Cinygmula	N	B	-	-	77	-	90	-	8	-	6	11	-	21	5	-
Epeorus	N	B	63	52	139	3	60	-	-	-	-	-	-	-	-	-
Heptagenia	N	B	-	-	20	-	-	-	-	-	-	-	-	-	-	-
PLECOPTERA																
Unidentified Plecoptera	N	B	2	1	-	3	-	6	-	-	-	-	-	-	-	-
Chloroperlidae	N*	B	-	7	10	21	-	-	-	-	-	-	-	-	1	-
Nemouridae			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nemoura	N	B	-	-	-	-	-	-	-	-	-	-	-	-	-	1
PSOCOPTERA																
Unidentified Psocoptera	A	D	-	-	-	-	-	2	-	-	-	-	-	-	-	-
TRICHOPTERA																
Trichoptera	L*	B	-	-	-	-	-	3	-	-	-	-	-	3	-	-
Rhyacophilidae			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhyacophila	L	B	-	-	-	-	-	-	9	8	19	18	-	10	20	-
LEPIDOPTERA																
Unidentified Lepidoptera	L	D	4	-	-	-	-	-	-	-	-	-	-	-	-	-
COLEOPTERA																
Staphylinidae	A	D	-	-	-	-	-	-	-	-	-	2	-	-	-	-

Appendix 7.6-1d. Stomach Contents of Dolly Varden/Bull Trout by Weight, Brucejack Gold Mine Project, 2012

Stomach Number			WC1-1	WC1-2	WC1-3	WC1-4	WC1-5	WC1-6	MC1-1	MC1-2	MC1-3	MC1-4	MC1-5	MC1-6	MC1-7	MC1-8
Date			28-Aug-12	28-Aug-12	1-Sep-12	1-Sep-12	1-Sep-12	1-Sep-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12	29-Aug-12
Sample No.			120100	120101	120102	120103	120104	120105	120106	120107	120108	120109	120110	120111	120112	120113
Fullness (%)			25	90	75	90	100	75	90	5	90	50	50	100	90	1
Digestion (%)			50	50	50	75	75	90	25	95	25	25	95	25	50	0
Actual Weight (mg)			318	78	423	159	246	51	24	2	89	39	27	233	100	1
Comments																
Species/Group	Stage	Origin														
HYMENOPTERA			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Unidentified Hymenoptera	A	D	185	1	1	-	-	2	-	-	5	-	-	-	-	-
Formicidae	A	D	-	-	-	-	-	-	5	-	-	-	-	-	-	-
DIPTERA																
Empididae	A	D	-	-	-	-	-	3	-	-	-	-	-	-	-	-
Chironomidae			-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chironomidae damaged	P	B	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Orthocladinae	L	B	-	-	-	-	-	-	-	-	5	-	2	4	1	-
Orthocladinae	P	B	-	-	-	-	-	-	-	-	1	-	-	3	-	-
Orthocladius	L	B	-	-	22	-	-	-	-	-	-	-	-	-	-	-
Psectrocladius	P	B	-	-	-	-	-	-	2	-	-	-	-	-	-	-
Diamesinae	L	B	-	10	3	-	-	-	-	-	-	-	-	-	-	-
Brachycera	L	D	-	-	-	-	-	-	-	-	-	-	8	20	-	-
NON-FOOD ITEMS																
Case materials			-	-	-	-	-	5	-	-	-	-	-	3	-	-
Pebble			10	2	9	5	13	-	-	-	-	-	-	-	-	-
TOTAL			318	78	423	159	246	51	24	8	89	39	27	233	100	1

Appendix 7.6-1e. Abbreviations Used in Stomach Contents Analysis Reports, Brucejack Gold Mine Project, 2010 to 2012

Abbreviation	Description
A	adult
cop	copepodite (juvenile copepod)
dam	damaged
E	egg
F	female
juv	juvenile
L	larva (first juvenile of homometabolous insect)
L*	larva too small to be identified further
M	male
N	nymph (juvenile of hemimetabolous insect)
N*	nymph too small to be identified further
P	pupa (second juvenile of homometabolous insect)
I to V	first through fifth copepodite stages
B	Benthic/epibenthic
D	Drift
TERR	Terrestrial
W	Water column
Z	Zooplankton
Estimated Weight	Used when parts add up to more than the actual weight recorded, usually when the sample is heavily digested.
X	Present (in fish diet studies)