APPENDIX 15-G
2011 FISH AND FISH HABITAT BASELINE REPORT

Seabridge Gold Inc.

KSM PROJECT
2011 Fish and Fish Habitat Baseline Report

SEABRIDGE GOLD

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KSM PROJECT

2011 FISH AND FISH HABITAT BASELINE REPORT

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Prepared for:

SEABRIDGE GOLD

Seabridge Gold Inc.

Prepared by:

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Executive Summary

The primary purpose of the 2011 KSM Fish and Fish Habitat Baseline Program was to provide baseline data within the Project area that may be impacted by proposed mine and infrastructure development. This report describes sampling procedures and results of the 2011 KSM Project Fish and Fish Habitat Baseline Program.

All watercourses to be crossed by a realigned section of the Transmission Line were assessed. Watercourses within a section of the Teigen Access Road were re-assessed due to recent flood events. Select watercourse crossings were assessed for the conceptual Treaty Access Road based upon fish bearing potential. For the realigned section of the Transmission Line, two stream sites were assessed, of which both were classified as fish bearing. For the conceptual Treaty Access Road, 20 stream sites were assessed, of which 13 were classified as fish bearing.

Single pass electrofishing CPUE was calculated as an index of relative abundance for Dolly Varden populations in South Teigen Creek (between the falls and seepage dam) and North Treaty Creek. No salmon species were caught, despite 5,221 s of electrofishing effort throughout both creeks. Dolly Varden adults and parr were the dominant life history stage caught in both creeks.

Steelhead snorkel/redd surveys were conducted within Teigen, South Teigen (downstream of the falls), Treaty and North Treaty creeks to confirm steelhead spawning presence, determine steelhead spawning habitat distribution throughout the watershed, determine timing of steelhead spawning and provide an index of adult abundance. Steelhead adults or redds were not detected in any creeks due to low water temperatures, high discharge and poor visibility. Snorkel surveys were determined to be ineffective until late June to early July; however steelhead spawning may have terminated at that time and visibility is likely poor.

Acknowledgements

This report was produced by Rescan Environmental Services Ltd. (Rescan). Christopher Burns (B.Sc., R.P.Bio.) was the Rescan Project Manager and author of the report. François Landry (M.Sc., R.P.Bio.) aided in project management and provided fish and fish habitat expertise. The following fisheries staff conducted field work and led field crews: Christopher Burns (B.Sc., R.P.Bio.), Glen Keddie and Mike Stamford (M.Sc.). Field assistance was provided by Jarvis Williams, Vernon Russell and James Morgan. Lakelse Helicopters provided helicopter support. Report production was co-ordinated by Jackie van der Eerden (Word Processing), Francine Alford (Graphics) and Pieter van Leuzen (GIS).

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Glossary 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.

CI	Confidence Interval
CPUE	Catch-Per-Unit-Effort
FDIS	Field Data Inventory System
FHAP	Fish Habitat Assessment Procedures
GPS	Global Positioning System
HV	Horizontal Visibility
ILP	Interim Locational Point
KSM	Kerr-Sulphurets-Mitchell
MOE	Ministry of Environment
MOF	Ministry of Forests
NCD	Non-Classified Drainage
NVC	No Visible Channel
QA	Quality Assurance
QC	Quality Control
RISC	Resource Information Standards Committee
SE	Standard Error
TMF	Tailing Management Facility
TRIM	Terrain Resource Inventory Mapping

1. Introduction

1.1 PROJECT PROPONENT

Seabridge Gold Inc. (Seabridge) is the proponent for the proposed KSM Project (the Project), a gold, copper, silver, molybdenum mine.

1.2 PROJECT LOCATION

The Project is located in the coastal mountains of northwestern British Columbia. It is approximately 950 km northwest of Vancouver and 65 km northwest of Stewart, within 30 km of the British Columbia–Alaska border (Figure 1.2-1).

1.3 PROJECT OVERVIEW

The Project is located in two geographical areas: the Mine Site and Processing and Tailing Management Area (PTMA), connected by twin 23-km tunnels, the Mitchell-Treaty Twinned Tunnels (Figure 1.3-1). The Mine Site is located south of the closed Eskay Creek Mine, within the Mitchell, McTagg, and Sulphurets Creek valleys. Sulphurets Creek is a main tributary of the Unuk River, which flows to the Pacific Ocean. The PTMA is located in the upper tributaries of Teigen and Treaty creeks. Both creeks are tributaries of the Bell-Irving River, which flows to the Nass River and into the Pacific Ocean. The PTMA is located about 19 km southwest of Bell II on Highway 37.

The Mine Site will be accessed by a new road, the Coulter Creek Access Road, which will be built from km 70 on the Eskay Creek Mine Road. This road will follow Coulter and Sulphurets creeks to the Mine Site. The PTMA will also be accessed by a new road, the Treaty Creek Access Road, the first 3-km segment of which is a forest service road off of Highway 37. The Treaty Creek Access Road will parallel Treaty Creek.

Four deposits will be mined at the KSM Project—Kerr, Sulphurets, Mitchell, and Iron Cap—using a combination of open pit and underground mining methods. Waste rock will be stored in engineered rock storage facilities located in the Mitchell and McTagg valleys at the Mine Site. Ore will be crushed and transported through one of the Mitchell-Treaty Twinned Tunnels to the PTMA. This tunnel will also be used to route the electrical power transmission lines. The second tunnel will be used to transport personnel and bulk materials. The Process Plant will process an average of 130,000 tpd of ore to produce a daily average of 1,200 t of concentrate. Tailing will be pumped to the Tailing Management Facility from the Process Plant. Copper concentrate will be trucked from the PTMA along highways 37 and 37A to the Port of Stewart, which is approximately 170 km away via road.

The mine operating life is estimated at 51.5 years. Approximately 1,800 people will be employed annually during the Operation Phase. Project Construction will take about five years, and the capital cost of the Project is approximately US$5.3 billion.

Figure 1.2-1

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KSM Project Location

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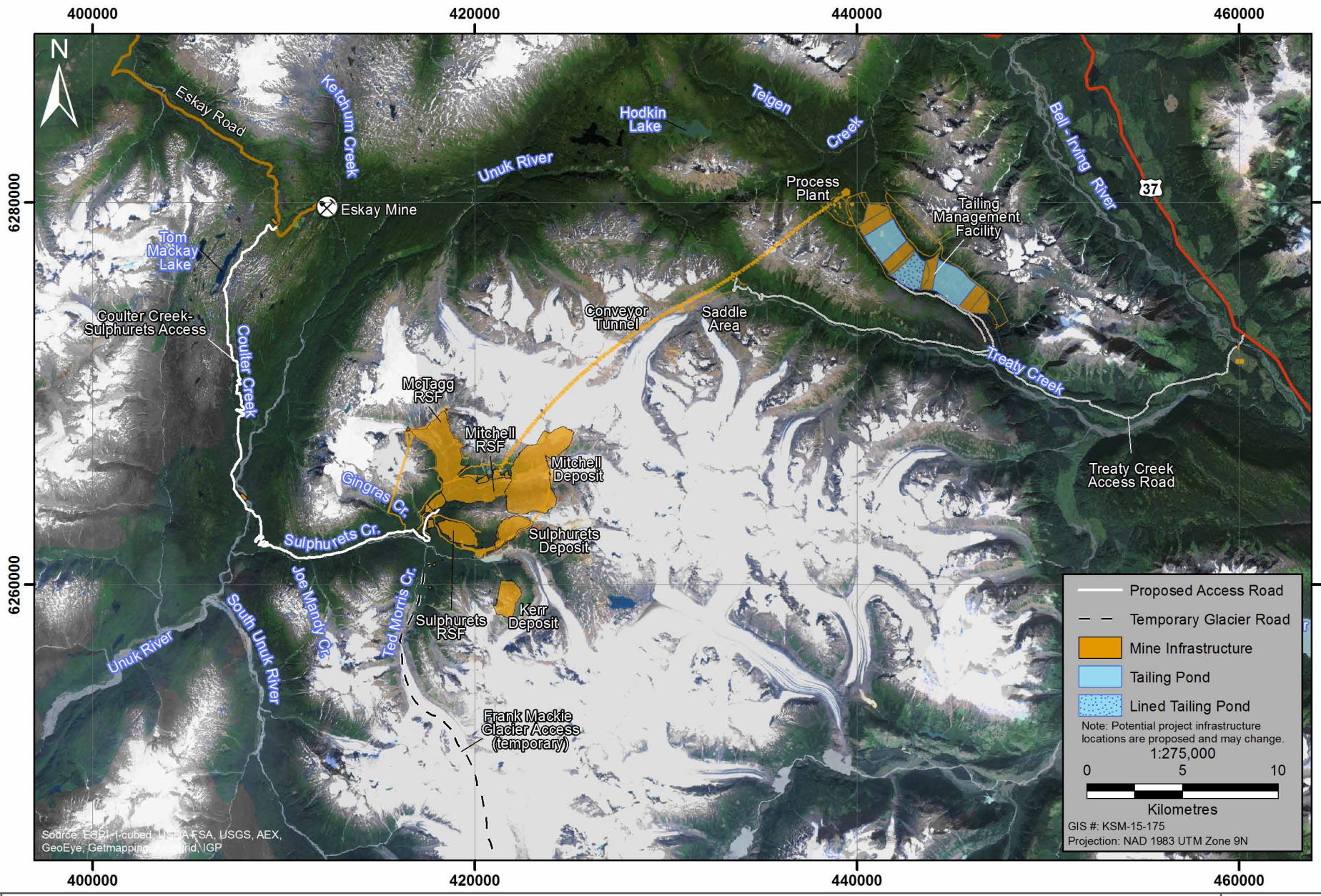

Figure 1.3-1

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KSM Project Layout

Figure 1.3-1

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2. Objectives

The Unuk and Bell-Irving rivers are large river systems that provide spawning migration routes for all five species of Pacific salmon and anadromous rainbow trout (known as steelhead trout), as well as habitat for resident trout (cutthroat and rainbow), resident char (Dolly Varden and bull trout) and whitefish.

The primary purpose of the 2011 KSM Fish and Fish Habitat Baseline Program was to provide baseline data on fish and fish habitat within the Project area that may be impacted by the development of the proposed mine and associated infrastructure. The objectives were as follows:

- determine fish presence, community composition, spatial distribution and barriers to fish movement for watercourses along proposed access roads and transmission line;
- assess the quality of fish habitat in watercourses along proposed access roads and transmission line;
- assess Dolly Varden abundance in South Teigen Creek and North Treaty Creek downstream of the TMF; and
- determine steelhead spawning habitat distribution and escapement/redd abundance in watercourses downstream of the TMF.

These objectives were achieved through field work in 2011, review of 2008, 2009 and 2010 baseline data (Rescan 2009, 2010, 2011), and review of relevant background information about fish and fish habitat distribution, abundance and habitat use within the study area.

3. Study Area

The fish and fish habitat study area encompasses three major watersheds: Unuk, Bell-Irving and Bowser rivers. The study area boundaries are based upon the locations of the proposed mine and infrastructure development (Figure 3-1). The 2011 fish and fish habitat assessments focused on the Transmission Line realignment, conceptual Treaty Access Road and watercourses downstream of the TMF.

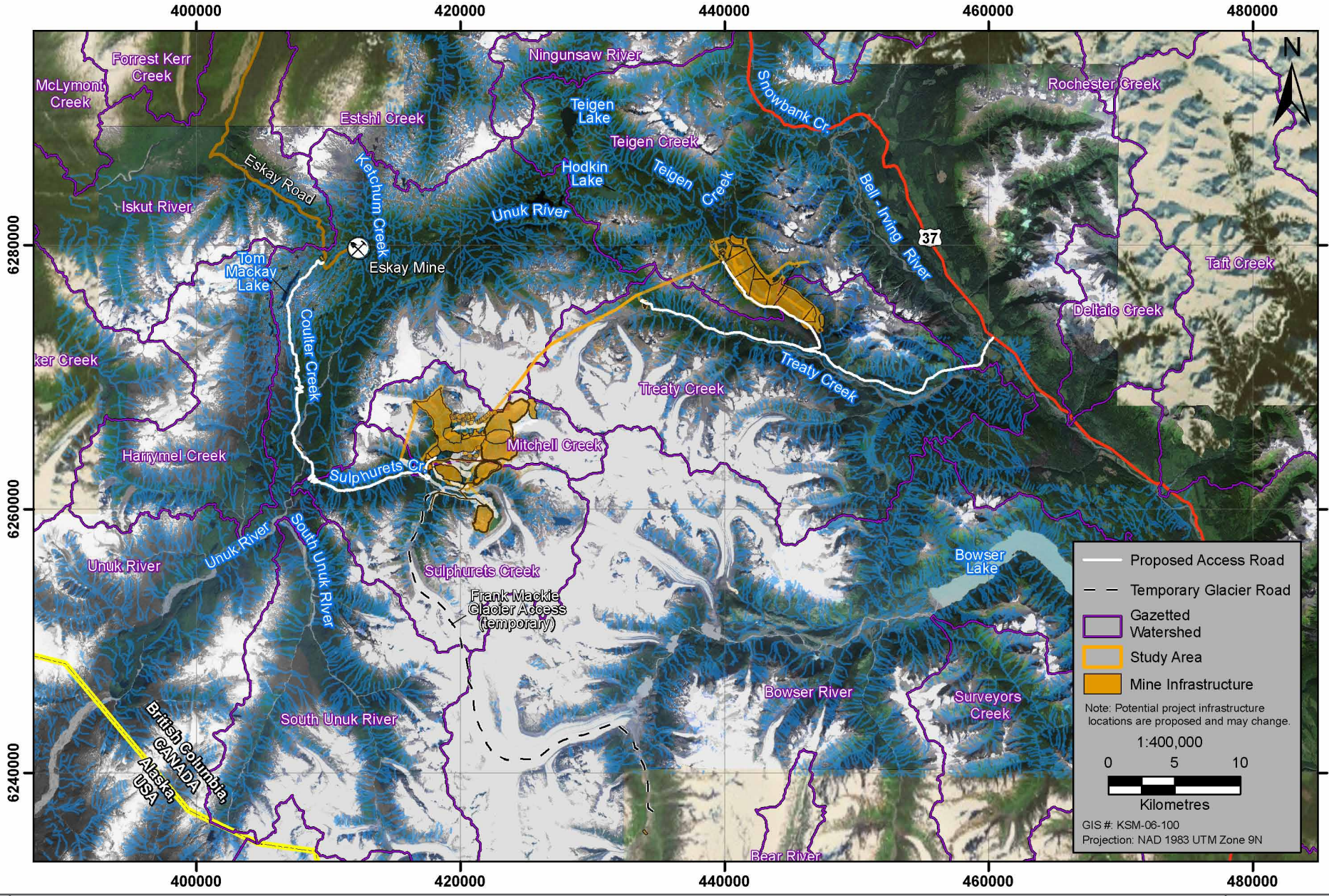

Figure 3-1

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KSM Fisheries Study Area, 2011

Figure 3-1

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4. Methods

4.1 FISH HABITAT COMPONENTS

For the purpose of this program, assessed sites were divided into three categories: access roads and transmission line, Dolly Varden abundance and steelhead spawning habitat. The access roads and transmission line category included watercourses crossed by a realigned section of the Transmission Line and a conceptual Treaty Access Road. The Dolly Varden abundance assessment included the reach of South Teigen Creek between the falls and the TMF seepage dam; and the reach of North Treaty Creek downstream of the TMF seepage collection dam to the large tributary confluence. Steelhead snorkel/redd surveys included watercourses downstream of the TMF.

4.2 ACCESS ROADS AND TRANSMISSION LINE

4.2.1 Study Design

The entire realigned section of the transmission line along Teigen Road was ground-truthed to identify watercourse crossings. Watercourses crossing the transmission line were assessed from August 21 to 23. The objectives of the watercourse assessments were to confirm fish presence, describe fish habitat and rank fish habitat suitability.

Select watercourse crossings were assessed for the conceptual Treaty Access Road. The access road route parallels Treaty Creek from its confluence with the Bell-Irving River to near the headwaters of the Creek. Within the study area, numerous watercourses are mapped through provincial Terrain Resource Inventory Mapping (TRIM). However, previous watercourse crossing assessments indicate that the majority of these watercourses are ephemeral drainages and are not streams (Rescan 2009, 2010, 2011a). Watercourses were selected based upon fish bearing potential that may be affected by road development. Watercourses crossing the access road were assessed on September 22 to 24 and October 11 to 13. The objectives of the watercourse assessments were to describe fish habitat and rank fish habitat suitability.

Select watercourse crossings were assessed for the Teigen Access Road. They were selected based upon surveyor requests and confirmation investigations. These crossings were assessed on September 14.

4.2.2 Fish Habitat

The locations of the proposed access roads and transmission line were ground-truthed with a map and compass. Field crews ground-truthed the proposed alignments for locations of streams, non-classified drainages (NCD) and no visible channels (NVC). 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 NCDs. Sites where water seeped or flowed overland, or where water pooled at a potential road crossing but where no channelization was apparent, were classified as NVC. For NCDs and NVCs, photos were taken facing upstream and downstream, global positioning system (GPS) coordinates (±10 m) were obtained and sites were flagged.

For all site classifications (i.e., NVC, NCD or stream), 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* (RISC 2001) and the *Reconnaissance 1:20,000 Fish*

and Fish Habitat Inventory: Site Card Field Guide (RISC 1999a). This protocol involved characterizing fish habitat over a 100 m-long section of stream by measuring physical attributes (e.g., channel width, gradient, temperature and water quality), characterizing cover types and substrate (dominant and subdominant cover and substrate type, cover abundance and location) and describing stream morphology. Table 4.2-1 presents a complete list of attributes measured at each stream crossing. Based on the attributes collected at the stream crossing in the field, professional expertise was used to rank habitat suitability for each fish life history stage (i.e., spawning, rearing and over-wintering) and overall habitat quality. Table 4.2-2 presents habitat suitability and overall habitat quality ranks and their corresponding criteria.

Table 4.2-1. Attributes Measured during Habitat Assessments at Stream Crossing Sites

Substrate	Physical Measurements	Habitat	Cover
Dominate type	Bankfull width (m)	Stream morphology	Total amount
Sub-dominant type	Wetted width (m)	Presence of bars	Dominant, sub-dominant and trace cover types
D (cm)	Residual pool depth (cm)	Presence of islands	Cover location
D95 (cm)	Bankfull depth (m)	Bank shape	Canopy closure (%)
Bank texture	Gradient (%)	Stream pattern	Riparian vegetation
	Temperature (°C)	Confinement	Riparian vegetation stage
	Conductivity (µS/cm)	Hillslope coupling	
	pH (log units)	Spawning, rearing, overwintering suitability	
	Turbidity	Overall habitat quality	
		Riparian function	

D = largest stone that will move in a normal flood period (measured along the intermediate axis; cm; RISC 2001).
D95 = stone that is in the top 5th percentile (by size; measured along the intermediate axis; cm; RISC 2001).
Turbidity was visually estimated.

Table 4.2-2. Life History Habitat Suitability and Overall Habitat Quality Criteria Assessed at Stream Crossing Sites

Life Stage Suitability Rank	Criteria
None	No habitat present for any life history stage
Poor	Most of the necessary physical/biological components of the habitat for this life history stage are missing or severely deficient
Fair	Some of the necessary physical/biological components of the habitat for this life history stage are present, but a key component is missing
Good	All of the necessary physical/biological components of the habitat for this life history stage are present
Overall Habitat Quality Rank	**Criteria**
None	No habitat present at crossing
Marginal	Low productive capacity
Important	Common habitat which supplies needs of fish – typically rearing/over-wintering and some potential and commonly observed spawning substrate
Critical	Rare or exceptionally productive or unusual habitat with very high habitat values which are of uncommon and/or highly valuable production

A minimum of two photographs was taken to document each site, one facing upstream from the proposed crossing and one facing downstream from the crossing. Additional photographs were taken of barriers or features. GPS coordinates were obtained and the site was flagged.

4.2.3 Fish Community

4.2.3.1 Community Composition

The stream crossing on the realigned section of the Transmission Line along Teigen Creek were sampled using backpack electrofishers following RISC *Fish Collection Methods and Standards* (RISC 1997), *Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Standards and Procedures* (RISC 2001) and the *Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Fish Collection Field Guide* (RISC 1999b). The primary objective of fish sampling was to confirm fish presence and the secondary objective was to determine the fish community composition (MOF 1998). Fish sampling occurred in the same locations where the habitat assessments occurred.

Electrofishing was conducted over a minimum 100 m-long stream section (50 m both upstream and downstream of each proposed crossing site); and for approximately 500 electrofishing seconds at each site. Only one electrofishing pass was made and no stop nets were used to prevent fish movement. Electrofishing in spawning areas during fish spawning activity was avoided to reduce the chance of harming fish and impacting spawning activities as required by the collection permit.

Biological information was collected on captured fish including species and length (to the nearest 1 mm). Dolly Varden and bull trout were identified to species based upon physical characteristics (e.g., branchiostegal rays) and habitat preferences. All fish were then returned live to the stream.

4.2.3.2 Stream Classification

A defensible, systematic approach was adopted to classify the fish bearing status of a stream crossing. 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 is presented in Table 4.2-3. The guidebook provides criteria for classifying streams as either fish bearing (i.e., Classes S1, S2, S3, 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 4.2-3. 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 access roads and 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.

4.3 DOLLY VARDEN ABUNDANCE

4.3.1 Study Design

A simple random design was used for this assessment. Abundance of Dolly Varden life history stages was assessed within the reach of South Teigen Creek between the falls and the TMF seepage dam from August 18 to 20. The reach was separated into 10 sites of 200 m in stream length. Sites were randomly selected for sampling with a random number generator from MS Excel. A standard site length of 200 m was selected because similar wetted depths, wetted widths, substrate composition, habitat unit composition (cascade-pool), and instream cover are present throughout the reach (Rescan 2010). Furthermore, 2010 sampling of Dolly Varden abundance in the lower reach of South Teigen Creek (between the falls and Teigen Creek confluence) used the same methods and site length of 200 m because of similar habitat conditions (Rescan 2011a).

Abundance of Dolly Varden life history stages was assessed within Hodder Creek on September 17. Hodder Creek was selected as a control site for South Teigen Creek because of similar channel morphology, instream cover, bankfull width, geographic position within the watershed, and species composition. The reach was separated into sites of 200 m in stream length. Non-adjacent sites were randomly selected for sampling with a random number generator from MS Excel. A standard site length of 200 m was selected for similar reasons stated above.

Abundance of Dolly Varden life history stages was assessed within the reach of North Treaty Creek downstream of the TMF seepage collection dam to the large tributary confluence from September 14 to 15. Due to channel complexity and variable instream cover throughout the reach, standard site lengths were not selected. Site length varied to encompass entire habitat units (riffle, pool, glide, cascade) to reduce variability of abundance data (Hankin 1984). Sites were identifed based upon representative habitat unit composition within the reach. Site boundaries commenced at a thalweg crossover point, included 1 crossover point, and ended at a crossover point. A crossover point is where the stream thalweg is in the centre of the channel during bankfull discharge (Stanfield 2005). A sub-sample of sites was selected for assessment with the use of a random number generator from MS Excel.

4.3.2 Fish Habitat

Detailed fish habitat assessments (FHAP) were conducted at North Treaty Creek sites due to channel complexity and variable instream cover throughout the reach (Johnston and Slaney 1996). At each site, UTM coordinates were recorded with a GPS unit. Temperature (°C), pH, and conductivity (µS/cm) were recorded using electronic meters.

FHAP assessments involved differentiating the stream into separate habitat units such as riffles, runs, cascades, glides and pools, and then recording an array of habitat attributes for each unit. These attributes included data on substrate composition, cover for fish and fish habitat type. A complete list of the attributes measured is presented in Table 4.3-1. Data were collected with a measuring tape, metre stick, or visual estimation. Stream habitats within these sites were separated into the following habitat units:

- pool – low velocity area with smooth, non-turbulent flow, low gradient (near 0%), and a concave bottom;
- glide – an area of smooth, non-turbulent flowing water with moderate velocity and gradient less than 3%;
- riffle – an area of turbulent, fast-flowing water with a gradient less than 3%;
- run – an area of low turbulence, fast-flowing water with a gradient less than 3%; and
- cascade – high gradient (>3%) area of turbulent, fast-flowing water.

Table 4.3-1. FHAP Attributes Assessed and Measured at Stream Sites

Habitat Type	Substrate Type	Physical Measurements	Habitat	Cover
% Pool	% Sand	Length (m)	Pool Type	% Deep Pool
% Riffle	% Gravel	Wetted Depth (m)	Pool Residual Depth (m)	% Boulder
% Glide	% Cobble	Bankfull Depth (m)	Fish Passage Barriers	% Instream Vegetation
% Cascade	% Boulder	Wetted Width (m)	Off Channel Type	% Overhanging Vegetation
% Run	% Bedrock	Bankfull Width (m)	Islands/Bars	% Undercut Bank
		Gradient (%)	Functional LWD Size Distribution	% LWD
		Bank Height (m)		% SWD
		Temperature (°C)		
		pH		
		Conductivity (µS/cm)		

4.3.3 Fish Community

In South Teigen and Hodder creeks, each site was located and flagged in the field. Backpack electrofishing was conducted within each site for approximately 1,000 electrofishing seconds; since previous assessments in South Teigen Creek determined this to be sufficient effort within a predetermined site length (Rescan 2011a). Electrofishing effort was not pre-determined for North Treaty Creek due to differences in site length.

Single pass electrofishing catch-per-unit-effort (CPUE) was calculated as an index of relative abundance for all life history stages. Electrofishing was conducted by one crew leader and one dip

netter. Discharge and habitat conditions in all creeks prevented the effective use of stop nets at the upstream and downstream ends of sites. The assumptions of the assessment were that:

- 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.

Fish were captured, counted, identified to species and life history stage. Fork length was measured (to the nearest 1 mm) for all Dolly Varden. Based upon 2009 fork length class distribution sampling data from Teigen and Treaty watersheds (Rescan 2010), Dolly Varden fry are 25 to 45 mm, parr are 45 to 85 mm, and sub-adults/adults are > 85 mm. Age structures were not collected because low Dolly Varden abundance was predicted based upon 2009 assessments (Rescan 2010), and the low abundance of sub-adult/adult Dolly Varden would not provide adequate sample size for analysis. Wet weight (to the nearest 0.01 g) with an Ohaus 200 g scale was collected from all Dolly Varden.

4.4 STEELHEAD SNORKEL/REDD SURVEY

Steelhead snorkel/redd surveys were conducted within Teigen, South Teigen (downstream of the falls), Treaty and North Treaty creeks to confirm steelhead spawning presence, determine steelhead spawning habitat distribution throughout the watershed, determine timing of steelhead spawning, and provide an index of adult abundance. Steelhead snorkel/redd surveys were conducted between May 25 and 27. Areas selected for snorkel/redd surveys varied depending upon the watershed and its relationship with project infrastructure.

Snorkel/redd survey methods followed those detailed in Johnston et al. (2007). Snorkel surveys were conducted with two snorkelers with previous experience conducting steelhead enumeration and redd surveys to develop a consistent application of redd identification. The following data were collected for each snorkel survey: survey date, start and end UTM, start and end time, water clarity (turbid, lightly turbid, moderately turbid, clear), horizontal visibility (m), weather (cloudy, partly cloudy, sunny), water and air temperature (°C), and precipitation (heavy rain, light rain, no rain). Horizontal visibility was measured by one snorkeler holding a black object in the water column, and another snorkeler measured the upstream distance at which he/she could longer see the object in the water column.

All steelhead observed were enumerated. All redds were identified, measured, flagged and georeferenced. Each redd was assigned a unique number. The number of fish on a redd was recorded. Redd longevity and observer efficiency in redd detection were estimated by tracking the condition of individual redds measured during previous surveys (Gallagher and Gallagher 2005). Each redd was classified as one of the following for each site visit:

1. new since last survey but still clear;
2. still measurable but already measured;
3. no longer measurable but still apparent;
4. no redd apparent, only a flag; and
5. poor conditions; cannot determine if present and measurable or not.

4.5 DATA ANALYSIS

Data collected during the fish habitat assessment and fish sampling associated with stream habitats were transcribed from field notes into the MOE Field Data Inventory System (FDIS) for data storage and

interpretation. Where applicable, data were represented as means and the statistic of dispersion was the standard error (SE) of the mean. Data outlier tests were employed to look for abnormal data using SYSTAT statistics software (SYSTAT 2004).

CPUE is an index of relative abundance that can be used to compare fish populations among different areas. This was based on the assumption that catch is proportional to fishing effort and capture efficiency is independent of field conditions (Hubert and Fabrizio 2007). It is defined as the number of fish captured per sampling device per unit time.

For electrofishing, the CPUE was calculated from the number of fish captured per 100 seconds:

*CPUE = number of fish caught * (100/electrofishing effort (s))*

SYSTAT was used for analyses of CPUE data. Data outlier tests were employed to look for abnormal data. Standard means and +/-95% confidence intervals were calculated for each stream. Bootstrapping techniques were used to derive means and percentile bootstrap +/-95% confidence intervals for each stream. Bootstrapping is a computer-based method for assigning measures of accuracy to sample means and is useful when the sample size is insufficient for straightforward statistical inference (Hubert and Fabrizio 2007). Bootstrapping is accomplished using 10,000 resamples from original dataset of each stream.

4.6 QUALITY ASSURANCE/QUALITY CONTROL

In order to ensure consistently accurate data collection, a Quality Assurance (QA) and Quality Control (QC) program was established at the onset of the field program. The program involved a practice session held in the field prior to any crew conducting stream and snorkel assessments to review data collection procedures. Throughout the course of the field program, a qualified and experienced Quality Assurance Biologist reviewed each completed data card daily. A QA checklist was also completed for each site. Whenever clarification was required on specific points, the card was returned to the crew leader for editing and was accepted only after the necessary changes were made. Data entry, into FDIS and other databases, subsequent to the field program provided another opportunity to ensure data consistency through application of the built-in quality assurance routine which generated a QA report for review. Comments were provided to address deficiencies and conflicts identified in the quality assurance report generated by FDIS. Data transcription quality was also verified by comparing a sub-sample of randomly selected site cards with the corresponding data entered into FDIS and into project maps. The standard for QC under the *Reconnaissance (1:20,000) Fish and Fish Habitat Inventory Protocol* is to verify 5% of all site cards (RISC 2001). The biological data were plotted to identify any outliers that may have resulted from transcription errors that occurred in the field.

5. Results

5.1 ACCESS ROADS

All watercourses to be crossed by the realigned section of the Transmission Line were assessed along Teigen Creek. Watercourses within a section of the Teigen Access Road were re-assessed. Select watercourse crossings were assessed for the conceptual Treaty Access Road based upon their fish bearing potential. Detailed site card data and photos are located in Appendices 5.1-1, 5.1-2 and 5.1-3. Stream crossing locations are shown in Figure 5.1-1 for the realigned section of the Transmission Line and Teigen Access Road. Stream crossing locations are shown in Figure 5.1-2 for the conceptual Treaty Creek Access Road.

For the realigned section of the Transmission Line, two crossings were classified as streams and two were classified as NCDs. Both stream crossings were classified as fish bearing based upon previous sampling data (Rescan 2010). For the Teigen Access Road, one fish bearing stream crossing (ILP 5001) was reassessed due to recent flood events in fall 2011. One fish bearing stream crossing (ILP 5000) was identified and assessed near ILP 5001. A total of 23 crossings were assessed for the conceptual Treaty Access Road. A total of 20 were classified as streams and the remainder were classified as NCDs (Figure 5.1-2). Of the 20 streams, 13 were classified as fish bearing based upon available existing information, habitat conditions, lack of fish movement barriers, and suitable gradient to support fish.

Table 5.1-1 presents a summary of each watercourse crossing. Details regarding stream classification, location, channel measurements, bed substrate, channel morphology, cover type, riparian habitat and habitat quality are presented in this table. Channel characteristics and fish habitat cover are site-specific, and habitat quality varies between sites. Generally, stream crossings along the Treaty Access Road are small, high gradient channels subject to continuous disturbance (i.e., high bed load movement) with poor quality rearing habitat and poor to none spawning habitat.

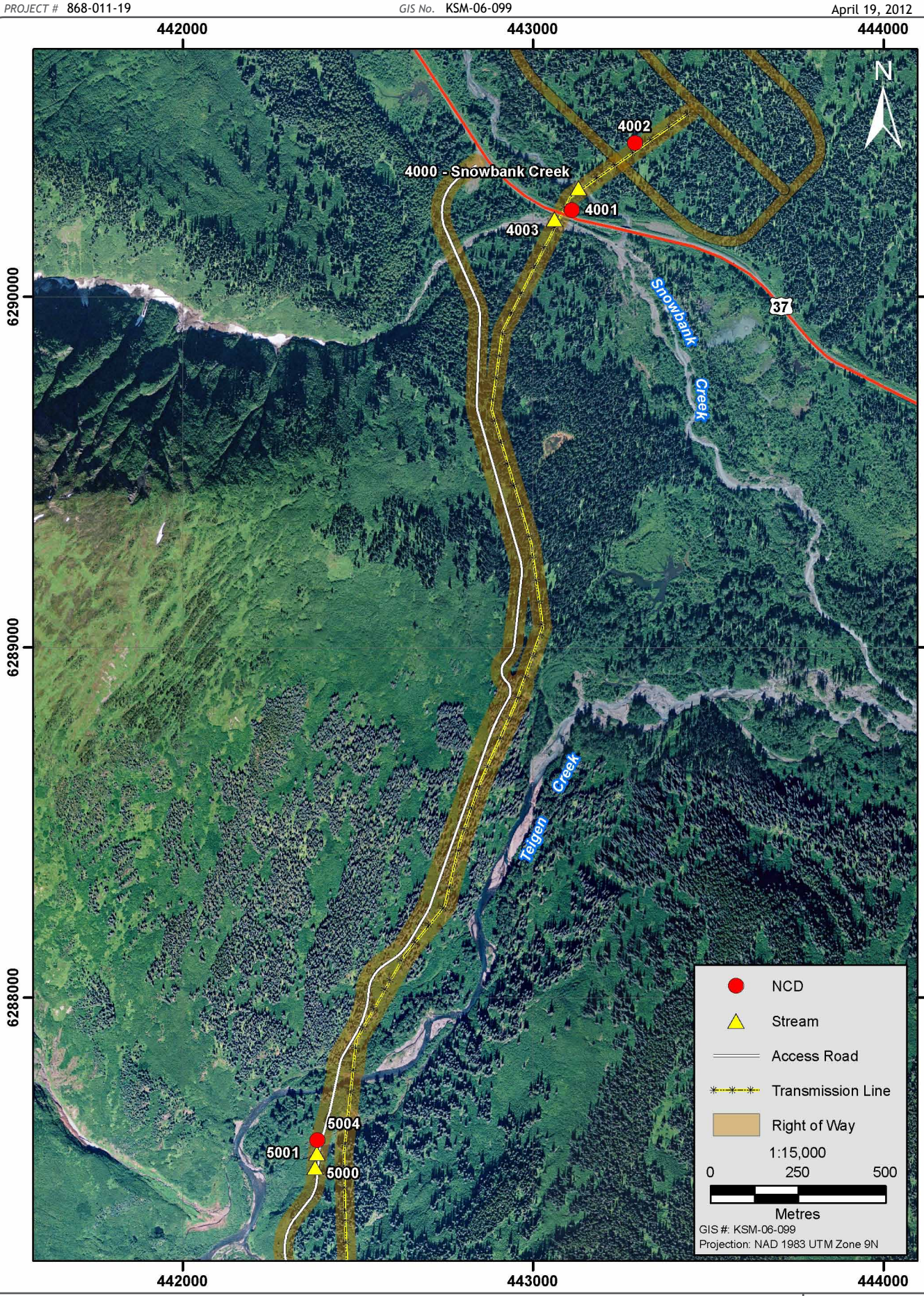
Table 5.1-1 presents a summary of fish species captured and historical fish presence information at stream sites along the proposed alignments. Adequate historical fish information exists (MOE) for the Transmission line and Teigen Access Road (Rescan 2010); therefore fish sampling was not conducted. Fish sampling was not conducted at stream crossings along the conceptual Treaty Access Road due to low water temperatures (<4°C) at the time of sampling, which is ineffective for electrofishing (Malaspina University-College 2006). However, historical fish information exists (MOE) for certain stream crossings (Rescan 2010 and 2011a).

5.2 DOLLY VARDEN ABUNDANCE

Appendices 5.2-1 and 5.2-2 present electrofishing effort, catch, and site locations in South Teigen, North Treaty and Hodder creeks. Appendix 5.2-3 presents biological data for fish sampled.

A total of four sites were sampled in both South Teigen Creek (Figure 5.2-1) and North Treaty Creek (Figure 5.2-2). Two control sites were sampled in Hodder Creek (Figure 5.2-3). Dolly Varden was the only species caught in South Teigen Creek and North Treaty Creek (Table 5.2-1). Four species were caught in in Hoddder Creek. No salmon species were caught in South Teigen and North Treaty creeks, despite 2,749 s and 2,472 s of electrofishing effort, respectively.

PROJECT # 868-011-19 GIS No. KSM-06-099 April 19, 2012



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Location of Realigned Section of the Transmission Line and Teigen Access Road Watercourse Crossings

Figure 5.1-1

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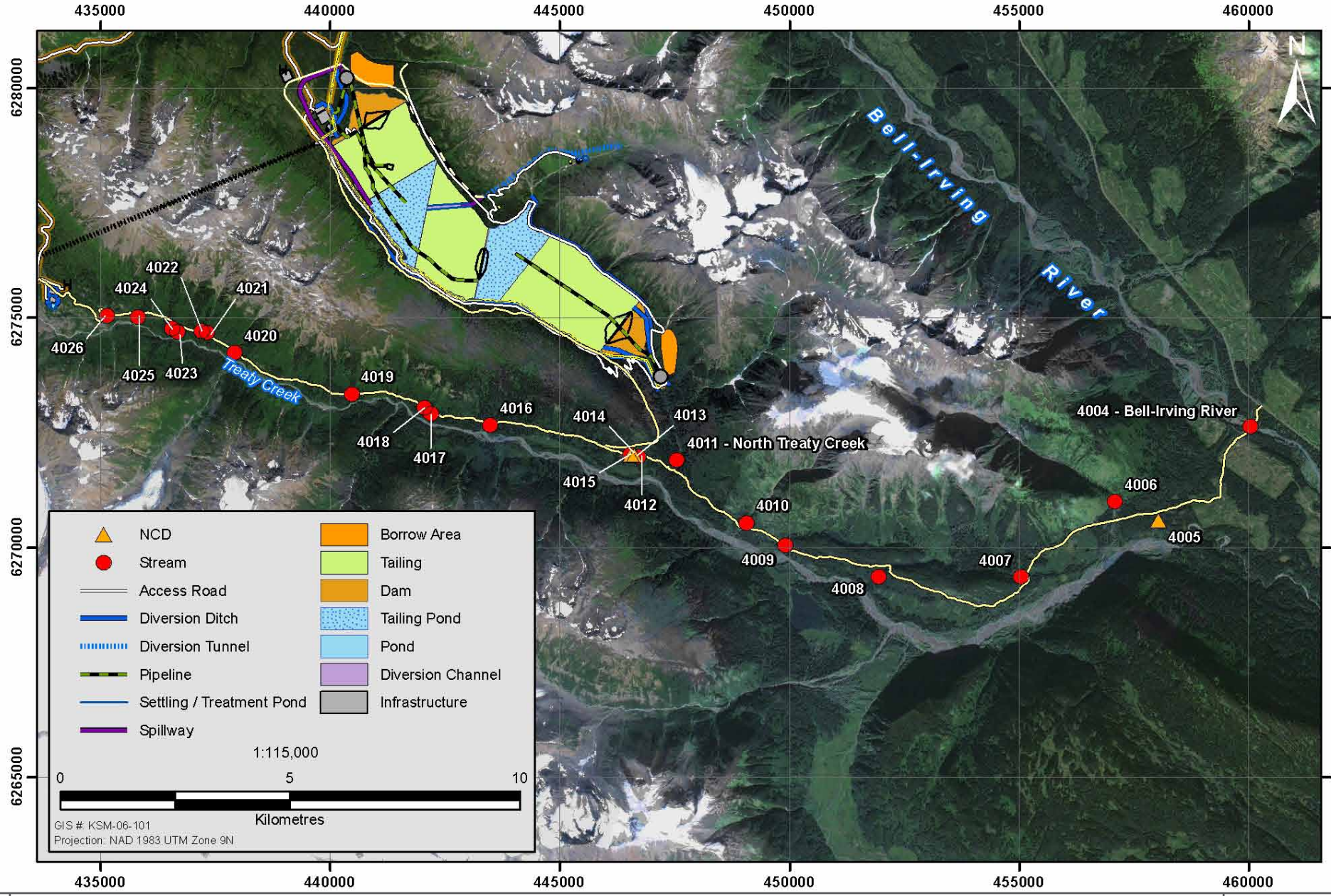

Figure 5.1-2

SEABRIDGE GOLD
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Location of Conceptual Treaty Access Road Watercourse Crossings

Figure 5.1-2

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Table 5.1-1. Individual Stream Crossings, 2011

Alignment	Waterbody Name	Habitat Type	Stream Class	Location		Channel Measurements	
				Easting	Northing	Mean Channel Width (m)	Mean Gradient (%)
Teigen Access Road	5000	Stream	S4	442378	6287516	1.3	1.0%
Teigen Access Road	5001	Stream	S2	442384	6287557	6.0	1.0%
Teigen Access Road	5004	-	NCD	442385	6287543	-	-
Transmission Line	4000 - Snowbank Creek	Stream	S2	443130	6290312	17.0	1.2%
Transmission Line	4001	-	NCD	443111	6290248	-	-
Transmission Line	4002	-	NCD	443292	6290440	-	-
Transmission Line	4003	Stream	S1	443062	6290223	31.3	4.0%
Treaty Access Road	4004 - Bell Irving River	Stream	S1	460039	6272653	70.0	0.5%
Treaty Access Road	4005	-	NCD	458037	6270608	-	-
Treaty Access Road	4006	Stream	S1	457093	6271005	26.0	10.0%
Treaty Access Road	4007	Stream	S2	455051	6269380	5.3	3.2%
Treaty Access Road	4008	Stream	S3	451947	6269378	3.4	14.3%
Treaty Access Road	4009	Stream	S3	449921	6270055	2.5	14.0%
Treaty Access Road	4010	Stream	S2	449071	6270547	8.2	13.0%
Treaty Access Road	4011 - North Treaty Creek	Stream	S2	447556	6271912	8.9	2.7%
Treaty Access Road	4012	Stream	S6	446725	6271994	1.7	34.0%
Treaty Access Road	4013	-	NCD	446635	6272012	-	-
Treaty Access Road	4014	-	NCD	446553	6272027	-	-
Treaty Access Road	4015	Stream	S6	446540	6272039	1.3	70.0%
Treaty Access Road	4016	Stream	S3	443496	6272677	3.3	16.5%
Treaty Access Road	4017	Stream	S6	442206	6272930	1.3	16.0%
Treaty Access Road	4018	Stream	S6	442057	6273057	1.8	6.5%
Treaty Access Road	4019	Stream	S6	440477	6273350	2.2	31.7%
Treaty Access Road	4020	Stream	S5	437932	6274250	3.7	32.5%
Treaty Access Road	4021	Stream	S3	437326	6274684	2.8	26.0%
Treaty Access Road	4022	Stream	S3	437207	6274718	1.7	16.0%
Treaty Access Road	4023	Stream	S6	436679	6274701	1.0	16.5%
Treaty Access Road	4024	Stream	S3	436571	6274780	2.2	11.0%
Treaty Access Road	4025	Stream	S3	435824	6275028	3.2	14.0%
Treaty Access Road	4026	Stream	S3	435155	6275052	2.5	11.0%

(continued)

Dashes indicate not applicable or no data available

Asterisks indicates previously sampled by Rescan (Rescan 2009, 2010, 2011) and/or FDIS data available

Riparian Vegetation Type: D = deciduous; C = coniferous; S = shrubs; G = grass; M = mixed

Dominant Substrate: F = fines; C = cobble; B = boulder; G = gravel

Morphology: CP = cascade pool; RP = riffle pool; SP = step pool; LC = large channel

Cover: B = boulder; IV = intream veg.; LWD = large woody debris; P = pool; OV = overhanging veg.; SWD = small woody debris; UB = undercut bank

Habitat: G = good; P = poor; F = fair; N = none

Species: BT = bull trout; CH = Chinook salmon; CO = coho salmon; DV = Dolly Varden; MWF = mountain whitefish;
SK = sockeye salmon; RB = rainbow trout/steelhead

Table 5.1-1. Individual Stream Crossings, 2011 (continued)

Alignment	Channel Measurements		Channel Characteristics		Habitat	
	Mean Residual Pool Depth (m)	Mean Bankfull Depth (m)	Dominant Substrate	Morphology	Dominant Cover Type	Riparian Vegetation Type
Teigen Access Road	-	0.2	F	RP	OV	S
Teigen Access Road	0.40	0.6	F	RP	SWD	S
Teigen Access Road	-	-	-	-	-	-
Transmission Line	0.50	0.4	G	RP	P	M
Transmission Line	-	-	-	-	-	-
Transmission Line	-	-	-	-	-	-
Transmission Line	-	0.5	G	RP	B	S
Treaty Access Road	-	-	G	RP	SWD	M
Treaty Access Road	-	-	-	-	-	-
Treaty Access Road	0.30	1.5	G	CP	B	M
Treaty Access Road	0.40	0.7	G	RP	SWD	M
Treaty Access Road	0.24	2.7	B	SP	B	M
Treaty Access Road	0.23	0.5	C	CP	SWD	C
Treaty Access Road	0.34	3.0	B	SP	B	S
Treaty Access Road	-	1.1	B	CP	B	D
Treaty Access Road	-	-	C	CP	SWD	S
Treaty Access Road	-	-	-	-	-	-
Treaty Access Road	-	-	-	-	-	-
Treaty Access Road	-	-	C	CP	SWD	S
Treaty Access Road	0.26	0.9	G	SP	LWD	C
Treaty Access Road	0.10	0.2	G	CP	SWD	C
Treaty Access Road	0.18	0.6	G	RP	SWD	S
Treaty Access Road	-	-	C	SP	SWD	C
Treaty Access Road	-	-	G	CP	B	S
Treaty Access Road	0.18	1.0	G	CP	OV	S
Treaty Access Road	-	-	G	CP	SWD	C
Treaty Access Road	0.10	0.6	G	SP	OV	S
Treaty Access Road	0.22	0.6	G	SP	SWD	C
Treaty Access Road	-	1.8	G	CP	B	S
Treaty Access Road	0.50	0.6	C	CP	B	S

Dashes indicate not applicable or no data available *(continued)*

Asterisks indicates previously sampled by Rescan (Rescan 2009, 2010, 2011) and/or FDIS data available

Riparian Vegetation Type: D = deciduous; C = coniferous; S = shrubs; G = grass; M = mixed

Dominant Substrate: F = fines; C = cobble; B = boulder; G = gravel

Morphology: CP = cascade pool; RP = riffle pool; SP = step pool; LC = large channel

Cover: B = boulder; IV = intream veg.; LWD = large woody debris; P = pool; OV = overhanging veg.; SWD = small woody debris; UB = undercut bank

Habitat: G = good; P = poor; F = fair; N = none

Species: BT = bull trout; CH = Chinook salmon; CO = coho salmon; DV = Dolly Varden; MWF = mountain whitefish;

SK = sockeye salmon; RB = rainbow trout/steelhead

Table 5.1-1. Individual Stream Crossings, 2011 (completed)

	Habitat Quality			Fish		
Alignment	Overwintering	Rearing	Spawning	Sampled	Fish Bearing Status	Species Present
Teigen Access Road	P	P	F	No	Confirmed	CO, DV
Teigen Access Road	F	F	F	Yes*	Confirmed	CO, DV
Teigen Access Road	-	-	-	-	-	-
Transmission Line	G	F	F	Yes	Confirmed	BT, CH, CO, DV, MWF, RB
Transmission Line	-	-	-	-	-	-
Transmission Line	-	-	-	-	-	-
Transmission Line	P	P	P	Yes*	Confirmed	DV, RB
Treaty Access Road	G	G	F	Yes*	Confirmed	BT, CH, CO, DV, MWF, SK, RB
Treaty Access Road	-	-	-	-	-	-
Treaty Access Road	P	P	N	No	Default	-
Treaty Access Road	G	G	G	Yes*	Confirmed	DV
Treaty Access Road	P	P	P	Yes*	Confirmed	DV
Treaty Access Road	P	P	P	No	Default	-
Treaty Access Road	P	F	N	No	Default	-
Treaty Access Road	G	F	P	Yes*	Confirmed	DV
Treaty Access Road	N	P	N	-	-	-
Treaty Access Road	-	-	-	-	-	-
Treaty Access Road	-	-	-	-	-	-
Treaty Access Road	N	P	N	-	-	-
Treaty Access Road	P	G	P	No	Default	-
Treaty Access Road	P	P	P	-	-	-
Treaty Access Road	P	P	P	-	-	-
Treaty Access Road	P	P	N	-	-	-
Treaty Access Road	P	P	N	-	-	-
Treaty Access Road	P	P	N	No	Default	-
Treaty Access Road	P	P	N	No	Default	-
Treaty Access Road	N	P	N	-	-	-
Treaty Access Road	G	G	P	No	Default	-
Treaty Access Road	P	P	N	No	Default	-
Treaty Access Road	F	F	P	No	Default	-

Dashes indicate not applicable or no data ava

Asterisks indicates previously sampled by Res

Riparian Vegetation Type: D = deciduous; C =

Dominant Substrate: F = fines; C = cobble; B = boulder; G = gravel

Morphology: CP = cascade pool; RP = riffle pool; SP = step pool; LC = large channel

Cover: B = boulder; IV = intream veg.; LWD = large woody debris; P = pool; OV = overhanging veg.; SWD = small woody debris; UB = undercut bank

Habitat: G = good; P = poor; F = fair; N = none

Species: BT = bull trout; CH = Chinook salmon; CO = coho salmon; DV = Dolly Varden; MWF = mountain whitefish;

SK = sockeye salmon; RB = rainbow trout/steelhead

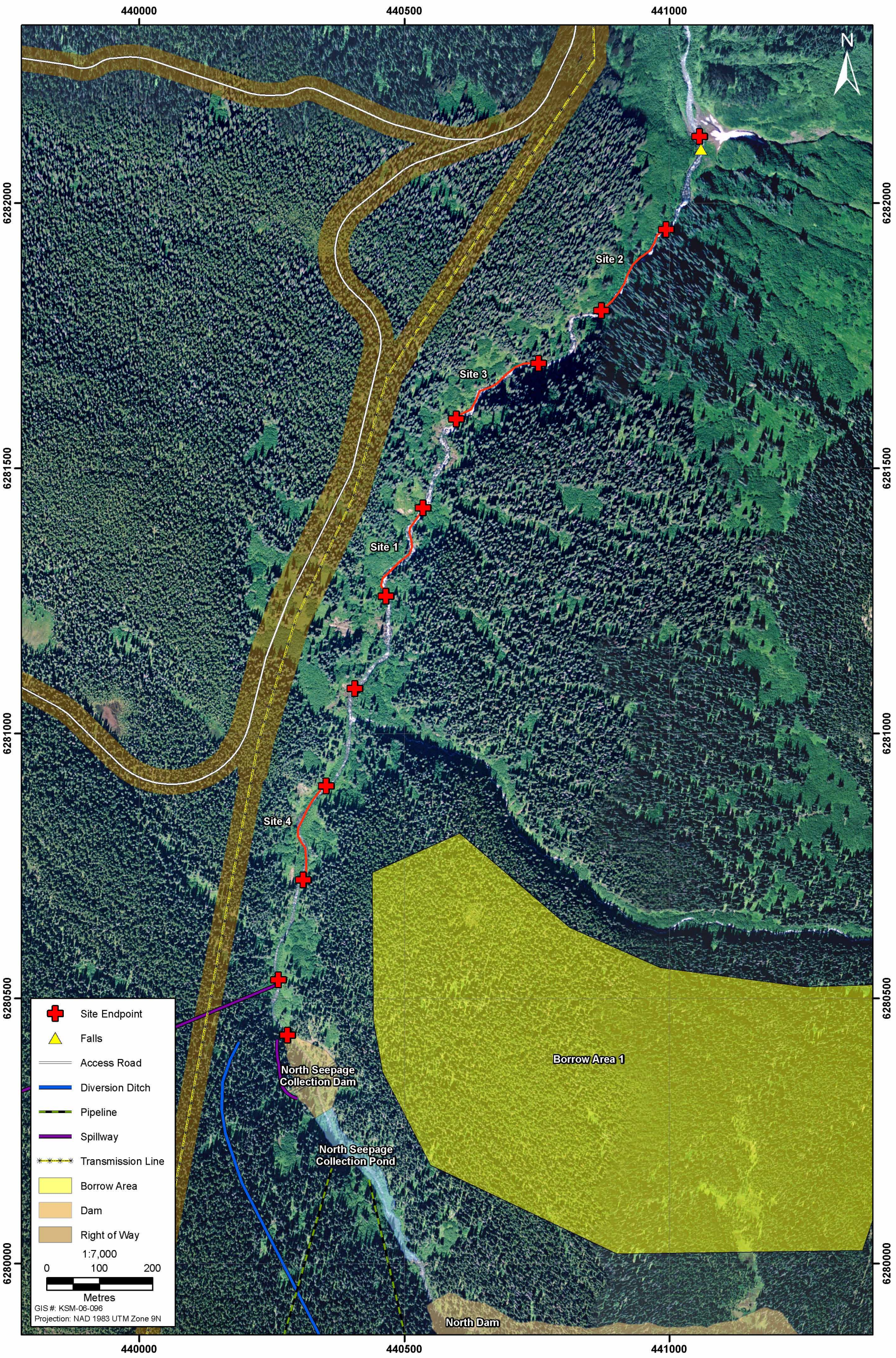

Figure 5.2-1

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Fish Sampling Locations in South Teigen Creek, 2011

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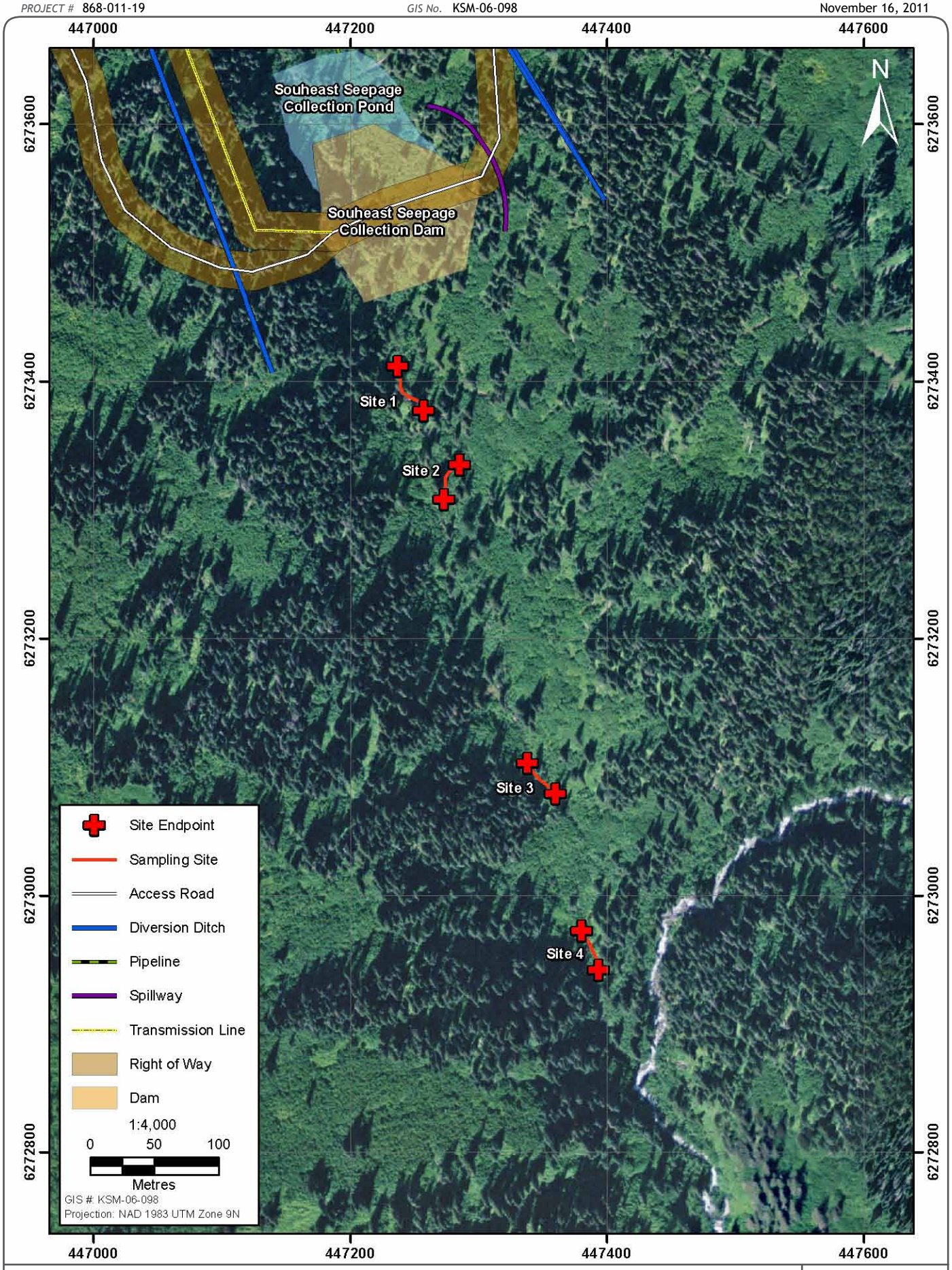

Figure 5.2-2

Fish Sampling Locations in North Treaty Creek, 2011

SEABRIDGE GOLD
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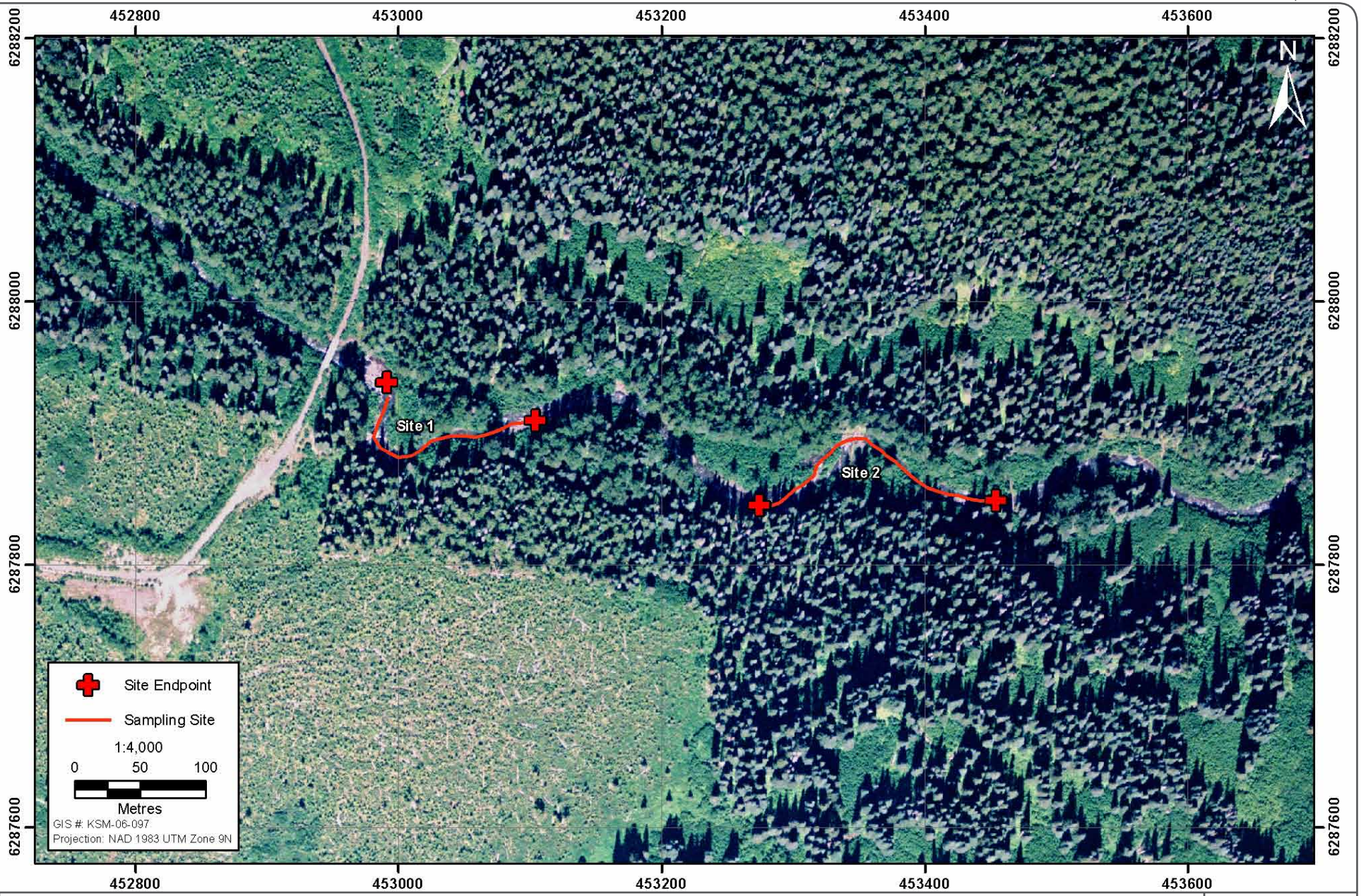

Figure 5.2-3

SEABRIDGE GOLD
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Fish Sampling Locations in Hodder Creek, 2011

Figure 5.2-3

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Table 5.2-1. Summary Statistics of Electrofishing Effort and CPUE, 2011

Watercourse	No. Sites	Total Effort (s)	Dolly Varden			Rainbow Trout			Chinook Salmon			Bull Trout		
			n	Mean CPUE	SE	n	Mean CPUE	SE	n	Mean CPUE	SE	n	Mean CPUE	SE
Hodder Creek	2	2,108	5	0.25	0.09	2	0.10	0.01	10	0.51	0.27	1	0.06	0.06
North Treaty Creek	4	2,472	15	0.61	0.22	0	-	-	0	-	-	0	-	-
South Teigen Creek	4	2,749	10	0.34	0.12	0	-	-	0	-	-	0	-	-

Dashes indicate not applicable

CPUE = catch-per-unit-effort, fish/100 s

SE = standard error of the mean

n = number of fish caught

Figure 5.2-4 shows a graphical comparison of regular CPUE means (+/- 95% CI) and bootstrapped CPUE means (+/- 95% CI). CPUE data is typically not normal normally distributed (i.e., negative binomial distribution) and sample size is low for this assessment; therefore bootstrapped techniques were used for graphical comparison of means not statistical analysis (Hubert and Fabrizio 2007). Because replication was low, the bootstrapped confidence intervals are likely narrower than true confidence intervals, whereas the regular confidence intervals are likely larger than the true confidence intervals. The graphical comparison shows that South Teigen Creek (below falls) is the only stream reach with a mean CPUE lying outside the CI of South Teigen Creek (above falls) and Hodder Creek. This suggests that CPUE is higher in South Teigen Creek (below falls) than South Teigen Creek (above falls) and Hodder Creek. However, greater sampling effort would be required in all streams to confirm this observation.

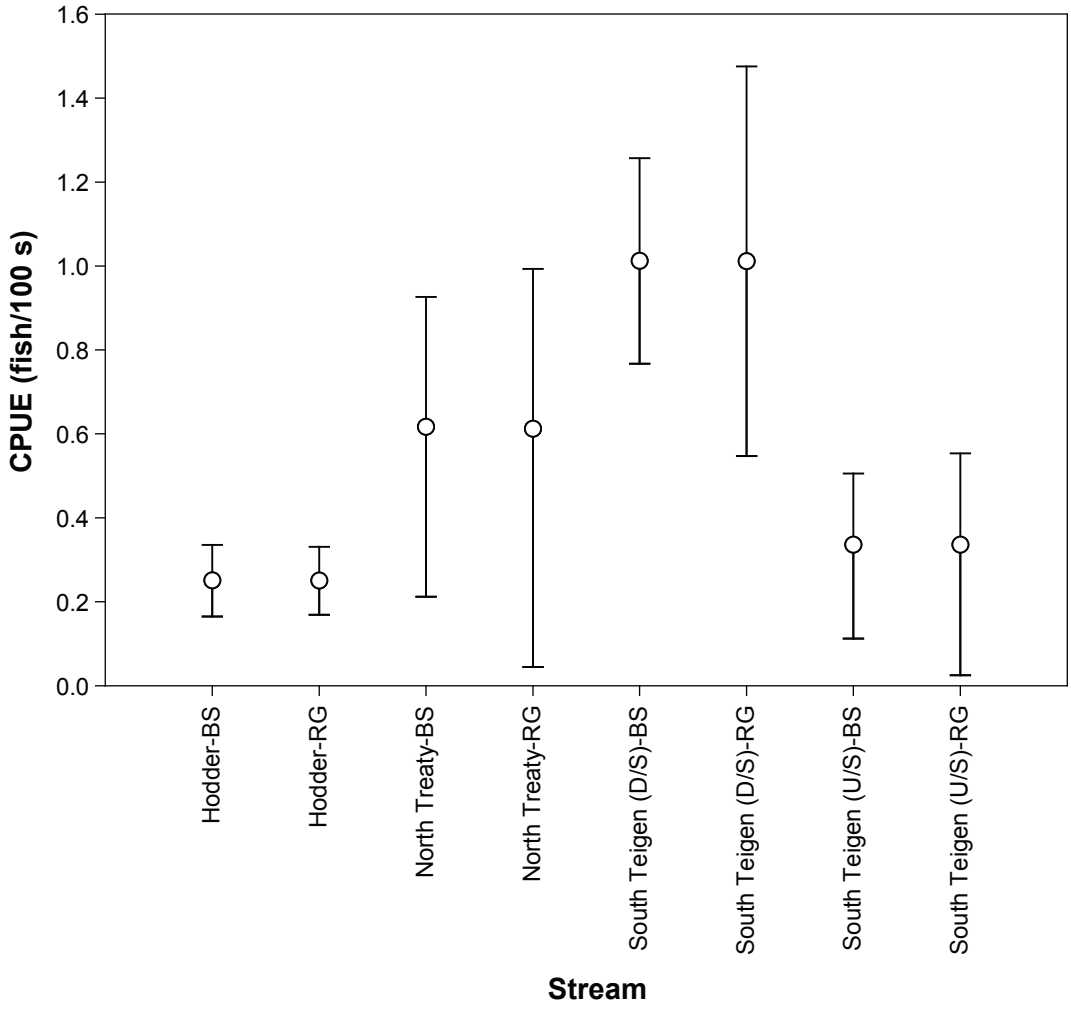
Dolly Varden parr and adults are the most dominant life history stages present within all creeks (Table 5.2-2). The low abundance or absence of fry in South Teigen Creek between the falls and the seepage dam supports previous habitat assessments in that Dolly Varden spawning habitat is limited within the reach; and that mainstem fry rearing habitat is poor (Rescan 2010). Mean Dolly Varden fork length and weight are shown in Table 5.2-3.

Detailed fish habitat data for North Treaty Creek is presented in Appendix 5.2-4. Photographs for North Treaty Creek sites are shown in Appendix 5.2-5. Table 5.2-4 shows a summary of site length (m), site area (m^2), and channel statistics for North Treaty Creek. Site length is typically 30 to 31 m with a mean site length of 36 m. Mean wetted area was 198 m^2. Mean residual pool depth is shallow within sites (0.4 m). Table 5.2-5 shows weighted mean bed substrate composition for North Treaty Creek. Substrate within creek sites is dominated by cobbles and boulders. Table 5.2-6 shows weighted mean habitat unit and habitat cover composition. Cascades and pool are the only habitat units present within the sites. Overhanging vegetation and boulders are the dominant cover types present within sites. The results of this habitat assessment correspond with previous habitat inventory mapping assessments conducted in 2009 (Rescan 2010).

5.3 STEELHEAD SNORKEL/REDD SURVEY

Steelhead fish counts and redd counts have been used to monitor steelhead and other salmonids in Canada and the United States (Johnson et al. 2007; Korman et al. 2010). As the product of reproductive adults, counts of redds provide an index of population size or spawner escapement (Johnson et al. 2007). Population growth rate (e.g., the number of recruits-per-spawner; Isaak and Thurow 2006) is derived from data sets in which estimates of escapement and recruits are available (Beland 1996). Redd counts can be used to estimate the number of female spawners in a given year by assuming one redd per female or by multiplying redd counts by a constant value to account for multiple redds per female (Duffy 2005). Redd counts have also been used to estimate escapement by multiplying redd counts by estimates of the total number of fish (male and female) per redd (Al-Chokhachy et al. 2005; Gallagher 2005).

From May 25 and 27, no steelhead or redds were detected in Teigen, South Teigen, North Treaty or Treaty creeks (Appendix 5.3-1). The lack of steelhead or redd detection was due to low water temperatures (4°C), poor water visibility (<1.2 m) and high discharge (Appendix 5.3-1). Previous redd surveys conducted on April 28 and 30, 2010, did not detect steelhead or redds due to low water temperatures (4°C) and discharge (Rescan 2011). Previous redd surveys conducted from June 5 and 7, 2009, did not detect steelhead or redds due to similar conditions in 2011 (Rescan 2010).



Notes: Bars represent +/- 95% confidence limits of the mean
BS = bootstrap mean
RG = regular mean
D/S = downstream of falls
U/S = upstream of falls

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Graphical Comparison of Bootstrap to Regular Means and 95% Confidence Limits for Streams

Figure 5.2-4

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Table 5.2-2. Summary Statistics of Electrofishing Effort and Dolly Varden Life Stage CPUE, 2011

Watercourse	No. Sites	Total Effort (s)	Fry			Parr			Adult			Combined				
			n	Mean CPUE	SE	n	Mean CPUE	SE	n	Mean CPUE	SE	n	Mean CPUE	SE	95% CI	Bootstrap Mean CPUE	Bootstrap 95% CI
Hodder Creek	2	2,108	0	-	-	0	-	-	5	0.25	0.09	5	0.25	0.09	0.17, 0.33	0.25	0.16, 0.34
North Treaty Creek	4	2,472	1	0.04	0.04	6	0.24	0.10	8	0.33	0.18	15	0.61	0.22	0.04, 0.99	0.62	0.21, 0.93
South Teigen Creek	4	2,749	0	-	-	4	0.13	0.05	6	0.20	0.08	10	0.34	0.12	0.02, 0.55	0.34	0.11, 0.51

Dashes indicate not applicable

CPUE = catch-per-unit-effort, fish/100 s

SE = standard error of the mean

n = number of fish caught

Table 5.2-3. Mean Fork Length and Weight of Dolly Varden, 2011

Watercourse	Attribute	Descriptor	Life History Stage			
			Fry	Parr	Adult	Combined
Hodder Creek	Fork Length (mm)	n	0	1	4	5
		Mean	-	94.0	154.8	142.6
		SE	-	-	19.6	19.4
	Weight (g)	n	0	1	4	5
		Mean	-	7.4	44.8	37.4
		SE	-	-	17.7	15.6
North Treaty Creek	Fork Length (mm)	n	1	6	8	15
		Mean	43.0	74.8	121.4	97.5
		SE	-	3.8	8.6	8.5
	Weight (g)	n	1	6	8	15
		Mean	0.6	4.2	17.7	11.1
		SE	-	0.5	4.0	2.8
South Teigen Creek	Fork Length (mm)	n	0	4	6	10
		Mean	-	71.8	115.2	97.8
		SE	-	3.6	4.7	7.7
	Weight (g)	n	0	4	6	10
		Mean	-	3.8	14.6	10.2
		SE	-	0.8	1.7	2.0

Dashes indicate not applicable

SE = standard error of the mean

n = sample size

Table 5.2-4. Summary of Site Size and Channel Statistics for North Treaty Creek, 2011

Site No.	Site Length (m)	Bankful Area (m2)	Wetted Area (m2)	Bankful Width (m)			Wetted Width (m)			Gradient (%)			Residual Pool Depth (m)
				n	Mean	SE	n	Mean	SE	n	Mean	SE	
1	31	182	160	3	6.2	0.7	3	5.1	0.1	3	2.2	0.3	0.4
2	30	194	190	2	6.1	0.4	2	5.7	0.7	2	2.3	0.9	0.3
3	31	199	168	3	6.0	0.8	3	5.1	0.6	3	2.5	0.6	0.6
4	52	362	274	4	7.3	0.4	4	5.5	0.3	4	2.0	0.3	0.4
Mean	**36**	**234**	**198**	**3**	**6.4**	**0.6**	**3**	**5.3**	**0.4**	**3**	**2.2**	**0.5**	**0.4**

SE = standard error
n = sample size

Table 5.2-5. Summary of Weighted Mean Substrate Composition for North Treaty Creek, 2011

Site No.	Weighted Mean Substrate Composition (%)				
	Sand	Gravel	Cobble	Boulder	Bedrock
1	0	10	74	16	0
2	0	10	69	21	0
3	0	9	42	49	0
4	0	21	47	32	0
Mean	**0**	**12**	**58**	**30**	**0**

Table 5.2-6. Summary of Habitat and Fish Cover Characteristics for North Treaty Creek, 2011

Site No.	Weighted Mean Habitat Composition (%)				Weighted Mean Cover Composition (%)							No. LWD Pieces	Weighted Riparian Cover (%)
	Cascade	Pool	Glide	Riffle	Pool	Boulder	IV	OV	UB	LWD	SWD		
1	85	15	0	0	15	13	0	4	7	10	5	3	28
2	90	10	0	0	2	15	0	42	5	1	2	1	60
3	85	15	0	0	9	27	0	30	1	1	9	3	46
4	53	47	0	0	19	18	0	28	0	9	14	2	46
Mean	**78**	**22**	**0**	**0**	**11**	**18**	**0**	**26**	**3**	**5**	**8**	**2**	**45**

IV = Instream Vegetation, OV = Overhanging Vegetation, UB = Undercut Bank, LWD = Large Woody Debris, SWD = small woody debris

Rescan hydrological data indicate that freshet typically commences in late May and early June (Rescan 2011b). A high period of discharge persists until July; however water visibility typically remains poor until early July (R. Larsen, pers. comm.). Discharge (Q) and horizontal visibility (HV) are important determinants of snorkeler detection probability (Korman et al. 2007). Horizontal visibility tends to decline with increasing discharge. The presence of glacial headwaters, in these watersheds, further limits horizontal visibility. Therefore, snorkel surveys are likely not effective until late June to early July; however steelhead spawning may have terminated at that time (M. Beere, pers. comm.).

Observations of adult steelhead during bull trout snorkel surveys indicate that steelhead are present in Teigen Creek during mid-September. The majority of steelhead would likely commence movement into Teigen Creek at 5°C during freshet (M. Beere, pers. comm.) when snorkeler detection and enumeration are not possible due to discharge and horizontal visibility. Therefore, the timing of steelhead snorkel surveys is difficult to determine annually (due to snow pack and melt) for effective enumeration and calculation of annual escapement. Therefore, the distribution of steelhead fry provides an indication of spawning habitat distribution in Teigen Creek (M. Beere, pers. comm.). Steelhead fry have not been caught in South Teigen or North Treaty creeks (Rescan 2009, 2010, 2011a).

6. Conclusion

The proposed transmission line and access road watercourse crossing fish habitat data provides an indication of the quality of fish habitat present at watercourses. This data will inform project design and watercourse crossing design to mitigate potential fish habitat impacts. If fish habitat impacts cannot be mitigated then this data will assist in fish habitat loss (i.e., HADD) determination, and eventual compensation.

Dolly Varden assessments provide an indication on the relative abundance between creeks and reaches. The assessment presents baseline CPUE data and its associated variability. The construction of the proposed TMF in the headwaters of South Teigen and North Treaty creeks may directly or indirectly affect fish abundance, condition, distribution and survival due to potential changes in water discharge.

The enumeration and detection of steelhead are difficult due to high discharge and poor water visibility. Snorkel surveys are likely not effective until late June and early July. The distribution of steelhead fry, from previous assessments (Rescan 2009 and 2010), provides an indication of spawning habitat distribution in Teigen Creek.

References

Definitions of the acronyms and abbreviations used in this reference list can be found in the Glossary and Abbreviations section.

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Appendix 5.1-1

Watercourse Crossing Site Location Data, 2011

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Appendix 5.1-1. Watercourse Crossing Site Location Data, 2011

Reference No.	Gazetted Name	ILP	Site No.	Date (yyyy/mm/day)	UTM Method	UTM Zone	UTM Easting	UTM Northing
75	-	5000	1	2011-09-14	GPU	9	442378	6287516
76	-	5001	2	2011-09-14	GPU	9	442384	6287557
77	Snowbank Creek	4000	1	2011-08-23	GPU	9	443130	6290312
78	-	4003	1	2011-08-23	GPU	9	443062	6290223
79	Bell Irving River	4004	1	2011-09-24	GPU	9	460039	6272653
80	-	4006	1	2011-09-23	GPU	9	457093	6271005
81	-	4007	1	2011-09-23	GPU	9	455051	6269380
82	-	4008	1	2011-09-22	GPU	9	451947	6269378
83	-	4009	1	2011-09-22	GPU	9	449921	6270055
84	-	4010	1	2011-09-22	GPU	9	449071	6270547
85	-	4011	1	2011-09-23	GPU	9	447556	6271912
86	-	4012	1	2011-10-11	GPU	9	446725	6271994
87	-	4015	1	2011-10-11	GPU	9	446540	6272039
88	-	4016	1	2011-10-11	GPU	9	443496	6272677
89	-	4017	1	2011-10-11	GPU	9	442206	6272930
90	-	4018	1	2011-10-12	GPU	9	442057	6273057
91	-	4019	1	2011-10-12	GPU	9	440477	6273350
92	-	4020	1	2011-10-12	GPU	9	437932	6274250
93	-	4021	1	2011-10-13	GPU	9	437326	6274684
94	-	4022	1	2011-10-13	GPU	9	437207	6274718
95	-	4023	1	2011-10-13	GPU	9	436679	6274701
96	-	4024	1	2011-10-13	GPU	9	436571	6274780
97	-	4025	1	2011-10-13	GPU	9	435824	6275028
98	-	4026	1	2011-10-13	GPU	9	435155	6275052

ILP = interim locational point

GPU = global positioning unit

Dashes indicate not applicable

Appendix 5.1-2

Watercourse Crossing Fish Habitat Data, 2011

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Appendix 5.1-2. Watercourse Crossing Fish Habitat Data, 2011

Locational Info				Channel																
Reference No.	Gazetted Names	ILP	Site #	Channel Width 1 (m)	Channel Width 2 (m)	Channel Width 3 (m)	Channel Width 4 (m)	Channel Width 5 (m)	Channel Width 6 (m)	Avg. Channel Width (m)	Method (for channel width)	Wetted Width 1 (m)	Wetted Width 2 (m)	Wetted Width 3 (m)	Wetted Width 4 (m)	Wetted Width 5 (m)	Wetted Width 6 (m)	Avg. Wetted Width (m)	Method (for wetted width)	Residual Pool Depth 1 (m)	Residual Pool Depth 2 (m)
75		5000	1	1.3	1.3	1.4	1.2	1.1		1.3	Metre tape	0.7	0.7	0.7	0.6	0.7		0.7	Metre tape		
76		5001	2	3.8	4.2	7.9	8.1			6.0	Metre tape	2.9	2.0	4.5	5.9			3.8	Metre tape	0.40	
77	Snowbank Creek	4000	1	20.0	12.0	16.0	19.0	18.0		17.0	Range finder	15.0	12.0	15.0	18.0	18.0		15.6	Range finder	0.50	
78		4003	1	40.0	30.0	30.0	25.0			31.3	Range finder	11.0	8.0	6.0	6.0			7.8	Range finder		
79	Bell Irving River	4004	1	70.0						70.0	Range finder	65.0						65.0	Range finder		
80		4006	1	30.0	25.0	19.0	30.0			26.0	Range finder	14.0	13.0	4.2	9.0			10.1	Metre tape	0.30	
81		4007	1	4.4	5.4	6.9	3.3	6.6		5.3	Metre tape	4.8	5.3	6.4	2.9	6.0		5.1	Metre tape	0.25	0.25
82		4008	1	4.4	3.8	2.4	3.2	3.5	3.0	3.4	Metre tape	3.9	2.5	2.5	3.0	2.8	2.7	2.9	Metre tape	0.25	0.20
83		4009	1	2.3	2.3	2.7	2.8	2.5		2.5	Metre tape	1.3	2.0	1.7	2.5	2.1		1.9	Metre tape	0.25	0.27
84		4010	1	6.0	9.0	12.0	5.6			8.2	Metre tape	2.5	3.5	2.6	4.4	3.5		3.3	Metre tape	0.25	0.27
85		4011	1	10.0	8.5	8.0	10.5	7.3		8.9	Metre tape	10.0	8.2	7.5	10.2	7.0		8.6	Metre tape		
86		4012	1	1.7	1.4	1.7	1.4	2.4		1.7	Metre tape	1.6	1.1	1.4	0.7	1.9		1.3	Metre tape		
87		4015	1	1.5	1.9	1.8	1.9			1.8	Metre tape	1.4	1.2	1.2	1.6			1.4	Metre tape		
88		4016	1	3.1	3.5	2.7	4.2	3.0		3.3	Metre tape	2.5	2.6	2.5	1.5	1.9		2.2	Metre tape	0.25	0.20
89		4017	1	0.9	1.5	1.5	1.7	0.8		1.3	Metre tape	0.8	1.4	1.4	1.6	1.0		1.2	Metre tape	0.10	0.10
90		4018	1	2.3	1.9	2.1	1.4	1.4		1.8	Metre tape	1.0	1.8	1.5	1.0	1.3		1.3	Metre tape	0.20	0.15
91		4019	1	2.0	2.4	1.9	2.6			2.2	Metre tape	2.0	2.3	1.6	2.3			2.1	Metre tape		
92		4020	1	2.3	3.1	3.4	5.8			3.7	Metre tape	1.3	2.8	3.1	2.0			2.3	Metre tape		
93		4021	1	3.0	3.5	2.6	2.2	2.4	3.0	2.8	Metre tape	1.3	1.4	2.3	1.2	2.1	2.8	1.9	Metre tape	0.20	0.15
94		4022	1	1.3	1.6	1.8	2.7	1.2		1.7	Metre tape	1.3	1.6	1.8	2.7	1.2		1.7	Metre tape		
95		4023	1	1.7	0.6	0.8	0.8			1.0	Metre tape	1.2	0.5	0.6	0.5			0.7	Metre tape	0.10	0.10
96		4024	1	2.8	2.3	2.5	1.9	1.6		2.2	Metre tape	1.2	1.0	2.4	1.5	1.6		1.5	Metre tape	0.30	0.20
97		4025	1	5.6	2.3	3.5	2.5	2.0		3.2	Metre tape	1.4	1.1	0.7	0.9	1.2		1.1	Metre tape		
98		4026	1	1.7	1.7	2.5	3.1	3.6		2.5	Metre tape	1.4	1.2	1.8	2.4	2.8		1.9	Metre tape	0.70	0.30

Locational Info				Channel																
Reference No.	Gazetted Names	ILP	Site #	Residual Pool Depth 3 (m)	Residual Pool Depth 4 (m)	Residual Pool Depth 5 (m)	Residual Pool Depth 6 (m)	Average Residual Pool Depth (m)	Method (for Residual Pool Depth)	Bankfull Depth 1 (m)	Bankfull Depth 2 (m)	Bankfull Depth 3 (m)	Bankfull Depth 4 (m)	Average Bankfull Depth (m)	Gradient 1 (%)	Gradient 2 (%)	Gradient 3 (%)	Gradient 4 (%)	Average Gradient (%)	Method (for gradient)
75		5000	1							0.2				0.2	1	1			1.0%	Clinometer
76		5001	2						Metre stick	0.8	0.5	0.6	0.3	0.6	1	1			1.0%	Clinometer
77	Snowbank Creek	4000	1						Metre stick	0.4	0.5	0.4		0.4	1	2	1		1.2%	Clinometer
78		4003	1							0.5	0.5	0.5		0.5	5	3			4.0%	Clinometer
79	Bell Irving River	4004	1												1	1			0.5%	Clinometer
80		4006	1						Metre stick	1.4	1.5			1.5	11	9			10.0%	Clinometer
81		4007	1	0.60	0.50			0.55	Metre stick	0.7	0.8	0.7		0.7	3	3	4		3.2%	Clinometer
82		4008	1	0.30	0.20	0.28	0.20	0.25	Metre stick	2.3	2.9	3.0		2.7	12	16	15		14.3%	Clinometer
83		4009	1	0.20	0.20			0.20	Metre stick	0.4	0.5			0.5	15	11	12	18	14.0%	Clinometer
84		4010	1	0.23	0.60			0.42	Metre stick	3.0				3.0	14	12			13.0%	Clinometer
85		4011	1							1.3	1.1	1.0		1.1	3	3	3		2.7%	Clinometer
86		4012	1												34				34.0%	Clinometer
87		4015	1												65	75			70.0%	Clinometer
88		4016	1	0.30	0.27			0.29	Metre stick	1.2	0.7	0.8		0.9	17	16			16.5%	Clinometer
89		4017	1						Metre stick	0.2	0.1			0.2	10	22			16.0%	Clinometer
90		4018	1						Metre stick	0.7	0.5			0.6	6	7			6.5%	Clinometer
91		4019	1												20	35	40		31.7%	Clinometer
92		4020	1												30	35			32.5%	Clinometer
93		4021	1						Metre stick	0.7	0.8	1.4		1.0	25	30	23		26.0%	Clinometer
94		4022	1												15	17			16.0%	Clinometer
95		4023	1						Metre stick	0.5	0.7			0.6	15	18			16.5%	Clinometer
96		4024	1	0.20	0.20	0.20		0.20	Metre stick	0.6	0.5			0.6	10	12			11.0%	Clinometer
97		4025	1							1.6	1.7	2.0		1.8	12	12	18		14.0%	Clinometer
98		4026	1						Metre stick	0.5	0.7			0.6	12	10			11.0%	Clinometer

Blank cells indicate not applicable or no data

Appendix 5.1-2. Watercourse Crossing Fish Habitat Data, 2011

Locational Info				Water							Cover							
Reference No.	Gazetted Names	ILP	Site #	Temperature (˚C)	Method (for Temperature)	Conductivity (µS/cm)	Method (for Conductivity)	pH	Method (for pH)	Turbidity	Total Cover	Small woody debris	Large woody debris	Boulders	Undercut banks	Deep pools	Overhanging vegetation	Instream vegetation
75		5000	1	8	Thermometer (mercury)	44	Recording meter	8.2	pH meter	C	Moderate 5-20%	Sub-dominant					Dominant	None
76		5001	2	8	Thermometer (mercury)	45	Recording meter	8.2	pH meter	C	Moderate 5-20%	Dominant				Trace	Trace	Trace
77	Snowbank Creek	4000	1	7	Thermometer (mercury)	129	Recording meter	8.2	pH meter	T	Moderate 5-20%		Trace		Sub-dominant	Dominant	Sub-dominant	
78		4003	1	6	Thermometer (mercury)	155	Recording meter	8.3	pH meter	T	Trace <5%	Sub-dominant		Dominant	Trace		Sub-dominant	
79	Bell Irving River	4004	1	6	Thermometer (mercury)	127	Recording meter	8.1	pH meter	T	Moderate 5-20%	Dominant		Sub-dominant			Trace	
80		4006	1	4	Thermometer (mercury)	93	Recording meter	8.3	pH meter	T	Moderate 5-20%	Trace	Trace	Dominant			Sub-dominant	
81		4007	1	6	Thermometer (mercury)	201	Recording meter	8.4	pH meter	C	Abundant >20%	Dominant	Sub-dominant		Trace	Trace	Sub-dominant	
82		4008	1	10	Thermometer (mercury)	160	Recording meter	8.3	pH meter	C	Abundant >20%	Sub-dominant	Sub-dominant	Dominant	Trace		Trace	
83		4009	1	7	Thermometer (mercury)	147	Recording meter	8.8	pH meter	C	Abundant >20%	Dominant	Sub-dominant	Sub-dominant	Trace		Sub-dominant	
84		4010	1	5	Thermometer (mercury)	119	Recording meter	8.5	pH meter	M	Abundant >20%	Trace	Trace	Dominant		Trace		
85		4011	1	4	Thermometer (mercury)	73	Recording meter	8.3	pH meter	T	Trace <5%	Trace		Dominant			Trace	
86		4012	1	4	Thermometer (mercury)	110	Recording meter	7.7	pH meter	C	Moderate 5-20%	Dominant	Trace	Trace			Sub-dominant	
87		4015	1	4	Thermometer (mercury)	110	Recording meter	7.6	pH meter	C	Moderate 5-20%	Dominant		Trace			Sub-dominant	
88		4016	1	4	Thermometer (mercury)	40	Recording meter	7.9	pH meter	C	Abundant >20%	Sub-dominant	Dominant	Trace		Sub-dominant	Sub-dominant	
89		4017	1	4	Thermometer (mercury)	200	Recording meter	7.9	pH meter	C	Abundant >20%	Dominant	Trace		Sub-dominant		Sub-dominant	
90		4018	1	5	Thermometer (mercury)	190	Recording meter	8.0	pH meter	C	Moderate 5-20%	Dominant			Trace		Sub-dominant	
91		4019	1	5	Thermometer (mercury)	230	Recording meter	8.2	pH meter	C	Moderate 5-20%	Dominant	Sub-dominant				Sub-dominant	
92		4020	1	5	Thermometer (mercury)	200	Recording meter	8.3	pH meter	C	Moderate 5-20%			Dominant				
93		4021	1	3	Thermometer (mercury)	290	Recording meter	8.4	pH meter	C	Moderate 5-20%	Sub-dominant			Trace		Dominant	
94		4022	1	2	Thermometer (mercury)	430	Recording meter	8.6	pH meter	C	Trace <5%	Dominant						
95		4023	1	4	Thermometer (mercury)	290	Recording meter	8.1	pH meter	C	Trace <5%	Sub-dominant					Dominant	
96		4024	1	4	Thermometer (mercury)	350	Recording meter	8.5	pH meter	C	Abundant >20%	Dominant	Sub-dominant			Trace	Sub-dominant	
97		4025	1	4	Thermometer (mercury)	270	Recording meter	8.6	pH meter	L	Trace <5%	Sub-dominant		Dominant			Trace	
98		4026	1	4	Thermometer (mercury)	110	Recording meter	8.5	pH meter	C	Abundant >20%	Sub-dominant	Trace	Dominant		Sub-dominant	Sub-dominant	

Locational Info				Cover														
Reference No.	Gazetted Names	ILP	Site #	Crown Closure	Functional LWD	LWD Distribution	Instream Vegetation	L. Bank Shape	L. Bank Texture Dominant	L. Bank Texture Subdominant	L. Bank Riparian Vegetation	L. Bank Riparian Vegetation Stage	R. Bank Shape	R. Bank Texture Dominant	R. Bank Texture Subdominant	R. Bank Riparian Vegetation	R. Bank Riparian Vegetation Stage
75		5000	1	0	None		None	Sloping	Fines		Shrubs	SHR	Sloping	Fines		Shrubs	SHR
76		5001	2	0	None		Vascular plants	Sloping	Fines		Shrubs	SHR	Sloping	Fines		Shrubs	SHR
77	Snowbank Creek	4000	1	1-20%	Few <1/Wb	Even	None	V-shaped	Fines	Gravels	Mixed C and D	MF	Undercut	Fines	Gravels	Mixed C and D	PS
78		4003	1	1-20%	None		None	V-shaped	Fines	Gravels	Shrubs	SHR	V-shaped	Fines	Gravels	Mixed C and D	MF
79	Bell Irving River	4004	1	1-20%	None		None	Sloping	Fines	Gravels	Mixed C and D	MF	Sloping	Fines	Gravels	Mixed C and D	MF
80		4006	1	1-20%			None	Sloping	Fines	Gravels	Mixed C and D	MF	Sloping	Fines	Gravels	Mixed C and D	MF
81		4007	1	41-70%	Abundant >1/Wb	Even	Moss	Undercut	Fines	Gravels	Mixed C and D	MF	Sloping	Fines	Gravels	Mixed C and D	MF
82		4008	1	21-40%	Abundant >1/Wb	Even	Moss	V-shaped	Gravels	Boulders	Mixed C and D	MF	V-shaped	Gravels	Boulders	Mixed C and D	MF
83		4009	1	71-90%	Few <1/Wb	Even	Moss	V-shaped	Fines	Gravels	Coniferous	MF	V-shaped	Fines	Gravels	Coniferous	MF
84		4010	1	1-20%	Few <1/Wb	Clumped	None	V-shaped	Bedrock		Shrubs	INIT	V-shaped	Bedrock		Shrubs	INIT
85		4011	1	1-20%	Few <1/Wb	Clumped	None	Sloping	Fines	Gravels	Deciduous	YF	Sloping	Fines	Gravels	Deciduous	YF
86		4012	1	71-90%	None		Moss	V-shaped	Fines	Gravels	Shrubs	SHR	V-shaped	Fines	Gravels	Shrubs	SHR
87		4015	1	71-90%	None		Moss	V-shaped	Fines	Gravels	Shrubs	SHR	V-shaped	Fines	Gravels	Shrubs	SHR
88		4016	1	71-90%	Abundant >1/Wb	Even	Moss	V-shaped	Fines	Cobbles	Coniferous	MF	V-shaped	Fines	Cobbles	Coniferous	MF
89		4017	1	71-90%	None		Moss	Sloping	Fines	Gravels	Coniferous	MF	Sloping	Fines	Gravels	Coniferous	MF
90		4018	1	>90%	None		Moss	V-shaped	Fines	Gravels	Shrubs	SHR	Sloping	Fines	Gravels	Shrubs	SHR
91		4019	1	41-70%	Abundant >1/Wb	Even	None	V-shaped	Fines	Gravels	Coniferous	MF	V-shaped	Fines	Gravels	Coniferous	MF
92		4020	1	1-20%	None		None	V-shaped	Fines	Gravels	Shrubs	SHR	V-shaped	Fines	Gravels	Shrubs	SHR
93		4021	1	>90%	None		None		Fines	Gravels	Shrubs	SHR		Fines	Gravels	Shrubs	SHR
94		4022	1	21-40%	None		None				Coniferous	MF				Coniferous	MF
95		4023	1	71-90%	None		None	V-shaped	Gravels		Shrubs	SHR	V-shaped	Gravels		Shrubs	SHR
96		4024	1	41-70%	Few <1/Wb	Even	None	Sloping	Fines	Gravels	Coniferous	MF	Sloping	Fines	Gravels	Coniferous	MF
97		4025	1	21-40%	None		None	V-shaped	Fines	Gravels	Shrubs	SHR	V-shaped	Fines	Gravels	Shrubs	SHR
98		4026	1	71-90%	None		None	Sloping	Cobbles	Boulders	Shrubs	SHR	Sloping	Cobbles	Boulders	Shrubs	SHR

Blank cells indicate not applicable or no data

Appendix 5.1-2. Watercourse Crossing Fish Habitat Data, 2011

Locational Info				Morphology								Features					
Reference No.	Gazetted Names	ILP	Site #	Bed Material Dominant	Bed Material Subdominant	D95 (cm)	D (cm)	Morphology	Channel Pattern	Coupling	Confinement	Feature Type	Feature Height (m)	Feature Length (m)	UTM Zone	UTM Easting	UTM Northing
75		5000	1	Fines	Gravels	5.0	5.0	RP	SR	DC	UN						
76		5001	2	Fines	Gravels	10.0	10.0	RP	SR	DC	UN						
77	Snowbank Creek	4000	1	Gravels	Cobble	20.0	30.0	RP	SR	PC	UN						
78		4003	1	Gravels	Cobble	30.0	40.0	RP	SR	DC	UN						
79	Bell Irving River	4004	1	Gravels	Fines			LC	SR	DC	UN						
80		4006	1	Gravels	Cobble	30.0	40.0	CP	SR	DC	OC						
81		4007	1	Gravels	Fines	15.0	12.0	RP	SR	PC	OC						
82		4008	1	Boulder	Cobble	60.0	25.0	SP	SR	CO	EN	C		2.0	9	451910	6269236
83		4009	1	Cobble	Gravels	35.0	5.0	CP	SR	CO	EN	C	9.0		9	449706	6269945
84		4010	1	Boulder	Cobble	100.0	100.0	SP	SR	CO	EN	F	20.0		9	449103	6270579
85		4011	1	Boulder	Cobble	50.0	40.0	CP	SR	CO	CO						
86		4012	1	Cobble	Gravels	30.0	20.0	CP	SI	CO	EN	C	20.0		9	446729	6271946
87		4015	1	Cobble	Gravels	30.0	20.0	CP	SI	CO	EN						
88		4016	1	Gravels	Cobble	40.0	15.0	SP	SR	CO	CO						
89		4017	1	Gravels	Fines	20.0	5.0	CP	SR	CO	UN						
90		4018	1	Gravels	Cobble	5.0	5.0	RP	SR	DC	UN	C	30.0	50.0	9	441982	6272843
91		4019	1	Cobble	Gravels	30.0	20.0	SP	SI	CO	EN	C	15.0	25.0	9	440540	6273189
92		4020	1	Gravels	Cobble	100.0	40.0	CP	SR	CO	EN						
93		4021	1	Gravels	Cobble	40.0	30.0	CP	SR	PC	UN	C	1.5				
94		4022	1	Gravels	Fines	90.0	40.0	CP	SR		N/A						
95		4023	1	Gravels	Cobble	25.0	15.0	SP	SR	DC	UN	C	20.0	20.0		436669	6274605
96		4024	1	Gravels	Fines	30.0	15.0	SP	SR	DC	UN	C	15.0				
97		4025	1	Gravels	Cobble	50.0	50.0	CP	SR	DC	UN						
98		4026	1	Cobble	Boulder	300.0	10.0	CP	SR	CO	EN						

Blank cells indicate not applicable or no data

RP = Riffle-pool

LC = Large Channel

CP = Cascade-pool

SP = Step-pool

SR = Straight

SI = Sinuous

DC = Decoupled

PC = Partially Coupled

CO = Coupled

UN = Unconfined

OC = Occasionally Confined

EN = Entrenched

C = Cascade

F = Falls

Appendix 5.1-3

Watercourse Crossing Photographs, 2011

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Appendix 5.1-3. Watercourse Crossing Photographs, 2011

ILP 5000 – Upstream

ILP 5000 – Downstream

ILP 5001 - Upstream

ILP 5001 - Downstream

ILP 5004 - NCD

ILP 4000 - Downstream

ILP 4000 – Upstream

ILP 4001 - NCD

ILP 4002 – NCD

ILP 4003 – Downstream

ILP 4003 Upstream

ILP 4004 - Downstream

ILP 4004 - Upstream

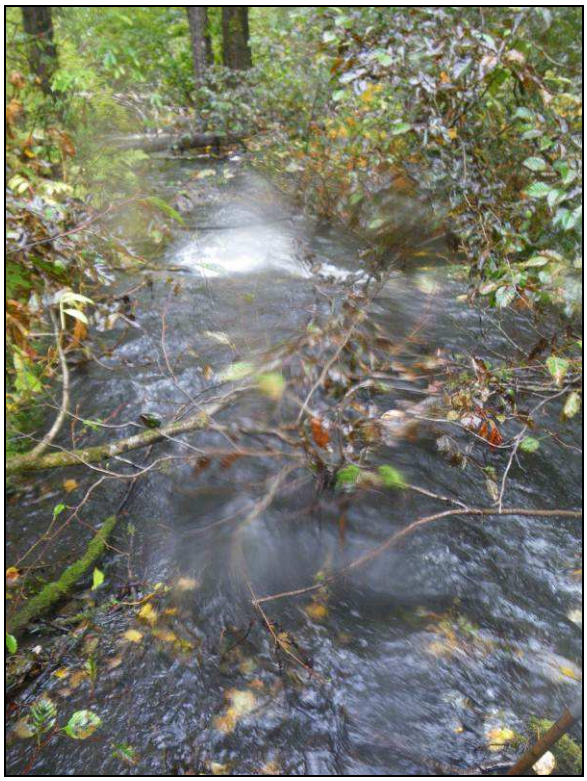
ILP 4004 - Aerial

ILP 4005 - NCD

ILP 4006 - Upstream

ILP 4006 - Downstream

ILP 4007 – Upstream



ILP 4008 - Downstream

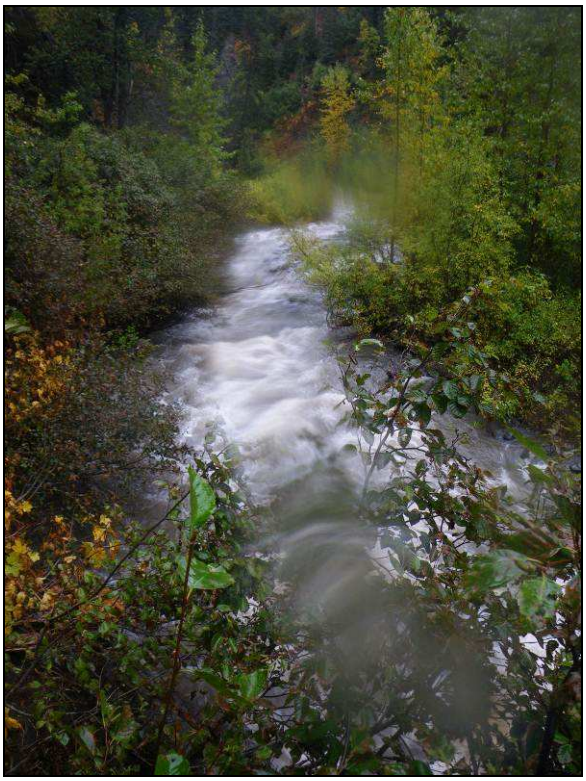
ILP 4008 – Upstream

ILP 4009 - Downstream

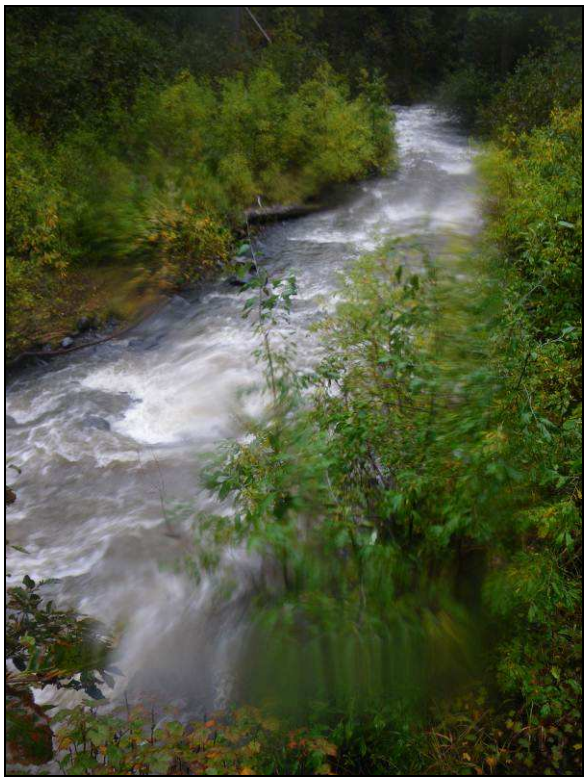
ILP 4009 - Upstream

ILP 4010 - Upstream

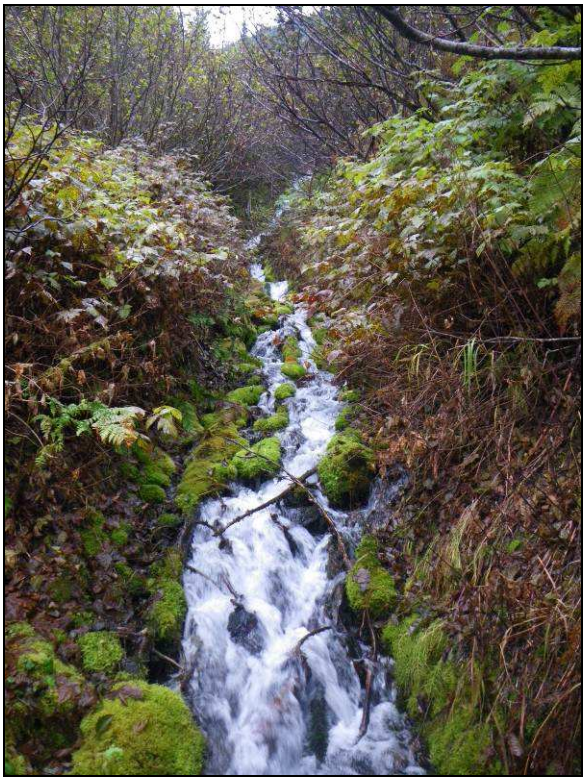
ILP 4010 – Downstream



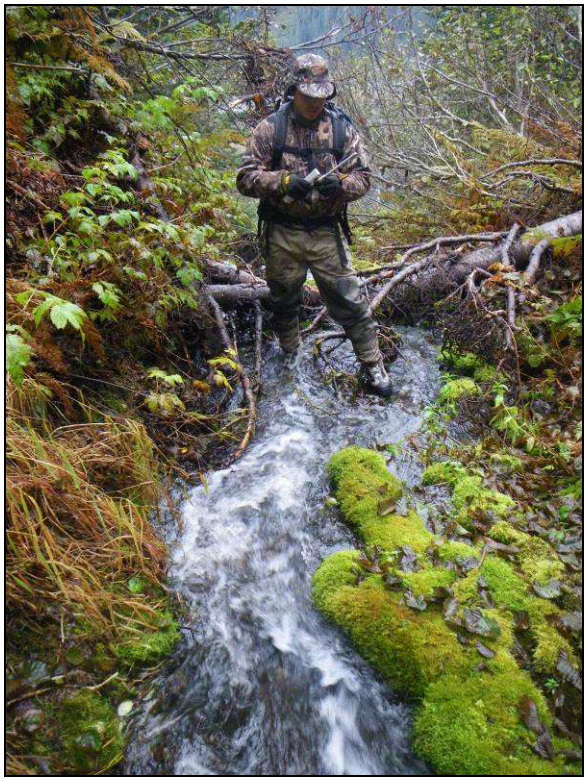
ILP 4011 - Upstream



ILP 4011 – Downstream



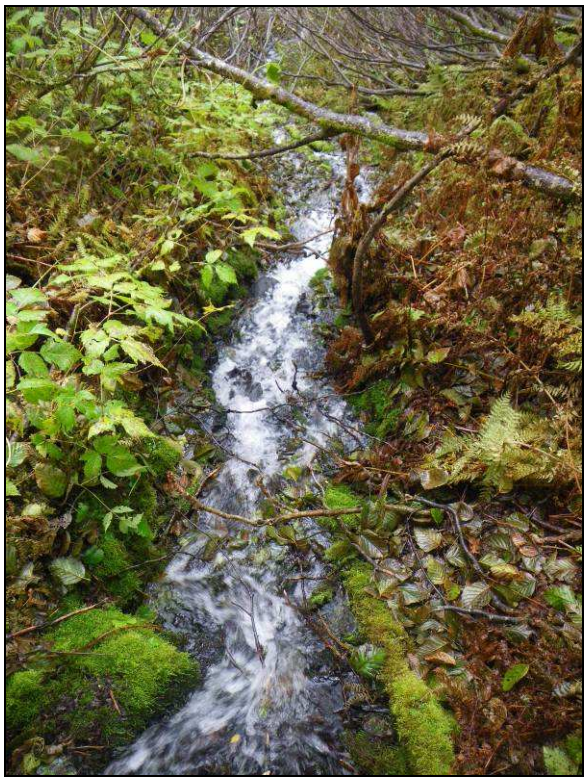
ILP 4012 – Upstream



ILP 4012 - Downstream

ILP 4013 - NCD

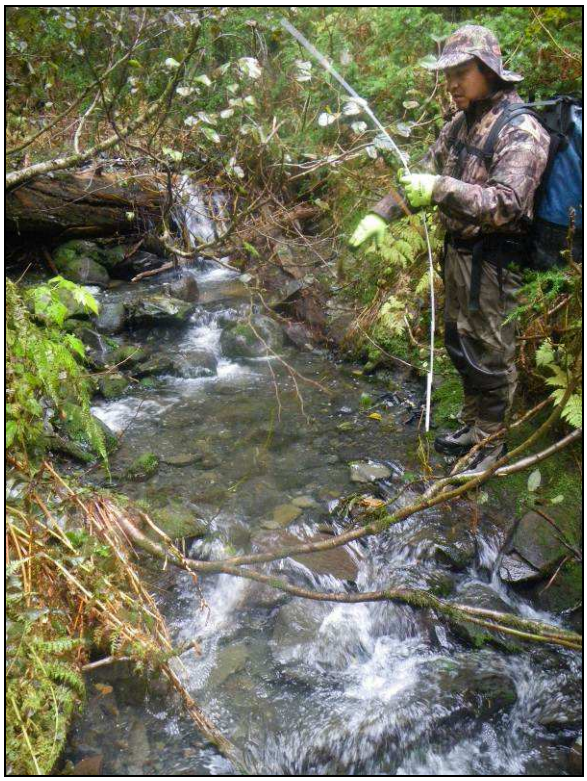
ILP 4014 – NCD



ILP 4015 – Downstream

ILP 4015 - Upstream

ILP 4016 – Downstream



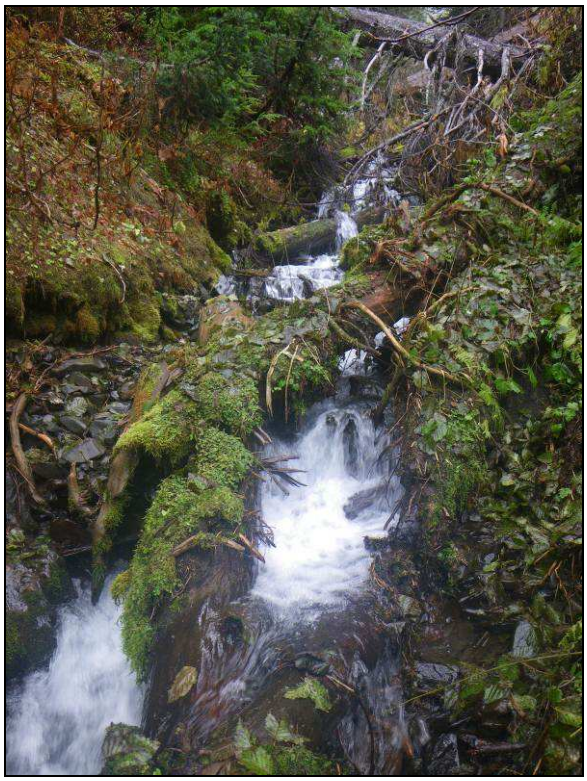
ILP 4016 - Upstream

ILP 4017 - Downstream

ILP 4017 - Upstream

ILP 4018 - Downstream

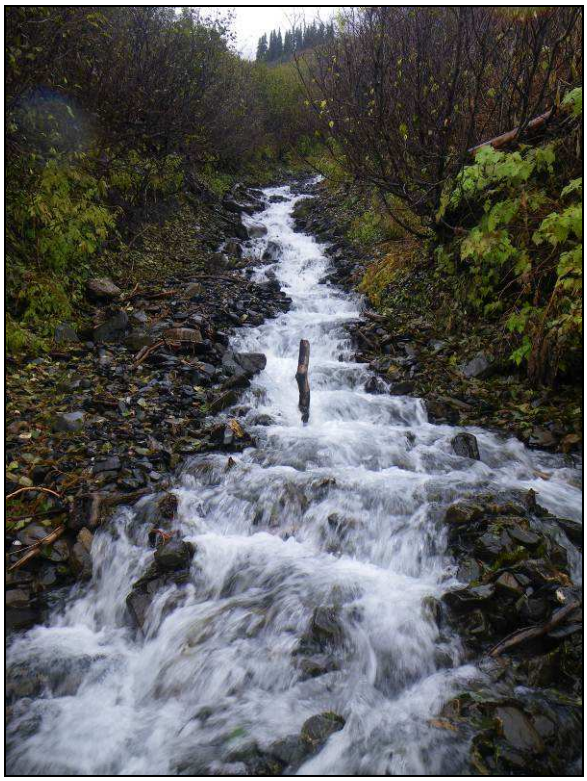
ILP 4018 - Upstream



ILP 4019 - Upstream

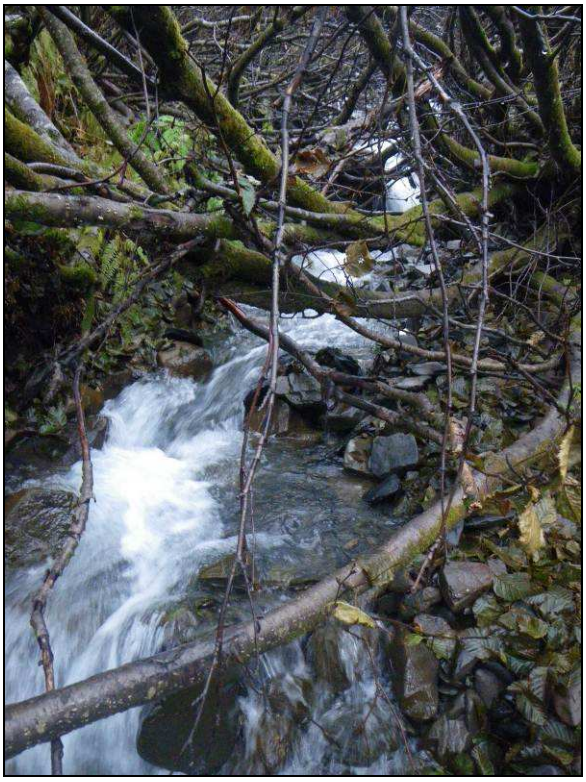
ILP 4019 - Downstream

ILP 4020 - Downstream



ILP 4020 - Upstream

ILP 4021 - Downstream

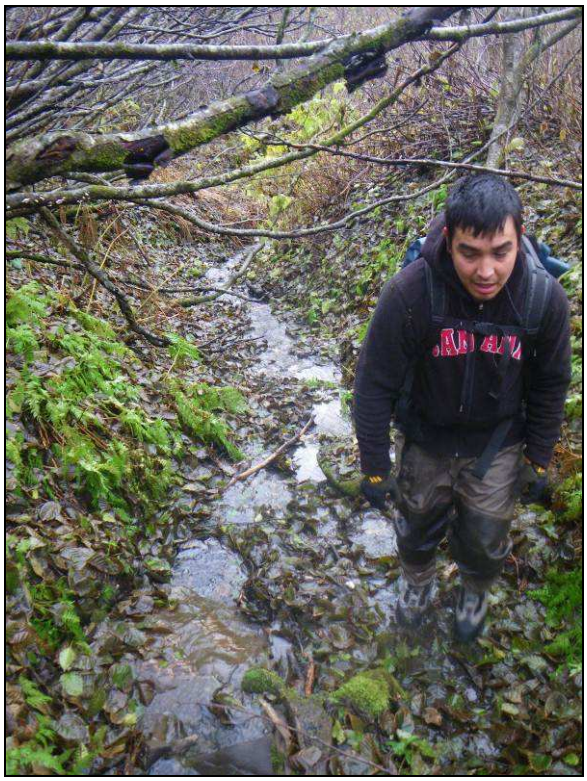


ILP 4021 - Upstream

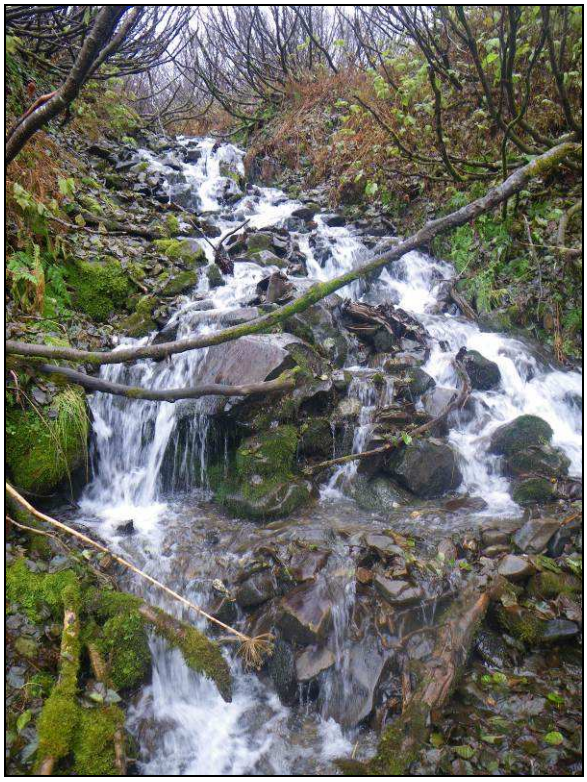
ILP 4022 - Upstream

ILP 4022 – Downstream

ILP 4023 - Upstream



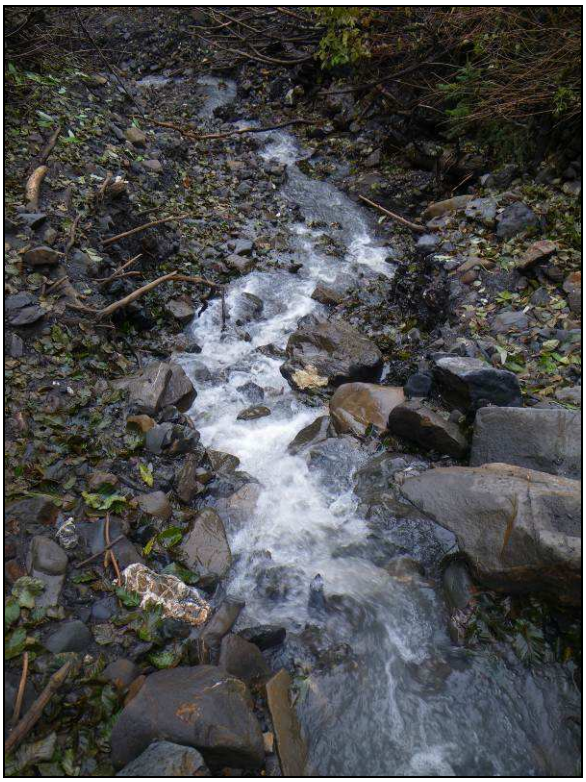
ILP 4023 - Downstream



ILP 4024 - Upstream

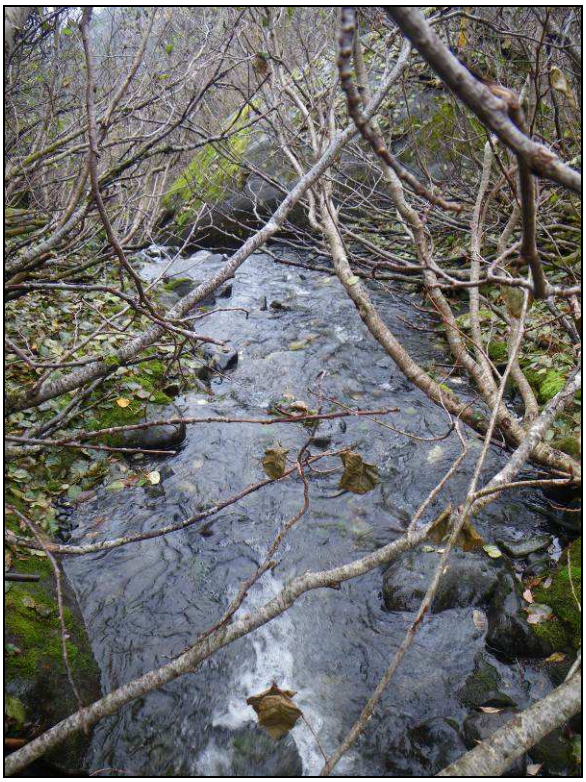
ILP 4024 - Downstream

ILP 4025 - Upstream



ILP 4025 - Downstream

ILP 4026 - Upstream



ILP 4026 - Downstream

Appendix 5.2-1

Dolly Varden Abundance Assessment Site Location Data, 2011

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Appendix 5.2-1. Dolly Varden Abundance Assessment Site Location Data, 2011

Reference No.	Gazetted Name	Local Name	ILP	Site No.	Date (yyyy/mm/day)	UTM Method	UTM Zone	UTM Easting	UTM Northing
41	Hodder Creek	Hodder Creek	1007	1	2011-09-17	GPU	9	452991	6287939
42	Hodder Creek	Hodder Creek	1007	2	2011-09-17	GPU	9	453274	6287809
43	Teigen Creek	South Teigen Creek - Upper	1008	1	2011-08-20	GPU	9	440535	6281425
44	Teigen Creek	South Teigen Creek - Upper	1008	2	2011-08-20	GPU	9	440993	6281950
45	Teigen Creek	South Teigen Creek - Upper	1008	3	2011-08-20	GPU	9	440753	6281698
46	Teigen Creek	South Teigen Creek - Upper	1008	4	2011-08-18	GPU	9	440352	6280900
47	Treaty Creek	North Treaty Creek - Upper	1009	4	2011-09-15	GPU	9	-	-
48	Treaty Creek	North Treaty Creek - Upper	1009	3	2011-09-15	GPU	9	447334	6273103
49	Treaty Creek	North Treaty Creek - Upper	1009	2	2011-09-14	GPU	9	447285	6273335
50	Treaty Creek	North Treaty Creek - Upper	1009	1	2011-09-14	GPU	9	447257	6273377

ILP = interim locational point

GPU = global positioning unit

Dashes indicate no data available

Appendix 5.2-2

Dolly Varden Abundance Assessment Effort and Catch Data, 2011

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Appendix 5.2-2. Dolly Varden Abundance Assessment Effort and Catch Data, 2011

Reference No.	Gazetted Name	Local Name	Site No.	Sampling Method	Method No.	Temperature (˚C)	Conductivity (µS/cm)	Turbidity	Haul or Pass	Effort (s)	Length (m)	Width (m)	Enclosure	Voltage (V)	Frequency (Hz)
41	Hodder Creek	Hodder Creek	1	EF	1	6.0	273	C	1	1213	200	6	O	400	30
42	Hodder Creek	Hodder Creek	2	EF	1	6.0	273	C	1	895	200	6	O	400	30
43	Teigen Creek	South Teigen Creek - Upper	1	EF	1	6.0	135	T	1	668	200	4	O	500	30
44	Teigen Creek	South Teigen Creek - Upper	2	EF	1	6.0	135	T	1	607	200	4	O	400	30
45	Teigen Creek	South Teigen Creek - Upper	3	EF	1	6.0	135	T	1	584	200	4	O	500	30
46	Teigen Creek	South Teigen Creek - Upper	4	EF	1	7.6	137	T	1	890	200	5	O	400	30
47	Treaty Creek	North Treaty Creek - Upper	4	EF	1	6.0	115	C	1	610	27	6	O	300	30
48	Treaty Creek	North Treaty Creek - Upper	3	EF	1	6.0	114	C	1	675	32	5	O	300	30
49	Treaty Creek	North Treaty Creek - Upper	2	EF	1	6.0	115	C	1	590	30	5	O	300	30
50	Treaty Creek	North Treaty Creek - Upper	1	EF	1	6.0	119	C	1	597	31	5	O	300	30

Turbidity:
C = clear
L = low turbidity
M =moderate turbidity
H = high turbidity

Enclosure:
O = open
C = closed
PE = partially enclosed

n = sample size

Appendix 5.2-2. Dolly Varden Abundance Assessment Effort and Catch Data, 2011

Reference No.	Gazetted Name	Local Name	Site No.	Pulse (%)	Make	Model	Total Catch (n)				Fry Catch (n)				Parr Catch (n)				Adult Catch (n)			
							DV	RB	CH	BT	DV	RB	CH	BT	DV	RB	CH	BT	DV	RB	CH	BT
41	Hodder Creek	Hodder Creek	1	12	Smith-root	LR24	2	1	3	0	0	0	3	0	0	0	0	0	2	1	0	0
42	Hodder Creek	Hodder Creek	2	12	Smith-root	LR24	3	1	7	1	0	0	7	0	0	0	0	0	3	1	0	1
43	Teigen Creek	South Teigen Creek - Upper	1	12	Smith-root	LR24	3	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0
44	Teigen Creek	South Teigen Creek - Upper	2	12	Smith-root	LR24	2	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0
45	Teigen Creek	South Teigen Creek - Upper	3	12	Smith-root	LR24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	Teigen Creek	South Teigen Creek - Upper	4	12	Smith-root	LR24	5	0	0	0	0	0	0	0	2	0	0	0	3	0	0	0
47	Treaty Creek	North Treaty Creek - Upper	4	12	Smith-root	LR24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	Treaty Creek	North Treaty Creek - Upper	3	12	Smith-root	LR24	4	0	0	0	0	0	0	0	3	0	0	0	1	0	0	0
49	Treaty Creek	North Treaty Creek - Upper	2	12	Smith-root	LR24	5	0	0	0	1	0	0	0	2	0	0	0	2	0	0	0
50	Treaty Creek	North Treaty Creek - Upper	1	12	Smith-root	LR24	6	0	0	0	0	0	0	0	1	0	0	0	5	0	0	0

Turbidity:
C = clear
L = low turbidity
M =moderate turbidity
H = high turbidity

Enclosure:
O = open
C = closed
PE = partially enclosed

n = sample size

Species:
DV = dolly varden
RB = rainbow trout
CH = chinook salmon
BT = bull trout

Appendix 5.2-3

Dolly Varden Abundance Assessment Biological Data, 2011

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Appendix 5.2-3. Dolly Varden Abundance Assessment Biological Data, 2011

Reference No.	Gazetted Names	Local Name	Site No.	Method	Method Number	Haul or Pass	Species Code	Length (mm)	Weight (g)	Life History Stage
41	Hodder Creek	Hodder Creek	1	EF	1	1	DV	162	43.92	A
41	Hodder Creek	Hodder Creek	1	EF	1	1	DV	120	16.85	A
41	Hodder Creek	Hodder Creek	1	EF	1	1	RB	100	12.84	A
41	Hodder Creek	Hodder Creek	1	EF	1	1	CH	60	1.84	F
41	Hodder Creek	Hodder Creek	1	EF	1	1	CH	60	1.67	F
41	Hodder Creek	Hodder Creek	1	EF	1	1	CH	56	2	F
42	Hodder Creek	Hodder Creek	2	EF	1	1	DV	130	23.58	A
42	Hodder Creek	Hodder Creek	2	EF	1	1	BT	212	108	A
42	Hodder Creek	Hodder Creek	2	EF	1	1	DV	207	95	A
42	Hodder Creek	Hodder Creek	2	EF	1	1	RB	204	99.7	A
42	Hodder Creek	Hodder Creek	2	EF	1	1	CH	61	2.39	F
42	Hodder Creek	Hodder Creek	2	EF	1	1	CH	56	2.69	F
42	Hodder Creek	Hodder Creek	2	EF	1	1	CH	53	2.1	F
42	Hodder Creek	Hodder Creek	2	EF	1	1	CH	58	2.8	F
42	Hodder Creek	Hodder Creek	2	EF	1	1	DV	94	7.41	P
42	Hodder Creek	Hodder Creek	2	EF	1	1	CH	52	1.97	F
42	Hodder Creek	Hodder Creek	2	EF	1	1	CH	56	2.1	F
42	Hodder Creek	Hodder Creek	2	EF	1	1	CH	57	1.62	F
43	Teigen Creek	South Teigen Creek - Upper	1	EF	1	1	DV	120	15.36	A
43	Teigen Creek	South Teigen Creek - Upper	1	EF	1	1	DV	103	13.37	A
43	Teigen Creek	South Teigen Creek - Upper	1	EF	1	1	DV	70	3.75	P
44	Teigen Creek	South Teigen Creek - Upper	2	EF	1	1	DV	125	16.7	A
44	Teigen Creek	South Teigen Creek - Upper	2	EF	1	1	DV	82	5.8	P
46	Teigen Creek	South Teigen Creek - Upper	4	EF	1	1	DV	130	21.2	A
46	Teigen Creek	South Teigen Creek - Upper	4	EF	1	1	DV	103	9.8	A
46	Teigen Creek	South Teigen Creek - Upper	4	EF	1	1	DV	110	11	A
46	Teigen Creek	South Teigen Creek - Upper	4	EF	1	1	DV	65	2.2	P
46	Teigen Creek	South Teigen Creek - Upper	4	EF	1	1	DV	70	3.3	P
48	Treaty Creek	North Treaty Creek - Upper	3	EF	1	1	DV	82	5.14	P
48	Treaty Creek	North Treaty Creek - Upper	3	EF	1	1	DV	90	6.39	A
48	Treaty Creek	North Treaty Creek - Upper	3	EF	1	1	DV	78	4.36	P
48	Treaty Creek	North Treaty Creek - Upper	3	EF	1	1	DV	82	5.47	P
49	Treaty Creek	North Treaty Creek - Upper	2	EF	1	1	DV	97	8.14	A
49	Treaty Creek	North Treaty Creek - Upper	2	EF	1	1	DV	79	4.84	P
49	Treaty Creek	North Treaty Creek - Upper	2	EF	1	1	DV	70	3.25	P
49	Treaty Creek	North Treaty Creek - Upper	2	EF	1	1	DV	43	0.61	F
49	Treaty Creek	North Treaty Creek - Upper	2	EF	1	1	DV	116	12.43	A
50	Treaty Creek	North Treaty Creek - Upper	1	EF	1	1	DV	58	2.04	P
50	Treaty Creek	North Treaty Creek - Upper	1	EF	1	1	DV	113	11.72	A
50	Treaty Creek	North Treaty Creek - Upper	1	EF	1	1	DV	146	28.76	A
50	Treaty Creek	North Treaty Creek - Upper	1	EF	1	1	DV	159	38.57	A
50	Treaty Creek	North Treaty Creek - Upper	1	EF	1	1	DV	110	11.65	A
50	Treaty Creek	North Treaty Creek - Upper	1	EF	1	1	DV	140	23.81	A

Species:
DV = Dolly Varden
RB = Rainbow Trout/steelhead
CH = Chinook Salmon
BT = Bull Trout

Method:
EF = Electrofisher

Life History Stage:
F = Fry
P = Parr
A = Adult

Appendix 5.2-4

Detailed Fish Habitat Data for North Treaty Creek, 2011

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Appendix 5.2-4. Detailed Fish Habitat Data for North Treaty Creek, 2011

Stream	Site No.	Date	Habitat No.	Habitat Type	Distance from Start (m)	Length (m)	Bankfull Area (m^2)	Wetted Area (m^2)	Proportional Length (m)	Proportional Wetted Area (m^2)	Slope	Depths				Widths	
											Gradient (%)	Wetted Depth 1 (m)	Wetted Depth 2 (m)	Wetted Depth 3 (m)	Bankfull Depth (m)	Wetted Width (m)	Bankfull Width (m)
North Treaty Creek	1	14-Sep-11	1	Cascade	0	14	54.6	72.8	0.5	0.5	1	0.4	0.4	0.3	1.1	5.2	3.9
North Treaty Creek	1	14-Sep-11	2	Pool	14	5	35.0	24.5	0.2	0.2	2.5	0.3	0.7	0.5	1.0	4.9	7.0
North Treaty Creek	1	14-Sep-11	3	Cascade	19	12	92.4	62.4	0.4	0.4	3	0.2	0.3	0.3	0.8	5.2	7.7
					Sum	**31**	**182.0**	**159.7**	**Cascade**	**0.8**							
									Pool	**0.2**							
North Treaty Creek	2	14-Sep-11	1	Cascade	0	26	171.6	171.6	0.9	0.9	3.5	0.1	0.4	0.4	1.1	6.6	6.6
North Treaty Creek	2	14-Sep-11	2	Pool	26	4	22.0	18.8	0.1	0.1	1	0.4	0.6	0.4	0.8	4.7	5.5
					Sum	**30**	**193.6**	**190.4**	**Cascade**	**0.9**							
									Pool	**0.1**							
North Treaty Creek	3	14-Sep-11	1	Cascade	0	11	60.5	50.6	0.4	0.3	3	0.3	0.2	0.4	0.7	4.6	5.5
North Treaty Creek	3	14-Sep-11	2	Pool	11	7	26.6	25.2	0.2	0.1	0.5	0.5	0.4	1.0	1.5	3.6	3.8
North Treaty Creek	3	14-Sep-11	3	Cascade	18	13	111.8	92.3	0.4	0.5	4	0.4	0.4	0.4	1.0	7.1	8.6
					Sum	**31**	**198.9**	**168.1**	**Cascade**	**0.9**							
									Pool	**0.1**							
North Treaty Creek	4	15-Sep-11	1	Cascade	0	10	92.0	70.0	0.2	0.3	3	0.0	0.3	0.4	1.0	7.0	9.2
North Treaty Creek	4	15-Sep-11	2	Pool	10	4	30.4	20.4	0.1	0.1	1	0.6	0.7	0.3	1.0	5.1	7.6
North Treaty Creek	4	15-Sep-11	3	Cascade	14	14	84.0	75.6	0.3	0.3	3	0.3	0.5	0.3	1.0	5.4	6.0
North Treaty Creek	4	15-Sep-11	4	Pool	24	24	156.0	108.0	0.5	0.4	1	0.6	0.8	0.7	1.7	4.5	6.5
					Sum	**52**	**362.4**	**274.0**	**Cascade**	**0.5**							
									Pool	**0.5**							

LWD = large woody debris

SWD = small woody debris

Appendix 5.2-4. Detailed Fish Habitat Data for North Treaty Creek, 2011

			Bed Material										Instream Cover			
Stream	Site No.	Date	Sand (%)	Weighted Sand (%)	Gravel (%)	Weighted Gravel (%)	Cobble (%)	Weighted Cobble (%)	Boulder (%)	Weighted Boulder (%)	Bedrock (%)	Weighted Bedrock (%)	Pool (%)	Weighted Pool (%)	Boulder (%)	Weighted Boulder (%)
North Treaty Creek	1	14-Sep-11	0	0	10	4.6	75	34.2	15	6.8	0	0.0	10	4.6	10	4.6
North Treaty Creek	1	14-Sep-11	0	0	10	1.5	80	12.3	10	1.5	0	0.0	30	4.6	1	0.2
North Treaty Creek	1	14-Sep-11	0	0	10	3.9	70	27.4	20	7.8	0	0.0	15	5.9	20	7.8
			Sum	**0**		**10.0**		**73.8**		**16.2**		**0.0**		**15.0**		**12.5**
North Treaty Creek	2	14-Sep-11	0	0	10	9.0	70	63.1	20	18.0	0	0.0	0	0.0	15	13.5
North Treaty Creek	2	14-Sep-11	0	0	10	1.0	60	5.9	30	3.0	0	0.0	20	2.0	20	2.0
			Sum	**0**		**10.0**		**69.0**		**21.0**		**0.0**		**2.0**		**15.5**
North Treaty Creek	3	14-Sep-11	0	0	0	0.0	70	21.1	30	9.0	0	0.0	0	0.0	15	4.5
North Treaty Creek	3	14-Sep-11	0	0	60	9.0	30	4.5	10	1.5	0	0.0	60	9.0	1	0.1
North Treaty Creek	3	14-Sep-11	0	0	0	0.0	30	16.5	70	38.4	0	0.0	0	0.0	40	22.0
			Sum	**0**		**9.0**		**42.0**		**49.0**		**0.0**		**9.0**		**26.6**
North Treaty Creek	4	15-Sep-11	0	0	15	3.8	50	12.8	35	8.9	0	0.0	15	3.8	15	3.8
North Treaty Creek	4	15-Sep-11	0	0	30	2.2	50	3.7	20	1.5	0	0.0	50	3.7	10	0.7
North Treaty Creek	4	15-Sep-11	0	0	10	2.8	40	11.0	50	13.8	0	0.0	0	0.0	20	5.5
North Treaty Creek	4	15-Sep-11	0	0	30	11.8	50	19.7	20	7.9	0	0.0	30	11.8	20	7.9
			Sum	**0**		**20.6**		**47.2**		**32.1**		**0.0**		**19.4**		**18.0**

LWD = large woody debris

SWD = small woody debris

Appendix 5.2-4. Detailed Fish Habitat Data for North Treaty Creek, 2011

			Instream Cover										Functional LWD Size			
Stream	Site No.	Date	Instream Veg. (%)	Weighted Instream Veg. (%)	Overhang Veg (%)	Weighted Overhang Veg. (%)	Undercut Bank (%)	Weighted Undercut Bank (%)	LWD (%)	Weighted LWD (%)	SWD (%)	Weighted SWD (%)	10-20 cm	20-50 cm	>50 cm	Total LWD Tally
North Treaty Creek	1	14-Sep-11	0	0.0	5	2.3	15	6.8	15	6.8	10	4.6	0	2	0	2
North Treaty Creek	1	14-Sep-11	0	0.0	1	0.2	0	0.0	20	3.1	5	0.8	0	1	0	1
North Treaty Creek	1	14-Sep-11	0	0.0	5	2.0	1	0.4		0.0	0	0.0	0	0	0	0
				0.0		**4.4**		**7.2**		**9.9**		**5.3**				
North Treaty Creek	2	14-Sep-11	0	0.0	40	36.1	5	4.5	1	0.9	0	0.0	0	1	0	1
North Treaty Creek	2	14-Sep-11	0	0.0	65	6.4	0	0.0	0	0.0	20	2.0	0	0	0	0
				0.0		**42.5**		**4.5**		**0.9**		**2.0**				
North Treaty Creek	3	14-Sep-11	0	0.0	80	24.1	0	0.0	1	0.3	30	9.0	0	0	0	0
North Treaty Creek	3	14-Sep-11	0	0.0	1	0.1	5	0.7	0	0.0	0	0.0	0	1	0	1
North Treaty Creek	3	14-Sep-11	0	0.0	10	5.5	1	0.5	1	0.5	0	0.0	1	1	0	2
				0.0		**29.7**		**1.3**		**0.9**		**9.0**				
North Treaty Creek	4	15-Sep-11	0	0.0	30	7.7	0	0.0	5	1.3	15	3.8	1	0	0	1
North Treaty Creek	4	15-Sep-11	0	0.0	60	4.5	0	0.0	0	0.0	1	0.1	0	0	0	0
North Treaty Creek	4	15-Sep-11	0	0.0	30	8.3	0	0.0	0	0.0	15	4.1	0	0	0	0
North Treaty Creek	4	15-Sep-11	0	0.0	20	7.9	0	0.0	20	7.9	15	5.9	1	0	0	1
				0.0		**28.3**		**0.0**		**9.2**		**14.0**				

LWD = large woody debris

SWD = small woody debris

Appendix 5.2-4. Detailed Fish Habitat Data for North Treaty Creek, 2011

			Pool		Riparian Cover (%)			
Stream	Site No.	Date	Pool Type	Residual Pool Depth (m)	Riparian Cover Type	Riparian Structure	Canopy Cover (%)	Weighted Canopy Cover (%)
North Treaty Creek	1	14-Sep-11	-	-	Conifer	Mature	40	18.2
North Treaty Creek	1	14-Sep-11	Scour	0.4	Conifer	Mature	10	1.5
North Treaty Creek	1	14-Sep-11	-	-	Conifer	Mature	20	7.8
								27.6
North Treaty Creek	2	14-Sep-11	-	-	Conifer	Mature	60	54.1
North Treaty Creek	2	14-Sep-11	Scour	0.3	Conifer	Mature	60	5.9
								60.0
North Treaty Creek	3	14-Sep-11	-	-	Conifer	Mature	80	24.1
North Treaty Creek	3	14-Sep-11	Scour	0.6	Conifer	Mature	20	3.0
North Treaty Creek	3	14-Sep-11	-	-	Conifer	Mature	35	19.2
								46.3
North Treaty Creek	4	15-Sep-11	-	-	Conifer	Mature	50	12.8
North Treaty Creek	4	15-Sep-11	Scour	0.2	Conifer	Mature	60	4.5
North Treaty Creek	4	15-Sep-11	-	-	Conifer	Mature	60	16.6
North Treaty Creek	4	15-Sep-11	Scour	0.4	Conifer	Mature	30	11.8
								45.6

LWD = large woody debris

SWD = small woody debris

Appendix 5.2-5

North Treaty Creek Site Photographs, 2011

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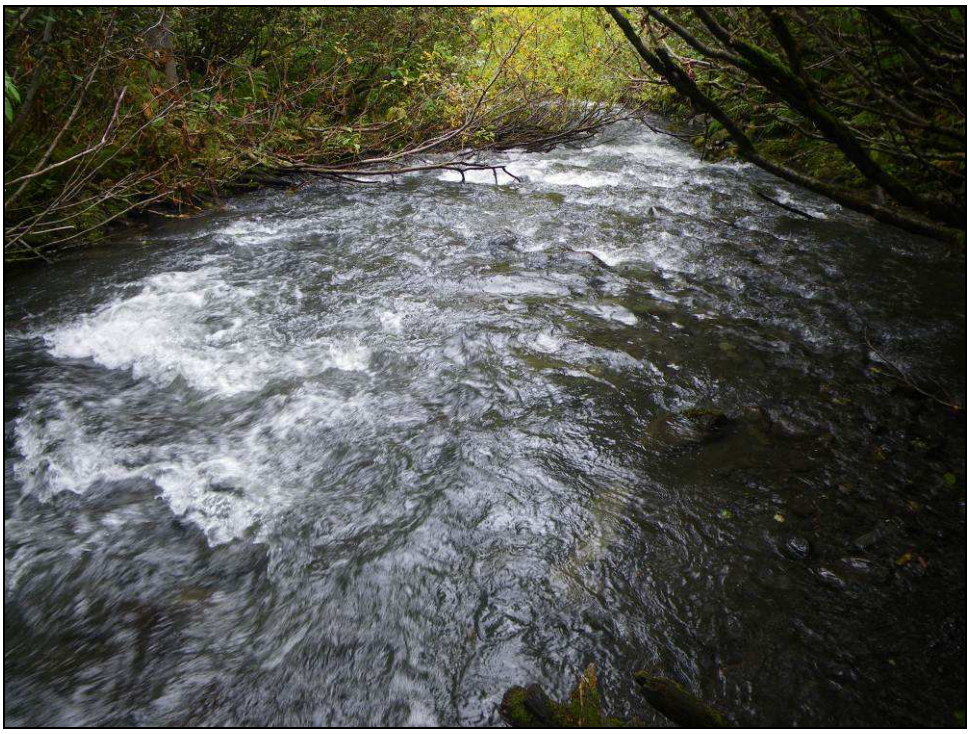
Appendix 5.2-5. North Treaty Creek Site Photographs, 2011

North Treaty Creek – Site 1 – Photo 1

North Treaty Creek – Site 1 – Photo 2



North Treaty Creek – Site 2 – Photo 1

North Treaty Creek – Site 2 – Photo 2

North Treaty Creek – Site 3 – Photo 1

North Treaty Creek – Site 3 – Photo 2

North Treaty Creek – Site 4 – Photo 1

North Treaty Creek – Site 4 – Photo 2

Appendix 5.3-1

Steelhead Snorkel Redd and Adult Enumeration Spawning Survey Data, 2011

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Appendix 5.3-1. Steelhead Snorkel Redd and Adult Enumeration Spawning Survey Data, 2011

Stream Name	Survey Date (d/m/y)	Survey Start Time	Survey End Time	Start Location	End Location	Water Clarity	Weather	Precipitation	Water Temp	Air Temp	No. Fish Observed	No. Redds Observed
Teigen Creek	25/5/2011	9:00	10:00	Km 10.5	-	Turbid (1.2 m)	Sunny	None	4	12	0	0
Teigen Creek	26/5/2011	9:00	10:00	Km 16.5	-	Turbid (0.8 m)	Sunny	None	4	12	0	0
South Teigen Creek	25/5/2011	10:00	10:30	Teigen Creek Confluence	-	Turbid	Sunny	None	3	12	0	0
South Teigen Creek	26/5/2011	10:00	10:30	Teigen Creek Confluence	-	Turbid	Sunny	None	3	12	0	0
North Treaty Creek	25/5/2011	11:30	12:00	Treaty Creek Confluence	-	Turbid	Sunny	None	3	12	0	0
North Treaty Creek	27/5/2011	11:30	12:00	Treaty Creek Confluence	-	Turbid	Sunny	None	3	15	0	0
Treaty Creek	27/5/2011	11:30	12:00	Tumbling Creek Confluence	-	Turbid	Sunny	None	3	15	0	0

Dashes indictae not available