

Cheakamus Project Water Use Plan

Trout Abundance Monitor in Cheakamus River

Implementation Year 5

Reference: CMSMON-2

Rainbow Trout Abundance Monitor of the Cheakamus River (Daisy lake to Cheakamus Canyon)

Study Period: 2007 - 2011

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CHEAKAMUS WATER USE PLAN

Rainbow Trout Abundance Monitor of the Cheakamus River (Daisy Lake to Cheakamus Canyon) 2007-2011

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REPORT





Study Limitations

This Trout Abundance Monitor (Monitor) was prepared for the exclusive use of BC Hydro. The Monitor is based on data and information, obtained during the previous documented investigations for the Cheakamus River project area, which included fourteen sampling sites, and is based solely on the site conditions observed during these investigations.

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1.0 INTRODUCTION

1.1 Background

BC Hydro operates the Cheakamus generating facility which consists of the Daisy Lake Dam and Reservoir and the Cheakamus Powerhouse connected by an 11 km tunnel through Cloudburst Mountain. The Daisy Lake Dam and Reservoir are located on the Cheakamus River about 40 km north of Squamish (Figure 1).

BC Hydro initiated a Water Use Plan (WUP) process for the Cheakamus Generating facility originally in 1996 but was put on hold when Fisheries and Oceans Canada (DFO) placed a Flow Order that specified that minimum flows be discharged from Daisy Lake Dam. The WUP was again initiated in 1999 and a Consultative Committee (CC) was established in June 1999 to oversee the WUP planning process (BC Hydro, 2002). The CC process and its final report were completed in May of 2002 without complete consensus. BC Hydro submitted a revised WUP to the Comptroller of Water Rights in October 2005 which was subsequently approved along with a recommended monitoring plan to address key issues and uncertainties identified by the CC.

During the WUP, the CC established a Fisheries Technical Committee (FTC) to examine issues and uncertainties of the potential impact of changes in the WUP on fish below the Daisy Lake Dam (BC Hydro, 2002). The FTC first conducted preliminary studies to understand the distribution of fish within the Cheakamus watershed. They then used this information to develop a set of impact hypotheses about the impact of dam operations on fish populations and aquatic ecosystems and outlined methods and approaches to test these hypotheses in their Terms of Reference (ToR) (BC Hydro 2007).

In particular, these studies and models indicated that the resident rainbow trout population in the reaches downstream of the Daisy Lake Dam appeared to be somewhat more sensitive to dam operations (BC Hydro, 2002). In addition, CC members also felt that the resident trout abundance levels are an indicator of ecological health of the upper Cheakamus watershed. The uncertainty surrounding the relationship between discharge from Daisy Lake Dam and the quantity of fish habitat and the resulting trout abundance was a key issue for the CC. The potential impact of the change in the WUP flow regime on trout abundance is uncertain because:

- 1) The actual differences in discharge downstream of Daisy Lake Dam between the Cheakamus WUP and pre-WUP flow regime are uncertain; and,
- 2) The impact of the pre-WUP condition is uncertain due to limited historical sampling data.

The lack of baseline data of the resident trout population downstream of Daisy Lake Dam coupled with the CC's rationale for the importance of a healthy resident trout population in the upper Cheakamus led to the need for a trout abundance monitor as part of the Cheakamus WUP monitoring program. BC Hydro subsequently incorporated a 5 year trout abundance monitor as one of the 10 monitors funded under the Cheakamus WUP (BC Hydro 2007). This report summarizes the results from Year 1 (2007) through to Year 5 (2011) of this 5 year study and makes some comparisons between the five years of data.

This project is a joint effort between Squamish Nation, the Squamish to Lillooet Sportfish Advisory Committee (SLSAC), and Golder Associates Ltd. (Golder). Squamish Nation provided overall direction and management of the project, with technical support from Golder. Two Squamish Nation fishery technicians assisted with all sampling and data collection and data compilation. The SLSAC provided one sports fisher to participate with a



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Squamish Nation angler in the adult trout enumeration component of this monitor. Golder provided the Project Biologists and technical oversight of the monitor's design, execution and reporting. The project team helped to foster and strengthen an already strong stewardship base in the Squamish River watershed.

1.2 Pre-WUP and WUP Minimum Flow Releases

Table 1 presents the minimum flow requirements for the WUP flow regime and the pre-WUP flow regime in the Cheakamus River.

Table 1: Overview of the minimum flow release requirements prior to the Cheakamus Water Use Plan and under the Cheakamus Water Use Plan regime

Minimum Flow from Daisy Dam	Pre-WUP (m ³ /s)	WUP (m ³ /s)
Jan 1 to Mar 31	5	5
Apr 1 to Oct 31	5	7
Nov 1 to Dec 31	5	3
Additional Flow Releases	Based on inflows to Daisy Lake Reservoir	Based on flow requirements at Brackendale Gauges

While changes in flow required to maintain the minimum flow at Brackendale are unpredictable and can create variability in the flow regime experienced by the trout population, the impact of these usually short term fluctuations is not expected to be biologically significant (BC Hydro, 2007). These short term fluctuations are most often within the range of discharge volumes found in the natural environment. For this reason, this monitor will be concerned only with the impact of changes to base flow releases on the resident trout population, and short-term fluctuations will largely be ignored with the exception of flood flow releases, which could have an impact.

1.3 Purpose and Objectives

The potential impact of the change in the annual flow release requirements as outlined in Table 1 on resident trout populations is uncertain largely due to a lack of baseline data on the impact of the pre-WUP flow regime. The overall purpose of this five year monitoring program is to answer the following fish management question:

- Do Daisy Lake Dam water flow releases affect the resident rainbow trout population located immediately downstream of Daisy Lake Dam? The parameters of interest include fish density or relative abundance, age class distribution, size-at-age, and relative condition.



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This management question is addressed through a test of four impact hypotheses that relate to three key phases in the life history of rainbow trout: spawning success, summer rearing (growth and survival), and over wintering survival. Direct measures of these parameters are outside the scope of this monitor. This study will therefore rely on the use of indicator variables to test the following four hypotheses:

- Ho1: Relative spawning success, as indicated by fry density at the time of sampling, is not correlated with average (or some other summary statistic) discharge during the spawning, incubation, emergence, and early rearing phases of development.
- Ho2: Relative rearing success, as indicated by relative condition, size-at-age, and abundance, is not correlated with average (or some other summary statistic) discharge during the summer growth season.

The following two hypotheses are used as a general test of the assumption that resident trout populations are not impacted by the change to WUP base operations.

- Ho3: Relative spawning success, as indicated by fry density at the time of sampling, remains stable or increases through time following implementation of the WUP.
- Ho4: Relative rearing success, as indicated by relative condition, size-at-age, and abundance, remains stable or increases through time following implementation of the WUP.

Since this is a five year study, carried out annually over five years, this monitoring report will focus on the statistical testing of the above four impact hypotheses and summarize the methodology, results and overall findings from Year 1 to Year 5 (2007, 2008, 2009, 2010 & 2011). The focus of the monitoring program is the population of resident rainbow trout, and even though all captured fish species were documented, the data analyses have been conducted on resident rainbow trout species only. For each year of sampling, which was carried out over a one to three week period at a standardized time of year (mid-September to mid-October), a report was prepared that summarized the findings of the monitor for each year. To address the impact hypotheses, the trout monitoring program assumes the study area is restricted to the upper section of the Cheakamus River, which is bounded by Daisy Lake Dam at its upstream end and the start of the canyon reach at its downstream end.



2.0 METHODS

This study utilized two programs for catching rainbow trout in the upper Cheakamus River and followed the methods proposed in BC Hydro's ToR (BC Hydro 2007). The first program, a multi-pass electrofishing program, was used to catch juvenile rainbow trout at ten select sites located between the Daisy Lake Dam and the Cheakamus Canyon. Methodology followed that of similar past studies (Ptolemy et al 2006, Riley and Korman 1995) and guidance from BC Hydro (Brent Mossop and Ian Dodd) and Ministry of Environment (MOE: Ron Ptolemy) staff. Prior to conducting field work in Year 1, field crew members attended a session on the Coquitlam River with Ron Ptolemy (MOE) to obtain practice with the standardized electrofishing methods used by MOE. The second program was an angling program that targeted adult rainbow trout in the Cheakamus River from the confluence of Rubble Creek to the Cheakamus Canyon. Data obtained from these two fish capture programs were used to provide information on fish density, size-at-age, relative condition and relative spawning success.

2.1 Sites

Ten representative sites located from Daisy Lake Dam to the anadromous fish barrier (Cheakamus canyon) were selected for electrofishing during Year 1 (2007) of this study (Figure 1). As described in the Year 1 report (Golder, 2007), field reconnaissance and the review of relevant literature contributed to the selection of these ten sites. A pilot snorkel survey was conducted on September 12th, 2007, but was found to be ineffective for site reconnaissance. Sites were chosen in 2007 based upon a stream bank reconnaissance of factors such as suitability for backpack electrofishing, accessibility, distribution throughout the project area, and suitable fry and parr habitat characteristics (*i.e.*, riffles, cascades, pools). Each site sampled in the Year 1 study was resampled during Years 2, 3, 4 and 5. Locating each site was completed using GPS coordinates, site flagging, and photographs from previous years.

2.2 Fish Capture

2.2.1 Multi-pass Electrofishing

Sites were sampled by multi-pass electrofishing in September 2007 to 2009 and in October 2010 and 2011. The electrofishing sampling dates varied for each year of the monitor and are presented as follows:

- Year 1 – September 13, 14, 15, 17, 18 and 19, 2007;
- Year 2 – September 11, 12, 20, 25, 26, 27, 29 and 30, 2008;
- Year 3 – September 23, 24, 25, 28, 29 and 30, 2009;
- Year 4 – October 4, 5, 6, 7 and 8, 2010; and,
- Year 5 – October 17, 18, 19, 20 and 21, 2011.



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Sampling dates varied between the years as a result of: 1) BC Hydro scheduled maintenance to the Cheakamus Generation Station, which required discharge from Daisy Dam instead of through the penstocks to the station; 2) unexpected high volume rain events which necessitated discharges from Daisy Dam that prevented electrofishing downstream due to logistic and safety concerns; and, 3) the availability of crews to accommodate a fluctuating schedule.

The fish capture methods, including electrofishing, were replicated for each year of the monitoring program. The crews consisted of a combination of Squamish Nation and Golder staff. The crews for each year of the monitor were:

- Year 1 – Heather Lamson (Golder), Allen Lewis II (Squamish Nation) and Allen Lewis III (Squamish Nation);
- Year 2 – Rob Hoogendoorn (Golder), Allen Lewis II (Squamish Nation), Allen Lewis III (Squamish Nation) and Max Schuetz (Golder);
- Year 3 – Robert Harrison (Golder), Rob Hoogendoorn (Golder), Allen Lewis II (Squamish Nation) and Allen Lewis III (Squamish Nation);
- Year 4 - Robert Harrison (Golder), Allen Lewis II (Squamish Nation) and Allen Lewis III (Squamish Nation); and,
- Year 5 - Robert Harrison (Golder), Allen Lewis II (Squamish Nation) and Allen Lewis III (Squamish Nation).

Allen Lewis II and Allen Lewis III have been involved in the field program since Year 1 and have the expertise and knowledge to consistently and reproducibly collect data over the 5 year period of the monitor.

Block nets were used in the field program to isolate the electrofishing sites. The block nets used in 2007 were each 15 m and 30 m long respectively with a mesh size of 1 and 4 mm. The block nets used in the 2008 through to the 2011 field program were light and easy to transport (15 m long by 2 m high, mesh size of 5 mm). Three or four passes were conducted at the sites in Years 1, 2 and 3, whereas three passes were conducted at each site in Years 4 and 5.

While focusing on minimal disturbance to fish, sites were enclosed using block nets prior to fishing to prevent immigration and emigration during multiple-pass depletion sampling. First, a 15 m long net was erected at the downstream boundary with the shore line angled slightly downstream. The net was held in place with a series of guy ropes, bipods and anchors, with the lead line knitted closely to the bottom using boulders as weights along the lead line. A 15 m net was then erected at the upstream boundary of the site and anchored in a similar fashion. This net was also used to close off the site to the off shore side by folding around the upper, mid channel corner of the site and attaching to the downstream net.

Some sites had variations of the methods described above. Sites 1 and 2 were located in a side-channel and full enclosure was achieved using a block net at upstream and downstream extents, with both sides bounded by shoreline. At Site 6 in 2009 and 2010, the off-shore side of the site was too fast to enclose using a block net; consequently a 1.9 cm (3/4 inch) stretch mesh nylon gillnet was employed along the outer margin. Site 8 was located at a bend in the river where eddy currents were strong. Instead of enclosing the site with block nets that resulted in a rectangular shaped site, this site was triangular in shape as a result of having the ends of the block nets wrapped and anchored at the point of the triangle at the furthest point from the shore.



Electrofishing methods used were aligned with MOE standardized methodologies as previously noted. The crews were equipped with a Smith Root 12B electrofishing backpack unit with a 25 cm diameter anode ring and a 3.2 long cathode. For each pass, sites were electrofished in a pattern starting from the downstream end and fishing upstream, sweeping the site in a zigzag pattern. Upon reaching the top of the site, a downstream sweep, which ended at the downstream shore corner, completed the pass. If the site was particularly wide, it was sectioned into quarters and fished similarly, starting with sampling the bottom outside corner and continuing sampling to the bottom inside corner, and then sampling to the upper outside corner and continuing sampling to the upper inside corner. Sampling continued after the upstream directed sampling was completed by sweeping downstream in a similar pattern. Fish captured during each pass were immediately processed before the next pass.

Electrofisher settings for pulse width and voltage settings were similar between years, while frequency settings were slightly higher in 2007 in comparison to 2008, 2009, 2010 and 2011. Level of effort for each pass, measured in electrofishing seconds, was also similar between years. Electrofisher settings and level of effort for each year of the monitor are provided in Appendix A.

2.2.2 Adult Sampling

Adult rainbow trout sampling for the monitor was conducted on:

- Year 1 – October 13 and 14, 2007;
- Year 2 – October 11 and 12, 2008;
- Year 3 – October 10 and 11, 2009;
- Year 4 - October 13 and 14, 2010; and,
- Year 5 – October 31 and November 1, 2011.

The schedule for sampling remained consistent between the first four years of the monitor when angling was conducted on the second weekend of October. The final year of adult sampling was delayed for over two weeks as a result of a combination of the unexpected high volume rain events and the maintenance work at the Cheakamus Generation Station, which required BC Hydro to discharge flows from Daisy Dam that were too high to effectively and safely electrofish..

A two person angling crew conducted the adult trout sampling. The crew consisted of Allen Lewis III (Squamish Nation) and Clint Goyette (SLSAC) in 2007 and Michael Lewis (Squamish Nation) and Clint for 2008 to 2011. Clint Goyette angled in all five years of the monitor. The Cheakamus River was fly-fished at four sites from Rubble Creek to the Cheakamus Canyon. All four sites were the same sites fished in 2007, 2008, 2009, 2010 and 2011 and were close to the juvenile electrofishing Sites 2, 3, 8 and 10. Approximately six hours were spent on the river each day of angling, with variable start and finish times for each year, from no earlier than 9:15 AM to no later than 5:30 PM. Of the six hours on the river, about five hours were actually spent fishing; time spent moving between fishing sites, note taking and taking scale samples from fish accounted for the other hour. Total fishing effort for each year of the monitor over the two days of angling was therefore roughly 20 hours, except for



2007 (7.9 hours) and 2011 (24.0 hours). The fishing effort by Allen Lewis III in 2007 was not included or factored into the CPUE calculation due to his lack of experience with angling and in 2011 a greater effort was contributed by both Clint Goyette and Michael Lewis. During 2008 Clint Goyette fly fished over two days, whereas Michael Lewis used a spinning reel with spoons and spinners on the morning of the first day before changing over to flies in the afternoon of the first day and duration of the second day.

During the angling, there were a variety of flies through the sampling years which yielded fish, which included the following:

- Year 1 – Hare’s Ear, Elk Hair Caddis, Lime Trude and Adams Irresistible;
- Year 2 – Hare’s Ear (dark brown), Czech Nymph (fluorescent green), Tom Thumb (orange belly, fluorescent green belly), Woolly Bugger (black with green bead), CDC Mayfly, and Wet Fly with red tag;
- Year 3 – Hare’s Ear (dark brown), Czech Nymph (fluorescent green), Bead leech (black with orange bead), CDC Mayfly, and various Wet Flies similar to Carey special and Doc Spratley, all in the size range of #8 to #14;
- Year 4 – Hot Spot Pheasant tail nymph, Partridge and Orange Wet Fly, Klinkhammer emerger, Adams (with orange post), and various Wet Flies similar to Carey special and Doc Spratley, all in the size range of #10 to #14; and,
- Year 5 – Royal Coachman Wet Fly and Green/Chartreuse Czech Nymph in size range of #8 to #10.

2.3 Fish Processing

Fish were processed using the same methods employed during all five years of sampling. Juvenile fish captured by electrofishing were anaesthetized in a clove oil dilution or using Alka-Seltzer and identified to species. All fish were measured to the nearest 1 mm fork length and were wet weighed to the nearest 1 g. Scale samples were collected from random samples of rainbow trout for the purposes of ageing. Once processed, the anaesthetized fish were allowed to recover and were released downstream of the site boundaries after each pass. After the last pass, all fish were released at the sampling site..

Representative samples of the rainbow trout caught by angling were measured for fork length but none were weighed to minimize handling. Scale samples from the measured fish were taken for age determination.

2.4 Habitat Assessment

Habitat assessments were carried out at all electrofishing sites and consisted of filling out Site Cards standardized by the Resource Inventory Committee (RIC). Additionally, sample site habitat description cards supplied by Ron Ptolemy, Ministry of Environment, were filled out. Depth and velocity were measured along transects at each site. Velocities were measured with a flow meter (Global Water Instrumentation Inc., Model FP101 flow probe) and depths were measured with a staff gage. Photographs were taken to document the site conditions during sampling. Site location was recorded in UTM coordinates using a handheld GPS, replicating methods used in 2007 through the following years.



2.5 Ageing of Rainbow Trout

Scales were processed in accordance with procedures described in Mackay et al. (1990). All scales were aged at the Golder fish ageing laboratory in Castlegar, B.C. Scales were temporarily mounted between two slides and examined using a microfiche reader. Where possible, several scales were examined and the highest quality scale was digitally scanned and saved as a JPEG-type picture file. All scales were examined independently by three experienced individuals and ages assigned. If assigned ages differed between the examiners the sample was re-examined jointly by the examiners to establish a final age.

Age classes were assigned through scale-based ageing to a proportion of the total rainbow trout caught on the Cheakamus River (the total was the sum of the fish caught by both electrofishing and by angling), Scale samples collected were not aged if they were regenerated scales, which grow rapidly and do not form ageing structures (circuli) until growth is complete (Ericksen 1999). The remaining fish that were not directly aged, were assigned ages using finite mixed distribution fitting methods according to MacDonald and Pitcher (1979). The finite mixed distribution fitting methods assess ages based on individual fish length; fish captured by angling, which did not have length measurements, were excluded from the mixed distribution model; therefore ages were assigned only to the fish with a length measurement. The finite mixed distribution fitting was performed in R version 2.12.0 (R Development Core Team 2008) using the package 'mixdist' version 0.5-3 (MacDonald and Du 2004).

Finite mixed distribution methods can assign ages to individuals based on the length-frequency distributions of both the aged and un-aged fish if the data are sufficiently informative. Three parameters are estimated for each age class using this modeling approach: the mean length of the fish in the age-class, the standard deviation of the lengths of the fish in the age-class and the proportion of fish in the total sample (aged and un-aged) belonging to each age-class. This analysis provided information on changes in the size-at-age and age class distribution of rainbow trout in the Cheakamus River. Such changes are important because they help answer the main management question for the Cheakamus WUP trout monitor: Do Daisy Lake Dam water flow releases affect the resident rainbow trout population located immediately downstream of Daisy Lake Dam?

The data were plotted in several ways prior to analysis to identify outliers and determine the necessary analytical steps. All rainbow trout captured and measured for length in 2007 through 2011 are shown in a length frequency plots (Figures 6), with the aged subset plotted below the length frequency information. All fish less than or equal to 65 mm were assumed to be 0 years old (or fry) and were considered as part of the aged sub-sample for model fitting. As the fish age the numbers of fish caught decrease, and the length of these fish of age-3, age-4, and age-5 classes appear to overlap, and there is no easily defined size for particular older ages. Due to the relatively low numbers and high degree of overlap of age-4 and age-5 fish with age-3 fish caught in the Monitor, these three oldest age classes were combined to give fish of age three years or older.

The starting parameters for fitting the data were obtained by using the aged fish. The mean length for each age class, the proportion of aged fish in each age class and the standard deviation around the mean length were extracted and used in the fitting. Three probable distributions were fitted to the data; the normal, lognormal and Poisson. The best fitting distribution was selected by determining the smallest chi-square value and the parameter estimation procedure was iterated 20 times to allow the parameters describing the distribution to be better estimated.



The best fitting model was used to assign a set of conditional probabilities to each un-aged fish. The set of conditional probabilities are the probabilities that the fish belongs to each age-class, conditional on its length. The conditional probabilities were summed by age-class to estimate the total number of fish in each age class. Individual fish were assigned an age for further analyses based on the set of conditional probabilities. Where conditional probabilities suggested the proportion of fish with lengths in a specified interval be split between age classes, ages were randomly assigned to the fish to match the proportions of the conditional probabilities.

2.6 Data Analysis

2.6.1 Data Management

Data were entered into excel spreadsheets developed by Golder for the project and into an Excel database designed by Ron Ptolemy (MOE). The latter database calculates Weighted Useable Area (WUA) from depth velocity transects and standardizes the input and presentation of data to that of other electrofishing removal depletion studies throughout BC. Habitat information collected on standard RISC site cards was entered into a Fisheries Information Summary System database.

2.6.2 Fish Density Estimates

Population estimates were calculated from maximum likelihood estimation (MLE) procedures (Riley and Korman 1995) using a program developed and supplied to the project by BC Hydro. The MLE procedure involves using fish removal data from each electrofishing pass to calculate the population size (or total number of fish) that would have been captured if sampling continued until no fish were remaining at the site (Appendices A to E). The program enabled the user to choose Bayesian analysis if the pattern of removal departed significantly from expected values ($CV > 0.25$). Estimates were given for each year class of rainbow trout and for any other species found at each site. Standard Error and Coefficient of Variation were shown for each population estimate. Density estimates were calculated based on the area of each site and were reported as fish/100m² for each rainbow trout age class.

2.6.3 Probability of Weighted Usable Area

To deal with the inherent variability in rainbow trout age-0 abundance at the same site among years due to hydraulic and habitat changes, raw population density was divided by a weighted usable area fraction, using methodologies designed by Ptolemy, et. al. (2006).

Weighted usable area (WUA) was computed using depth/velocity data input into spreadsheets (Appendices A to E). Standardized age-0 densities were computed as observed density/WUA (or probability of useable area) for year site comparisons. These methods were not applied to age classes older than age-0 as habitat use by older age classes is more affected by factors other than depth and velocity (Ptolemy, Pers. comm. 2007).



2.6.4 Adult Abundance

Adult abundance was reported as Catch Per Unit Effort (CPUE) calculated by dividing the total catch by the total level of fishing effort (rod hours) for both anglers. The CPUE was based upon both Clint Goyette's and Michael Lewis' fishing effort and total catch for 2011, 2010, 2009 and 2008. For 2007, as previously noted, Allen Lewis III's fishing effort was not included so the data analyses relied upon only Clint's effort and catch.

2.6.5 Size at Age

Length-at-age growth relationships were generated for rainbow trout by averaging the length for each age-class and by using the von Bertalanffy growth model (Ricker 1975). The addition of 0.5 to the age category (*i.e.*, age 0 fish are presented as age-0.5) allowed the length-at-age regression curve and the Y-intercept to more accurately reflect the actual age of the fish, given an assumed hypothetical hatch date of March 1st.

The von Bertalanffy equation was used to estimate parameters L_{inf} and k for determining growth at age using non-linear weighted least squares where:

$$L_f = L_{inf} (1 - \exp [- k (Age)])$$

Where L_f = average fork length for an age class and Age = scale estimated age class + 0.5 years. To avoid weighting the von Bertalanffy growth curve analysis by small age classes, average size at age (as opposed to individual fish data) was used in developing the model with the regression model weighted by numbers of fish in each age class.

2.6.6 Relative Condition

Relative condition was calculated using the Fulton's Condition Factor (hereafter 'condition factor') which is an indicator of the plumpness of a fish (Lagler 1956). The coefficient of condition (K_{FL}) is calculated for each fish as:

$$K_{FL} = (W \times 100) / L^3$$

Where W is weight in grams and L is the length in cm of the individual fish. Differences in condition factor between years were assessed by ANOVA.

2.6.7 Relative Spawning Success

Ideally, a stock/recruitment model would be developed to determine relative spawning success (*i.e.*, Ricker, 1975); however, the data collection required for the development of such a model is beyond the scope of this project.

In this monitoring study, relative spawning success is determined by development of an indicator variable, which is an index of recruits per spawner (BC Hydro). An index of relative spawning success was calculated by estimating the average density of rainbow trout fry (age 0+) at the 10 sites, after adjusting for WUA, for a given year and then dividing this estimate of fry density by adult abundance as measured by the catch per unit effort for the previous year. This assumes that adult abundance, as measured in the angling survey for the previous year, is an index of the number of rainbow trout spawners that would have spawned in the Spring and that these spawners produced the Age-0+ trout that were sampled at the 10 sites by electrofishing.



2.6.8 Daisy Lake Dam Water Discharge

BC Hydro has provided the hourly mean discharge data from Daisy Lake Dam for this study. Discharge data were summarized as daily means for plotting data from 2007 to 2011. To describe the flow regime in the Cheakamus River during the study period, and to compare the relative discharges among years, a flow duration curve (FDC) was created using daily mean discharge data from 2007 to 2011. A FDC plots discharge versus the percent of time that a given discharge is met or exceeded. A separate FDC was created for the summer rainbow trout growth season, defined as June through September, and for the whole year. Basic descriptive statistics calculated for discharge data in each study year data were the mean, 90th percentile (Q_{90}), and the 10th percentile (Q_{10}). Q_{90} and Q_{10} are commonly used as indices of high and low flow, respectively (Davie 2002; Jha et al. 2008).

2.6.9 Statistical Analyses

A random complete block (RCB) ANOVA was used to compare the densities of age-0 rainbow trout among study years, where year was the main effect and sample site was the block effect. Density was log-transformed to better meet model assumptions of normality of residuals and equal variance. Length-at-age was compared among study years using ANOVA. If the effect of year was significant in ANOVA models, Tukey's Honestly Significant Difference (HSD) test was used to assess which years differed.

A series of General Linear Models (GLMs) was used to determine how condition factor was affected by the factors year, sample site, and age class. Weight was the response variable and length was included as a predictor variable in all candidate models. Length was transformed to the power of three and divided by 100,000 for scaling, following the equation for Fulton's Condition Factor, so that weight could be modeled using a GLM instead of a non-linear model. Other candidate variables that were considered for inclusion in the model were year, site, age-class, year: length, and age: length. The site: length interaction was not a candidate variable, meaning that the slope of the weight to length relationship was assumed to be equal across sample sites. Akaike's Information Criterion (AIC) was used for model selection, where the model with lowest AIC score was considered the best supported model (Burnham and Anderson 2002) and was selected for interpretation.

Linear regression was used to assess the relationship between discharge during the summer growth season and density of age-0 rainbow trout at each site and year. Three regressions were conducted to assess which of mean discharge, Q_{90} and Q_{10} were the best predictors of fish densities. Exploratory analyses indicated that sampling site was not a significant factor when added to the regression so it was not included in the model.

Linear regression was also used to assess the relationship between discharge during the summer growth season (mean, Q_{90} and Q_{10}) and mean condition factor of age-0 rainbow trout at each site and year. Regressions were not done for older age classes of fish because the time lag for older fish (*i.e.*, older fish are affected by the discharge in several different years) makes it difficult to assess the effect of discharge on condition. Because there were three similar comparisons, a Bonferonni corrected significance level of 0.017 (0.05/3) was used for the condition/density versus discharge regressions. To test whether condition factor also depended on the density of rainbow trout, linear regression was used.



3.0 RESULTS

3.1 General Site Conditions

Sampling by electrofishing was conducted in the Fall of each year, with the Year 5 electrofishing conducted from October 17th to 21st, 2011, the latest in the season compared to the sampling periods in Year 1 (September 13th to 20th, 2007), in Year 2 (September 11th to 30th, 2008), in Year 3 (September 23rd to September 30th, 2009), and in Year 4 (October 4th to October 8th, 2010). Sampling by angling was also conducted in the Fall of each year during the second weekend of October (13-14, 2007; 11-12, 2008; 10-11, 2009; and 13-14, 2010) with the exception of Year 5 (October 31 to November 1, 2011). A considerable factor influencing the timeline for the electrofishing and angling programs was the river discharge conditions prior to and during the sampling period. These discharge conditions varied between years.

Discharges prior to the Year 1 (2007) field program were variable and unexpectedly high (as high as 45 m³/s) and sampling had to be postponed until a more typical seasonal discharge rate occurred (See Section 3.8 and Figures 14a - f). Discharge rates from Daisy Lake Dam began to decline in mid-September 2007 and, shortly thereafter, the field program proceeded. In Year 2 (2008), the sampling program was conducted from mid- to end of September and was preceded by a period of discharges of approximately 8 m³/s which were less variable and lower than those experienced in 2007 (Figures 14b and 14c). Also, in Year 2, an algal growth covering the substrate throughout each site in the study area was observed, which appeared to be less extensive and abundant during subsequent field sampling in 2009, 2010 and 2011. In Year 3 (2009), the field program was delayed due to high discharges with a peak in flow of approximately 40 m³/s observed the week prior to conducting the field work in late September; average flow during the field program approximated 16 m³/s. The Year 4 (2010) sampling period occurred in early to mid-October (October 4th to 14th) as a result of maintenance work being conducted at Daisy Dam throughout September, which required the dam to spill to keep water levels in the reservoir low. The average discharge in Year 4 from the dam during the field program (10.9 m³/s) was seven times lower than the discharge in the preceding 2 weeks (76.0 m³/s) and ten times lower than the last week of September (110.7 m³/s). In Year 5 (2011), discharges from Daisy Dam prior to the field program were also high as a result of unexpectedly high seasonal inflows to the Daisy Reservoir, and maintenance to one of the turbines at the Cheakamus Generating Station. The high discharges necessitated postponement of both the electrofishing and the angling programs until mid- to late October. The average discharge over the four weeks prior to beginning the field program (70 m³/s) was more than twice that compared to the average discharge during the week of electrofishing (33 m³/s).

3.2 Age Classes and Length/ Frequency Distribution

Of 150 rainbow trout caught in 2011 (146 by electrofishing and 4 by angling), 136 were aged using scales and 14 were assigned an age using mixed distribution fitting. The best fitting model to the 2011 data used the lognormal distribution with the additional constraint of a constant coefficient of variation, with the final age class (3 and older) proportion fixed to the value estimated from the aged fish sub-sample. In 2010, of the 240 rainbow trout captured (220 fish caught by electrofishing and 20 fish caught by angling), 133 individuals were aged by scale ageing and the remaining 107 were assigned age classes using the mixed distribution analysis. The ages of the 554 rainbow trout caught in 2009 (535 by electrofishing and 19 by angling) were estimated by scale ageing 78 fish and modeling the age-length relationship using the finite mixed distribution model to assign age



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classes to the 476 fish that were not scale aged. The 2008 year had 301 rainbow trout captured (291 by electrofishing and 10 by angling) with age determination by scale ageing for 55 fish and by age class assignment of 246 fish using the finite mixed distribution model. Of the 181 rainbow trout captured in 2007 (170 by electrofishing and 11 by angling) 44 had scales aged, 46 were assigned to age-0 based on the length-frequency distribution, and the remaining 91 fish were assigned ages based on the proportion of age classes of all fish of a particular length, which were determined by summing conditional probabilities of age at a given length from all scale aged fish. The best fitting models of the mixed distribution analysis for the 2010, 2009 and 2008 data used the lognormal distribution with the additional constraint of a constant coefficient of variation. The 2010 and 2009 mixed distribution best fit models had the final age class (3 and older) proportion fixed to the value estimated from the aged fish sub-sample. The mixed distributions for the rainbow trout captured in 2011, 2010, 2009, 2008, and 2007 are presented Figures 2 - 5.

The total catch of rainbow trout by electrofishing was lowest in 2011 compared to all previous years (Table 2). The proportion of age-0 fish was similar in 2007 (0.31), 2010 (0.33), and 2011 (0.27), and more than twice as large in 2008 (0.81) and 2009 (0.81). There was a greater proportion of age 2 and 3+ fish in 2010 (0.54) and 2011 (0.39) compared to earlier years (2007 =0.09, 2008=0.08, 2009=0.04); Table 2). A strong cohort in one year was not traceable in the sampling results from subsequent years. For instance, there was a large proportion (0.81) of age-0 fish in 2009 but a relatively small proportion (0.13) of age-1 fish in 2010. The length-frequency distributions of all rainbow trout captured by electrofishing in 2007 through 2011 are presented in Figure 6.

Table 2: Number of Fish and Proportion of Fish in each Age Class of Rainbow Trout Sampled by Electrofishing in the Cheakamus River in 2007, 2008, 2009, 2010 and 2011

Age	2007 2		008 2		009 2		010 2		011	
	#Fish	Proportion								
0	53	0.31	186	0.64	434	0.81	72	0.33	40	0.27
1	101	0.59	83	0.29	79	0.15	29	0.13	50	0.34
2	14	0.08	20	0.07	6	0.01	102	0.46	45	0.31
3+	2	0.01	2	0.01	16	0.03	17	0.08	11	0.08
Total	170		291		535		220		146	

3.3 Juvenile Density Estimates

Catches of rainbow trout by electrofishing in the study area during 2007 to 2011 were 170, 291, 535, 220, and 146, respectively. During the five years of the study, density estimates at the 10 sample sites ranged from 0.5 to 48.48 rainbow trout/100m² for age-0 fish, 0.5 to 23.2 rainbow trout/100m² for age-1 fish, 0.6 to 13.2 rainbow trout/100m² for age-2 fish, and 0.5 to 9.5 rainbow trout for age-3+ fish (Table 4).

RCB ANOVA indicated that densities of age-0 rainbow trout differed significantly among year (P<0.0001), while accounting for differences among sample sites. Tukey's HSD tests indicated that 2007 and 2010, 2007 and 2011, and 2010 and 2011 did not differ significantly but all other comparisons among years had significantly different densities (Table 3).



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Densities of age-0 rainbow trout were lowest in 2011, ranging from 0.5 to 7.8 rainbow trout/100m² for age-0 fish, 1.1 to 13.2 rainbow trout/100m² for age-1 fish, 0.6 to 6.8 rainbow trout/100m² for age-2 fish, and 0.5 to 2.7 rainbow trout for age-3+ fish (Table 4). In comparison, the densities of age-0 fish were slightly greater at most sites in 2007 and 2010, and much greater in 2008 and 2009 (Figure 7). Densities of age-1 fish were generally lower in 2010 and 2011, and higher and similar densities at most sites in 2007-2009 (Figure 8). Densities of age-2 fish were greater in 2010 and 2011 compared to 2007 to 2009 (Figure 9). There was a similar trend for age-3+ fish, with higher densities and more sites where age-3+ were caught in 2010 and 2011 compared to 2007-2009 (Figure 10).

Trends in the adjusted densities at each site (densities divided by probability of use) were similar to unadjusted rainbow trout densities, with the highest densities observed in 2009 and low densities in 2007 and 2011 (Figure 11). Compared to trends in unadjusted densities, adjusted densities in 2010 were slightly higher relative to other years of low density (*i.e.*, 2007, 2008, 2011) because of low probability of use in 2010 (Figure 11). Probability of use of sample sites was similar in all other years (2007, 2008, 2009, and 2011) but lower in 2010 (Table 5).

Table 3: P-values from Tukey's Honestly Significant Difference (HSD) test comparing densities of age-0 rainbow trout among years in the Cheakamus River

Year Comparison	P-value
2010-2011	0.5
2009-2011	<0.0001
2008-2011	<0.001
2007-2011	0.9
2009-2010	<0.0001
2008-2010	0.02
2007-2010	1
2008-2009	0.02
2007-2009	<0.0001
2007-2008	0.005



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Table 4: Population Estimates and Estimated Densities of Juvenile Rainbow Trout in the Cheakamus River from Multi-Pass Electrofishing Methods

Site Age		2007 2008		2009 2010		2011		Population Estimate	Density (RB/100m ²)	Population Estimate	Density (RB/100m ²)
		Population Estimate	Density (RB/100m ²)	Population Estimate	Density (RB/100m ²)	Population Estimate	Density (RB/100m ²)				
1	0	2	2.86	1	1.25	9	6.92	3	2.14	1	0.66
	1	5	7.14	4	5.00	4	3.08	5	3.57	2	1.33
	2	---	---	1	1.25	2	1.54	9	6.43	10	6.65
	3+	---	---	---	---	---	---	1	0.71	4	2.66
2	0	4	3.20	16	8.70	28	14.97	5	3.03	4	2.00
	1	11	8.80	6	3.26	13	6.95	7	4.24	7	3.50
	2	2	1.60	5	2.72	3	1.60	16	9.70	7	3.50
	3+	---	---	2	1.09	6	3.21	2	1.21	1	0.50
3	0	1	0.71	25	22.62	52	48.48	12	7.02	4	2.73
	1	2	1.43	1	0.90	5	4.66	1	0.58	6	4.10
	2	2	1.43	---	---	---	---	4	2.34	---	---
	3+	---	---	---	---	---	---	1	0.58	---	---
4	0	4	2.24	30	19.05	68	43.38	10	6.06	2	1.21
	1	4	2.24	---	---	10	6.38	4	2.42	5	3.03
	2	---	---	---	---	---	---	8	4.85	1	0.61
	3+	---	---	---	---	---	---	---	---	---	---
5	0	12	7.89	38	25.33	57	36.77	9	7.41	8	6.84
	1	30	19.74	21	14.00	16	10.32	4	3.29	4	3.42
	2	---	---	2	1.33	---	---	16	13.17	8	6.84
	3+	---	---	---	---	---	---	1	0.82	---	---
6	0	6	5.00	32	21.77	98	52.41	17	10.37	12	7.84
	1	17	14.17	10	6.80	4	2.14	1	0.61	9	5.88
	2	---	---	2	1.36	---	---	10	6.10	2	1.31
	3+	---	---	---	---	---	---	1	0.61	---	---



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Site	Age	2007 2008				2009 2010		2011			
7	0	8	4.28	17	8.67	52	23.57	4	2.0	4	3.61
	1	10	5.35	12	6.12	8	3.63	1	0.50	5	4.52
	2	2	1.07	---	---	---	---	7	3.50	3	2.71
	3+	1	0.53	---	---	---	---	3	1.50	1	0.90
8	0	14	15.30	25	36.23	73	45.63	5	4.78	4	6.58
	1	13	14.21	16	23.19	4	2.50	1	0.96	8	13.17
	2	---	---	---	---	---	---	6	5.74	4	6.58
	3+	---	---	---	---	---	---	---	---	---	---
9	0	4	4.97	6	6.49	13	11.76	6	10.43	---	---
	1	2	2.48	2	2.16	3	2.71	---	---	2	2.00
	2	---	---	---	---	---	---	2	3.48	---	---
	3+	---	---	---	---	1	0.90	---	---	---	---
10	0	0	0.00	3	1.62	15	15.87	1	0.50	1	0.52
	1	9	8.82	11	5.95	13	13.76	5	2.50	2	1.05
	2	8	7.84	10	5.41	1	1.06	25	12.50	10	5.23
	3+	1	0.98	---	---	9	9.52	8	4	5	2.62



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Table 5: Probability of Use and Adjusted Density for Age 0 Rainbow Trout at each Site Electrofished (Adjusted Fish/100m² = Population Density Divided By Probability of Use)

Site	2007		2008 2		009		2010 2		011	
	Probability of Use	Adjusted Fish/100m ²								
1	0.385	7.4	0.387	3.2	0.303	22.8	0.182	11.8	0.078	8.4
2	0.363	8.8	0.430	20.2	0.364	41.1	0.161	18.9	0.117	17.1
3	0.396	1.8	0.435	52.0	0.302	160.5	0.262	26.8	0.427	6.4
4	0.408	5.5	0.217	79.0	0.480	89.0	0.054	111.2	0.367	3.3
5	0.377	20.9	0.412	58.0	0.649	64.0	0.202	36.6	0.594	11.6
6	0.437	11.4	0.351	62.0	0.392	110.0	0.270	38.4	0.228	34.4
7	0.405	10.6	0.432	20.0	0.299	61.0	0.168	11.9	0.569	6.3
8	0.531	28.8	0.365	68.0	0.225	394.0	0.274	17.5	0.205	31.3
9	0.194	25.6	0.126	51.0	0.187	102.0	0.050	208.3	0.139	0.0
10	0.278	0.0	0.505	3.0	0.187	35.0	0.058	8.7	0.325	1.6

* Note: Error was discovered in Year 2 (Golder 2008) calculations and values have been corrected for this table.



3.4 Adult Abundance

CPUE of rainbow trout by angling was greatest in 2009 (5.3 fish/hour), followed by 2010 with a CPUE of 2.3 fish/hour, which were both greater than the CPUEs in 2011, 2008 and 2007, which were 0.2 fish/hour, 0.5 fish/hour and 1.4 fish/hour, respectively (Table 6). Angling in 2011 yielded the lowest number of adult rainbow trout caught during the monitor (four fish), even though the angling effort (24 rod-hours) was greater than all other years. The anglers reported optimal humidity and temperature conditions and the presence of invertebrate hatches while fishing in 2011 yet little sign of fish rising to food or bait.

Table 6: Adult abundance presented as the number of rainbow trout angled at each site and the catch-per-unit-effort (CPUE)

Angling Result	2007	2008	2009	2010	2011
# rainbow trout	11	10	110	42	4
Total hours	7.9	20.0	20.8	18.0	24.0
CPUE (# fish/hr)	1.4	0.5	5.3	2.3	0.2

3.5 Size at Age of Juvenile and Adult Rainbow Trout

3.5.1 Size at Age for Years 1 through 5

Size at age of adult and juvenile rainbow trout captured by electrofishing and angling during each year is presented in Table 7.

Comparisons of cohort mean lengths between years show notable increases in size which were generally regular for age-0 to age-2 rainbow trout, with an exception of 2010 age-2 (122.5 mm) from 2009 age-1 (115.0 mm) trout. This cohort displayed roughly a 7% increase in mean length from age-1 to age-2 in 2010, which is significantly lower than the previously observed increases in cohort mean lengths at age-2 in 2009 and 2008 of roughly 70%.

ANOVA indicated that length-at-age differed among years for all age-0, age-1, and age-2 fish (all $P < 0.0001$), but not for age-3 fish ($P = 0.1$). For age-0, age-1, and age-2 fish, Tukey's HSD tests indicated that length-at-age differed between some years but not for others (Table 8). Length-at-age was greater in 2009 and 2010 than in other years for all age classes, with the exception of age-2 fish in 2010 (Tables 7 & 8).

Table 7: Mean, standard deviation (SD) and sample size (n) of fork length of Rainbow Trout Caught by Electrofishing and Angling in each Age Class of Rainbow Trout Sampled on the Cheakamus River from 2007 to 2011

Age	2007			2008 2			009 2			010			2011		
	Mean Length	SD	n	Mean Length	SD	n									
0	36.9	6.2	53	45.2	8.2	186	51.7	11.6	434	54.0	8.8	72	45.8	7.2	40
1	96.0	15.9	101	95.6	19.7	83	115.0	19.6	79	101.5	12.6	29	98.8	18.4	50
2	164.2	21.2	14	163.3	45.9	24	158.5	17.1	6	122.5	28.6	107	133.6	20.3	45
3+	212.9	40.6	13	222.8	58.1	5	183.3	13.3	16	210.1	52.8	32	198.3	69.7	15



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Table 8: P-values from Tukey's Honestly Significant Difference (HSD) tests comparing length-at-age among years for different age classes of rainbow trout in the Cheakamus River. Length-at-age did not differ among years for age-3+ fish so Tukey's tests were not used for this age group

Year Comparison	Age Class			
	0 1		2	3+
2007-2008	<0.001	1.0	0.05	-
2007-2009	<0.001	<0.001	1.0	-
2007-2010	<0.001	0.6	<0.001	-
2007-2011	<0.001	0.9	<0.001	-
2008-2010	<0.001	0.6	<0.001	-
2008-2011	1.0	0.9	0.2	-
2009-2008	<0.001	<0.001	0.6	-
2009-2010	0.40	0.01	<0.001	-
2009-2011	0.004	<0.001	0.04	-
2011-2010	<0.001	1.0	<0.001	-

3.5.2 Von Bertalanffy Growth Curve and Predicted Length

Average fork lengths and predicted fork lengths using the von Bertalanffy growth curve for each age class are provided in Table 9. As was done in previous years of the study, the model combining data from all years by age class was considered more reflective of the overall population and is presented in Figure 12. Parameter estimates for the asymptotic fork length (L_{inf}) and the growth rate (k) were 298.7 (asymptotic standard error =109.3) and 0.287 (asymptotic standard error =0.15), respectively.

Table 9: Average Fork Lengths and Predicted Fork Lengths (FL) for each Age Class of Juvenile and Adult Rainbow Trout Using the Von Bertalanffy Growth Curve

Age	Count	Average FL	Predicted FL
0	785	49.1	39.9
1	342	101.2	104.5
2	198	134.6	152.9
3	85	203.2	189.3
4	15	257.5	216.6
5	1	360.0	237.0



3.6 Relative Condition of Rainbow Trout

Mean condition factor for each age class varied among years, ranging from 0.36 to 1.28, with the highest values in 2011 and very low values in 2008 (Table 10). There was no clear trend in condition factor over time (Figure 13).

To investigate whether the variables year, site, age, and their interactions influenced the condition factor of rainbow trout, six GLMs were evaluated and the best supported model was selected (Table 11). Weight was the response variable and length transformed to the power of three and divided by 100,000 for scaling, following the equation for Fulton's Condition Factor, was a predictor variable in all models. The model that had the lowest AIC score and was therefore selected for interpretation included the predictor variables length, year, age, year:length, and age:length. The variables year and age (categorical predictor variables) were included in the selected model meaning that the intercept of the weight-length relationship differed by year and age class. This suggests that the condition factors differed significantly by year and age class. The inclusion of the year:length and age:length interactions in the model suggests that slope of the weight-length relationship differed among years and age classes.



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Table 10: Mean condition factor, sample size (n) and standard deviation of juvenile rainbow trout caught by electrofishing in the Cheakamus River

Age	2007			2008 2			009 2			010			2011		
	n	Mean	SD	n	Mean	SD	n	Mean	SD	n	Mean	SD	n	Mean	SD
0	53	0.955	0.41	169	0.770	0.84	429	0.991	0.43	72	0.703	0.30	40	1.28	0.27
1	101	0.996	0.28	83	0.562	0.27	79	1.019	0.27	29	0.857	0.29	50	1.07	0.17
2	14	0.821	0.31	20	0.635	0.33	6	1.135	0.05	102	0.769	0.28	44	1.10	0.09
3+	2	0.801	0.41	2	0.359	0.10	16	1.119	0.10	17	0.856	0.33	11	1.08	0.08
All Ages	170	0.967	0.327	274	0.694	0.692	530	1.001	0.404	220	0.766	0.29	146	1.138	0.20

Table 11: Akaike's Information Criterion (AIC) and ranking of candidate models used to assess which variables affected the condition factor of rainbow trout in the Cheakamus River. Weight was the response variable in all models

Predictor Variables Included In Model	AIC	Model Ranking
Length, Year, Age, Year:Length, Age:Length	15289.74	1
Length, Year, Site, Age, Year:Length, Age:Length	15293.65	2
Length, Year, Site, Age, Year:Length,	15420.68	3
Length, Year, Site, Year:Length	15826.32	4
Length, Year, Year:Length	15829.52	5
Length, Year	15868.73	6



3.7 Relative Spawning Success

The relative spawning success index was calculated for each year of the Monitor by dividing the average WUA adjusted age-0 fish densities for all 10 sites (Table 5) by the CPUE recorded for adults caught in the previous year (Section 3.4) to give an index value that is expressed as age-0 fish/100m²/adult/hour. As this index relies on adult CPUE data from the previous year the relative spawning success index was unable to be determined for the first year of the monitor in 2007. The relative spawning index was the highest in 2009 with a calculated value of 215.9 age-0 fish/100m²/adult/hour. This varies in comparison to the 2008, and 2010 relative spawning success index values of 29.7 and 9.2 age-0 fish/100m²/adult/hour, respectively; and the lowest index value of 5.2 age-0 fish/100m²/adult/hour for 2011. Relative spawning success, as measured by this index, provides little reliability to expand to reach-scale population estimates because capture efficiencies of rainbow trout by angling is unknown and the yearly cohort abundance data may suggest this population is open to emigration and or immigration.

3.8 Daily Mean Discharge from Daisy Lake Dam

Discharge in the Cheakamus River varied over the five years of the study (Figure 14). During the summer growth season for rainbow trout, discharge was relatively higher in 2007, 2010, and 2011 and lower in 2008 and 2009 (Table 12). Discharge was especially high during 2011, when the Q₁₀, and indicator of the lowest flows, and the mean discharge were double or nearly double that in other years. Q₉₀, an indicator of the highest flows that occurred, was also much greater in 2007, 2010 and 2011 (88.8-132.5 m³/s) compared to 2008 and 2009 (50.4 and 59.1 m³/s). The flow duration curve using all five years of data shows how probable a given flow is likely to occur during the summer growth season (Figure 15).

Table 12: Descriptive statistics for discharge in Cheakamus River during the summer growth period (June to September), 2007-2011

Discharge Variable	2007	2008 2009	2010	2011	
Q ₁₀ ^a	12.2	7.9	14.2	21.9	55.9
mean	50.4	28.3	29.3	57.7	96.8
Q ₉₀ ^a	116.0	59.1	50.4	88.8	132.5

^a Q₁₀ is the 10th percentile discharge and Q₉₀ is the 90th percentile discharge

3.9 Discharge and Rainbow Trout Density and Condition

To address the hypotheses as presented in the Terms of Reference, where they are concerned with fry densities and relative rearing successes, the investigation into the relationship between density and condition factor with discharge was evaluated for only age-0 rainbow trout. Linear regressions indicated a significant negative relationship between density of age-0 rainbow trout and mean discharge (P <0.001), Q₁₀ (P =0.003), and Q₉₀ (P<0.001). Q₉₀, an indicator of the highest flows during the summer growth season, explained more variance (r²=0.39) in age-0 density than mean discharge (r²=0.32) or Q₁₀ (r²=0.18). The high densities of age-0 trout that were observed in 2008 and 2009 (Figure 16) corresponded with much lower flows during the summer growth period compared to other years (Table 12).



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There were also significant but weak positive relationships between condition factor and mean discharge for age-0 rainbow trout ($P < 0.001$; $r^2 = 0.20$), Q_{10} ($P < 0.0001$; $r^2 = 0.27$), and Q_{90} ($P = 0.003$; $r^2 = 0.16$). However, these relationships appeared to be largely driven by very high discharge and condition factor in 2011, and condition factor was very similar in all other years across a range of discharges. Therefore, the data suggest a very weak or no relationship between discharge and condition factor of rainbow trout. The relationship between condition factor and density of rainbow trout was not significant ($P = 0.9$).



4.0 DISCUSSION

The primary objectives of the Cheakamus Trout Monitor are to summarize the results of the five year study and quantitatively compare these results to determine whether WUP discharge flows from Daisy Dam affect resident rainbow trout population downstream of the dam and above the anadromous barrier.

The approach and methods used to address the Monitor's management question followed procedures outlined in BC Hydro's ToR (BC Hydro 2007) and allowed for comparisons with previous sampling on the Cheakamus River and data from other watersheds.

Our discussion focuses on: the limited understanding of the life history of resident rainbow trout in the upper Cheakamus River; the life-history data and abundance indices used to test the four impact hypotheses; the impact hypotheses conclusions and how they address the management questions; and recommendations for future investigation.

4.1 Literature Review and Data Gaps

To examine baseline conditions in the study area, a literature review was completed during the first, third, fourth, and fifth years of the Cheakamus Trout Monitor. We found the existing information available for comparison with this segment of the Cheakamus River that is downstream of Daisy Lake Dam to the anadromous barrier was limited. There are three previous studies, Triton 2006, Riley and Korman 1995 and Clark 1989a, which looked at rainbow trout densities in the Cheakamus River during the early fall (September/October). Triton electrofished four sites above the anadromous barrier that were within the area of the Monitor's electrofishing Sites 5, 6, 7, 8 and 9 (Triton 2006). Triton had undertaken this study as part of a fish abundance study in the non-anadromous reach of the Cheakamus River as part of the Cheakamus River recovery studies conducted in 2006 following the train derailment and sodium hydroxide spill in August 2005 (Triton 2006). Riley and Korman (1995) electrofished two adjacent sites above the anadromous barrier that were in close proximity to Site 8. All of Clark's (1989a) sites were located below the anadromous barrier although this investigation was able to provide useful information concerning Cheakamus River rainbow trout. An unpublished report that looked at the recreational fishery potential of the Cheakamus River upstream of the anadromous barrier (Clark 1989b) provides estimates of density in 1988 for comparison to this monitoring program.

Despite previous sampling above the anadromous barrier there is a limited understanding of the life history of this population. Uncertainties include: a) extent of spawning in the mainstem and in tributaries, and the subsequent distribution of juveniles, b) the extent of emigration or displacement of rainbow trout downstream from Daisy Lake (note: rainbow trout have been salvaged from the spillway of Daisy Lake Dam, Alexis Hall, BC Hydro pers. Comm. January 2010), c) extent of emigration out of the study area downstream, and d) extent of immigration into the study area from Daisy Lake Reservoir and Rubble Creek. Such uncertainties are common to other rainbow trout monitoring programs (e.g., the Lower Columbia River, Golder 2009) and can limit the strength of the inferences that can be drawn from the data collected under the Monitor's study design.



4.2 Indices of Abundance of Rainbow Trout

4.2.1 Density

Estimated densities of age-0 rainbow trout were significantly different among years. Densities increased in most sites from 2007 to 2008 and from 2008 to 2009, with a notable peak in 2009, before decreasing in all sites in 2010 and in most sites in 2011. Only one other study has assessed abundance of rainbow trout in the Cheakamus River during the study period to compare the trends we observed. Korman *et al.* (2011) estimated anadromous rainbow trout abundance in a section of the Cheakamus River below the migration barrier during the Fall of 2008 to 2010 and found the greatest abundance in 2008, a decline in 2009 and further decline in 2010. Therefore, these authors also observed a decline in abundance from 2008 and 2009 to 2010, but our results differed in that abundance was greatest in 2009.

Previous studies have estimated densities of rainbow trout in the non-anadromous section of the Cheakamus River between Daisy Dam and the migration barrier prior the beginning of this study in 2007. Triton's four "Upstream" study sites are within the Monitor's Sites 5 through 9 (Triton 2006) and Riley and Korman's two sampling sites (Sites 6a and 6b) sampling for young-of-the-year (age-0) are in the vicinity of Site 8. Densities from Years 1 to 5 of the Monitor appear to be generally lower than those fry densities calculated from Triton's study in 2006 (25 to 87 fish/100 m²). Adjusted mean fry densities from the Triton study (76 fish/100 m²) compared to the mean adjusted densities from the Monitor were similar in 2008 (51.8 fish/100 m²) and 2010 (62.5 fish/100 m²) and differed notably in 2007 (19.5 fish/100 m²), 2009 (146.2 fish/100 m²) and 2011 (21.1 fish/100 m²; Triton 2006). The mean age-0 density at our site 8 for 2007-2011 ranged from 5 to 46 fry/100 m² compared to the density estimates of 11 and 20 fry/100m² in Riley and Korman at comparable sites (1995). Our estimate of age-0 density from 2007 (15 fry/100m²) was consistent with the density estimates by Riley and Korman whereas higher densities were observed in 2008 (36 fry/100m²) and 2009 (46 fry/100m²) and lower densities observed in 2010 (5 fry/100m²) and 2011 (7 fry/100m²). Conclusions drawn from comparisons to these previous studies should be limited because different methodologies were likely used.

Mean density of age-0 rainbow trout in the same reach of the Cheakamus River was 31.4 fish/100m² in a study in 1988 (Clark 1989b), which was higher the mean density of 11.7 fish/100m² for all sites from 2007 to 2011. However, the adjusted densities were similar between 1988 (36.9 fish/100m²) and 2007 to 2011 (44.5 fish/100m²). Clark (1989b) reported that 30% of the habitat in the study reach was suitable for rainbow trout fry, which was similar to the 30% probability of use at electrofishing sites in 2007 to 2011. However, Clark's (1989b) habitat suitability estimate of 30% was based on whole stream transects, whereas the probability of use at electrofishing sites was not reported. Overall, the density and habitat suitability estimates appear similar between the Clark (1989b) study and the 2007-2011 monitoring program, but it is not clear how comparable, if at all, these results are because of different sites and methodologies. For this reason, limited weight is put on comparisons to Clark (1989b) when assessing the effects of dam operations of the rainbow trout populations of the Cheakamus River.

When analyzing the probability of use data, some velocity measurements that were implausibly high (e.g., 4-5 m/s) were observed and many others were 0.0 m/s. The number of velocity measurements that were very high (>1.5 m/s at depths of 0.01 m or greater) was relatively low (less than 3% of total) so is unlikely to have significantly affected the results even if some were inaccurate. There were, however, a substantial number of velocities of 0.0 m/s in the dataset. Sample sites were along the shoreline and much of the habitat that was very close to the bank and near large boulders could have had velocities of zero or close to zero. It is also possible that some of the 0.0 m/s velocities were inaccurate measurements. Unfortunately, there is no way to screen the



data or determine which of the zero velocities could be errors, and which are accurate. Therefore, all the original velocity-transect data were included in the report, but we acknowledge that if some of the zero velocities were inaccurate (should have been higher values), the probability of use estimates would be biased low, and the adjusted density estimates would be biased high. There is also uncertainty in the adjusted fish densities that stems from the habitat suitability data (Ptolemy *et al.* 2006) that was used to calculate the probability of use at each site. In some cases small differences in stream velocity corresponded to large differences in the probability of use, which suggests that changes or biases in velocity or habitat preference could result in a high degree of uncertainty in adjusted densities.

When tracking the relative abundance of a given cohort (*i.e.*, fish hatched in particular year) across years, strong cohorts did not usually necessarily continue to be relatively abundant in future years. For example, there were high densities of age-0 rainbow trout in 2008 and 2009 but relatively low densities of age-1 trout in 2009-2010. However, age-2 trout in 2010 and 2011 (the same cohort) had relatively high densities and made up a large part of the catch. The reason for the failure of the abundance of a cohort to carry over to subsequent years is not clear. The observed fluctuations in abundance of cohorts could be related to immigration or emigration from the study area, changes in survival, discharge fluctuations or other unknown factors. In the Korman *et al.* (2011) study of anadromous rainbow trout in the Cheakamus River, relative cohort abundances were not consistent across years and survival was sometimes greater than 100%, suggesting that their study area was open to migration.

Recruitment of age-0 rainbow trout from the study area has been suggested to explain an observed increase in age-0 fish density from March to October, in 2006 at sites downstream of the sodium hydroxide spill site and upstream of the anadromous barrier (Triton 2006). Emigration or displacement of rainbow trout downstream from Daisy Lake has also been noted and could influence the population in the study area (Matt Foy, pers. comm. January 2009). Without an understanding of rainbow trout emigration/immigration above the anadromous barrier it is difficult to assess the potential impact of flows on the population. Emigration/immigration in the Cheakamus River watershed could be assessed using techniques, such as tagging, telemetry, microchemistry of fish structures, or genetics.

In the second year of the Monitor (2008), algal growth was observed covering the river substrate at each site in the study area. The algal growth appeared to be less extensive and abundant over the following three years of the Monitor (2009, 2010, and 2011). Although growth of algae on river substrates could possibly affect electrofishing capture efficiencies, we believe this was not the case in the Monitor as there is no apparent correlation between the observance of the algal growth and an observed effect on rainbow trout densities. A review of literature on this topic did not shed light on the potential influence of algal growth on our electrofishing results.

4.2.2 Relationship between Density and Discharge

There was a significant negative relationship between age-0 rainbow trout density and discharge in the Cheakamus River during 2007-2011, which supports the hypothesis that relative spawning success is negatively correlated with mean discharge during the summer growth period (management hypothesis #1). All three discharge statistics (mean, Q_{10} and Q_{90}) had a significant relationship to density, but Q_{90} , an indicator of the highest flows during the summer growth period, explained the most variance in density ($r^2=0.39$), followed by the mean discharge ($r^2=0.32$) and Q_{10} ($r^2=0.18$). These analyses suggest that relatively higher discharge is



associated with lower age-0 densities, and that high discharge events (Q_{90}) during the summer growth period may have the greatest influence on rainbow trout densities. These findings agree with literature on the early life-history of rainbow trout, given that juveniles prefer low velocity habitats (McPhail 2007; Korman *et al.* 2011) and habitat availability during summer has a large influence on juvenile production (Berger and Gresswell 2009).

Comparisons of both the probability of habitat use and the capture efficiency to discharge among and within sites during sampling did not show any correlations that would suggest an influencing effect on density and its relationship to discharge. These comparisons to discharge are presented in figures 22 and 23 for probability of use and figures 24 and 25 for capture efficiency.

Other than discharge, another environmental variable that could influence rainbow trout catches was conductivity. There was a correlation between conductivity and both density and discharge, in the years with higher discharge and lower fish densities had lower conductivity and years with lower discharge and higher fish densities had higher conductivity. The removal-depletion analysis (Riley and Korman 1995) estimates capture probability from consecutive electrofishing passes, and then generates estimates of total abundance at each site. This means that abundance estimates should not be influenced by factors, such as conductivity, that may affect capture probability. However, if assumptions of the removal-depletion model are violated (*e.g.*, population not closed or capture probabilities are not homogeneous among individuals), then abundance estimates may not be reliable and it is difficult to relate abundance to factors like discharge or conductivity. Exploratory analyses did not indicate a correlation between capture efficiency and conductivity in the data from 2007 to 2011. Although we cannot rule out the possibility that varying productivity had some effect on density estimates, because of the removal-depletion analysis used, conductivity was not likely a primary factor influencing the differences in fish density observed during the 5-year monitoring program.

4.2.3 Adult Abundance

The index of adult abundance (CPUE) varied among years with the highest CPUE in 2009 and the lowest in 2011, with similar amounts of angling effort expended from 2008-2011. However, CPUE from angling in this study is likely not a good index of abundance because of limited angling effort (~2 days per year) and the many factors that can affect the ability to catch trout. It is difficult to draw conclusions about adult abundance based on these data, although the year with the greatest adult CPUE (2009) was also the year with the highest densities of trout caught by electrofishing.

4.2.4 Adult Spawning Success

Relative spawning success, calculated as the age-0 density divided by the adult CPUE, was used as an index of the number of juveniles produced by each adult spawner among the years of the Monitor. The highest relative spawning success was in 2009 (215.9 age-0 fish/100m²/adult/hour), distantly followed by 2008 and 2010 (29.7 and 9.2 age-0 fish/100m²/adult/hour, respectively), with the 2011 value being the lowest (5.2 age-0 fish/100m²/adult/hour). Spawning success for 2007 could not be calculated as it was the first year of the monitor and there was no adult catch data available for the previous year. However, this index of relative spawning success is likely not a good indicator of the spawner-recruit relationship for a number of reasons. For instance, capture efficiencies of rainbow trout by angling are unknown and likely vary among years. Also, analysis of cohorts did not show consistent relative abundances across years, which may indicate that the study area is an open system with emigration and immigration of rainbow trout. Hence measuring spawning success via this



approach carries significant uncertainty and does not provide an adequate indication of spawning success. Spawning success will therefore not be considered in evaluation of the hypotheses and management question.

4.3 Life-History of Rainbow Trout

4.3.1 Length and Growth

Length-frequencies and scale ageing information from 2007 through to 2011 showed similar size ranges for age-0 rainbow trout compared to other studies in the Cheakamus River (Table 7; Riley and Korman 1995; McCubbing *et al.* 2006). The mean length of age-0 rainbow trout in the Monitor ranged from 37 ± 6 mm (mean \pm SD; 2007) to 54 ± 9 mm (2010). Riley and Korman (1995) used a size range of 30 to 90 mm to identify rainbow trout fry, based on an interpretation of length-frequency data collected during their study. McCubbing *et al.* (2006) distinguished Cheakamus fry by lengths of 20mm to 79mm based on data collected on rainbow trout in late summer and early fall on the lower Cheakamus River. The Monitor indicates that from Year 1 to Year 4 the age-0 mean length increased successively each year (2007 = 37 ± 6 mm; 2008 = 45 ± 8 mm; 2009 = 52 ± 12 mm; and 2010 = 54 ± 9 mm) yet in Year 5 the mean length (2011 = 46 ± 7 mm) resembled more closely the value from Year 2. Overall, the lengths of age-0 rainbow trout observed in this study were similar to those reported in the previous studies on the Cheakamus River. The increase in age-0 mean length observed from 2007 to 2010 may suggest an increase in availability of resources for age-0 rainbow trout over the recent years following the sodium hydroxide spill upstream of the anadromous barrier in 2005 (Triton 2006).

Comparisons of the mean lengths of cohorts between years display growth rates that are generally consistent among cohorts with some exceptions (age-0 in 2011, age-1 in 2010 and 2011 and age-2 in 2010; see Results section 3.5.1). However, the mean length of age-0 fish increased each year from 2007 to 2010, then decreased in 2011. Mean length and density of age-0 fish were both greatest in 2008 and 2009, suggesting that conditions for growth and survival were good those years compared to 2007 and 2010-2011. That length and density were both highest in 2008 and 2009 also suggests that density-dependent interactions were not occurring for age-0 trout in the study area. The trend of increasing length-at-age of age-0 fish from 2007 to 2010 provides some support to the management hypothesis (#4) that relative rearing success remains stable or increases through time following implementation of the WUP. However, the decline of length-at-age in 2011 did not follow that trend.

The von Bertalanffy growth curve, used to predict length of rainbow trout, provided similar fork-lengths for age-0 to age-2 fish compared with those of the average fork lengths. For age-3+ rainbow trout, however, the von Bertalanffy growth curve appeared to be less accurate as the predicted fork-lengths were noticeably different than the average fork length. This is likely due to the greater sample size of the age-0, age-1 and age-2 fish.

4.3.2 Condition Factor

Modelling of the weight to length relationship indicated that the factors year and age class and their interactions were significant suggesting that condition factor varied by year and age class but not by sample site. Mean condition factor was higher for all ages in 2007, 2009 and 2011 in comparison with 2008 and 2010. Condition factor showed no clear trend over time and appeared to generally be alternating between decreasing and increasing from 2007 to 2011. Because there was no clear trend in condition factor over time, it is difficult to



evaluate the management hypothesis #4 (H_0 : relative rearing success remains stable or increases through time following implementation of the WUP), but we cannot reject this null hypothesis based on the condition data. The large differences in condition factor among years for cohorts and age classes might be explained by immigration and emigration of fish from the study area, or changes in environmental conditions. Condition factor of age-0 and age-1 fish was greatest in 2011 when densities were the lowest, but there was not a significant relationship between condition and density. This suggests that the condition of rainbow trout was not density dependent during our study.

Some of the conditions factors in 2008 were much lower than would be expected compared to other years and other studies of rainbow trout in British Columbia, which raises the possibility that there could errors in the weight data. Golder reviewed the data and field protocols used and could not find evidence of systematic errors in measurement, data management or analysis. For instance, weigh scales were calibrated before each sampling season, and the anomalous weights were recorded for all age classes and most sites in 2008. Although some condition factors were outside of the range of what is typically observed for rainbow trout, careful examination of the data and the methods used did not indicate any reason why the weights would be wrong. Re-analysis of the data after screening and removing outliers was conducted to see what influence the potentially erroneous data had on the results (data not shown). The cleaned data showed similar trends to the raw un-cleaned data. Therefore, even if some of the weight data were inaccurate, these errors will not have significantly affected the conclusions of the study.

4.3.3 Effect of Discharge on Condition

Our results suggested a weak relationship between condition factor and river discharge, although the relationship appeared to be mostly driven by very high discharge and condition factor in 2011. It is difficult to assess the effect of discharge on condition factor because many other factors that were not assessed in this study, such water temperature or immigration/emigration, likely also affect mean fish condition of the population. Thus, the condition factor data provide little support for the management hypothesis #2 that rearing success is correlated with discharge during the summer growth period.

4.4 Management Question

The management question seeks to define whether impacts occur to the rainbow trout population above the anadromous barrier and below Daisy Lake Dam as a result of dam operations under the current (WUP) water management structure. The four hypotheses developed to address the management question were tested with the parameters measured over the five years of the Monitor and were discussed in the above sections. Summary and conclusion of the impact hypotheses are as follows:

- Ho1: A correlation does not exist between rainbow trout relative spawning success (measured by fry density) and the mean dam discharge over the summer growth period;
 - Ho1 Conclusion: A significant correlation does exist between age-0 density and mean discharge. The null hypothesis is rejected. High mean discharge correlates with low age-0 density; and low mean discharge correlates with high age-0 density;



- Ho2: A correlation does not exist between rainbow trout relative rearing success (measured by relative condition, size-at-age, and abundance) with the mean dam discharge over the summer growth period;
 - Ho2 Conclusion: There is no correlation between age-0 relative condition and size-at-age to mean discharge. The null hypothesis is accepted;
- Ho3: Relative spawning success (measured by fry density) remains stable or increases over the Monitor's 5 years and is therefore not impacted by Daisy Dam operations under the WUP;
 - Ho3 Conclusion: Age-0 density does not increase or stay the same during the course of the Monitor. The hypothesis is rejected. Age-0 densities fluctuate during the Monitor with no clear trend of increase or remaining stable;
- Ho4: Relative rearing success (measured by relative condition, size-at-age, and abundance) remains stable or increases over the Monitor's 5 years and is therefore not impacted by Daisy Dam operations under the WUP;
 - Ho4 Conclusion: Relative condition and size-at-age do not remain stable or increase during the course of the Monitor. The hypothesis is rejected. Condition factor alternates between decrease and increase from 2008 to 2011 and size-at-age increases through to 2010 and decreases in 2011.

Daisy Lake Dam water flow releases appear to have an effect on the resident rainbow trout population located immediately downstream of the dam. The mean discharge from the dam over the summer growth period was shown to have a significant negative relationship with juvenile rainbow trout density sampled in the fall; however, there was no correlation between mean discharge and rainbow trout relative condition, size-at-age, and abundance. Changes under the WUP do not appear to have resulted in an increase or stabilization of rainbow trout population parameters of density, relative condition, size-at-age, and abundance. This does not necessarily suggest that under the WUP the rainbow trout relative spawning and rearing success are impacted; rather, that these effects are inconclusive at this point without the collection of further evidence.

4.5 Recommendations

The following recommendations are presented for the Five Year Rainbow Trout Monitor:

- Without knowledge of both capture efficiency among years and of study area recruitment (with existing evidence from cohort abundance of an open system), spawning success is not likely measured using the angling program as an indicator of spawning success, and has no value for testing hypotheses 1 and 3. In future, a similar program should provide capture efficiencies and estimates of recruitment;
- Better estimates of spawner abundance and distribution (*e.g.*, mainstem or tributaries) are needed if managers want to assess the effects of dam discharges on rainbow trout spawning success and seeding of the habitat with juveniles;
- Future programs should age as many rainbow trout as possible with lengths greater than 120 mm to obtain more accurate estimates of age-class of older trout;



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- Assess emigration and immigration in the Cheakamus River watershed using techniques such as tagging, telemetry, microchemistry of fish structures, or genetics; and,
- A longer term study is required to assess if Daisy Lake Dam operational changes under the WUP influence rainbow trout populations immediately downstream as measured by relative condition, size-at-age, abundance, and density.



5.0 CLOSURE

We trust this report provides you with the information you require at this time. Should you have any questions regarding the contents of this report, or require any further information, please do not hesitate to contact Robert Harrison at 604-296-4200.

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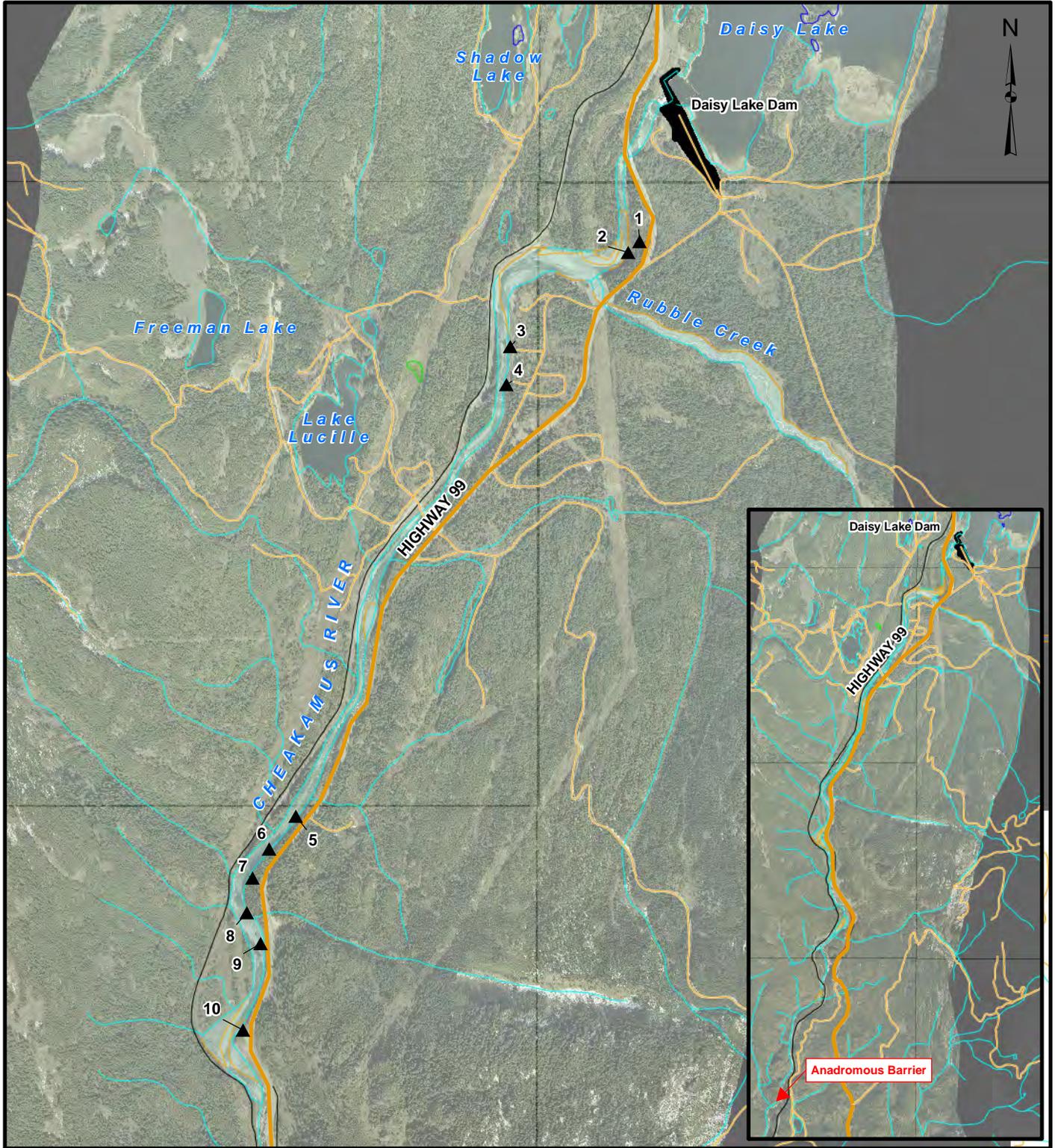
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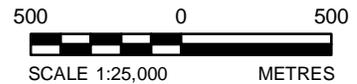
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LEGEND

- ▲ Sampling Site Location



REFERENCE

Ortho imagery and base information provided by WMS openmaps.gov.bc.ca.
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 10

PROJECT
BC HYDRO'S CHEAKAMUS RIVER MONITORING PROGRAM #2
CHEAKAMUS TROUT MONITOR YEAR 5
(DAISY LAKE TO CHEAKAMUS CANYON)

TITLE
SAMPLING SITE LOCATION MAP



PROJECT No. 10-1422-0041			SCALE AS SHOWN	REV. 0
DESIGN	AK	14JAN10		
GIS	JP	09JAN13		
CHECK				
REVIEW				

FIGURE 1



FIGURES

Trout Monitor 2007-2011

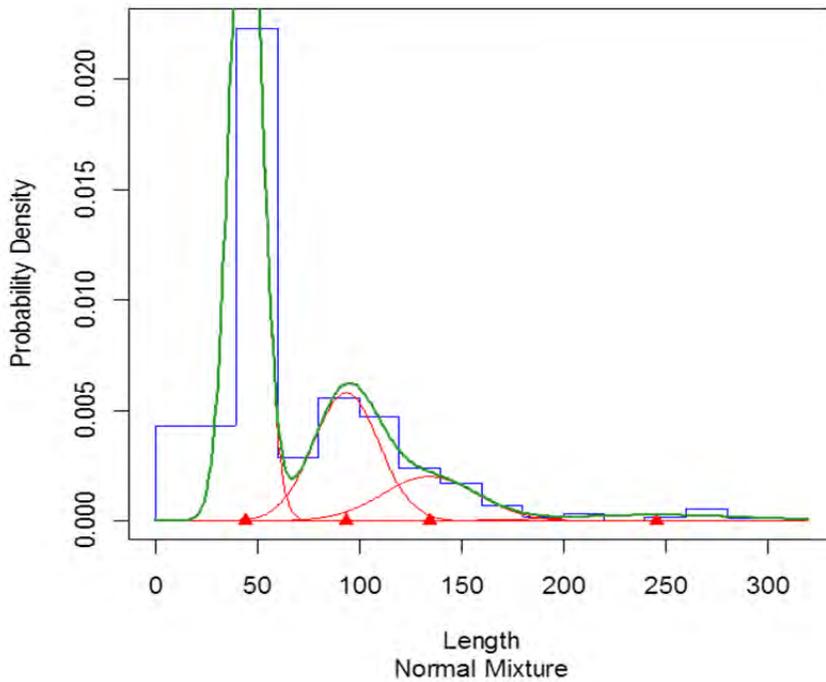


Figure 2: Mixed distribution fit to 2008 Cheakamus River rainbow trout data. The blue line is the binned length-frequency data, the green line outlines the summed mixed distributions, and the red triangles denote the mean length for each age class (0, 1, 2 and 3+). The red lines represent the probability density distribution for each age class.

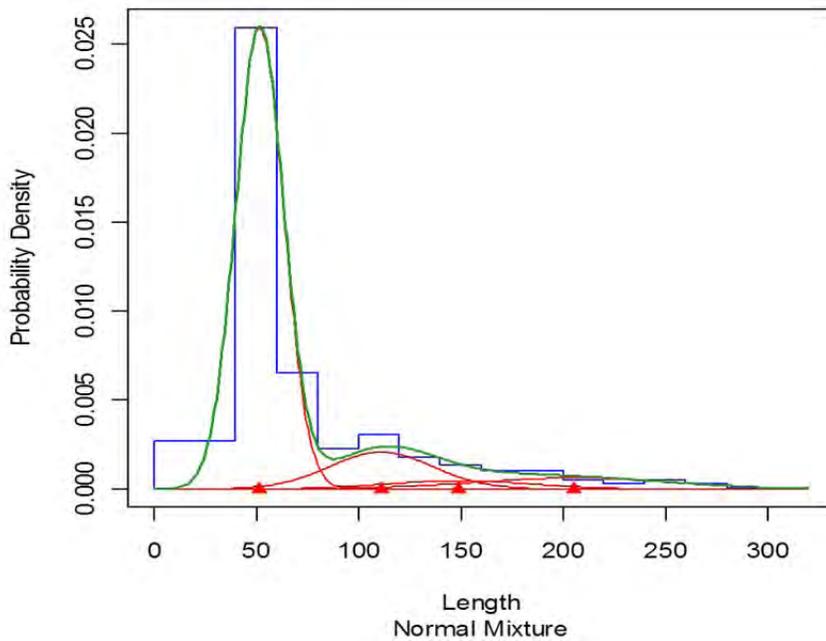


Figure 3: Mixed distribution fit to the 2009 Cheakamus River rainbow trout data. The blue line represents the grouped length-frequency data, the green line represents the summed mixed distributions, and the red triangles are the mean lengths for each age class (0, 1, 2 and 3+). The red lines represent the probability density distribution for each age class.



FIGURES

Trout Monitor 2007-2011

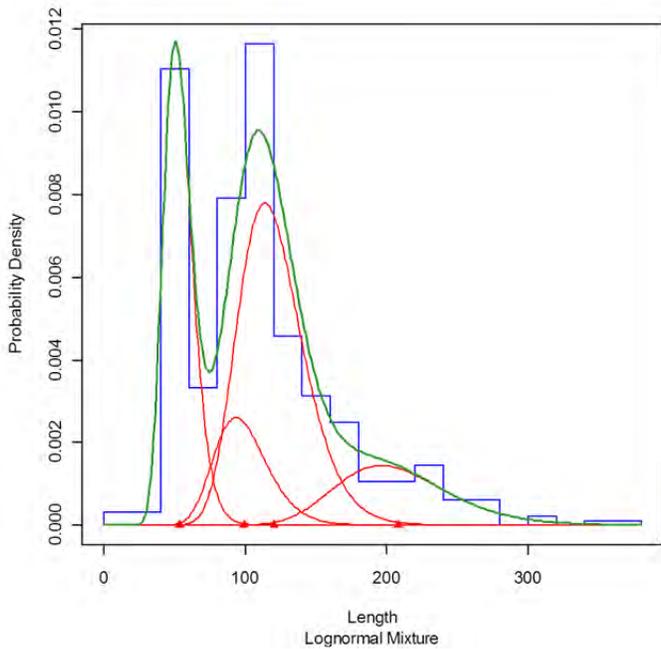


Figure 4: Mixed distribution fit to the 2010 Cheakamus River rainbow trout data. The blue line represents the grouped length-frequency data, the green line represents the summed mixed distributions, and the red triangles are the mean lengths for each age class (0, 1, 2 and 3+). The red lines represent the probability density distribution for each age class.

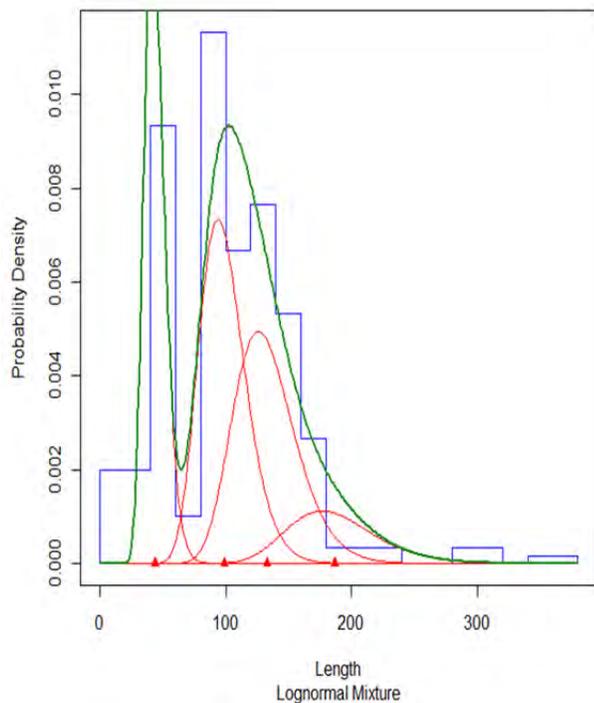
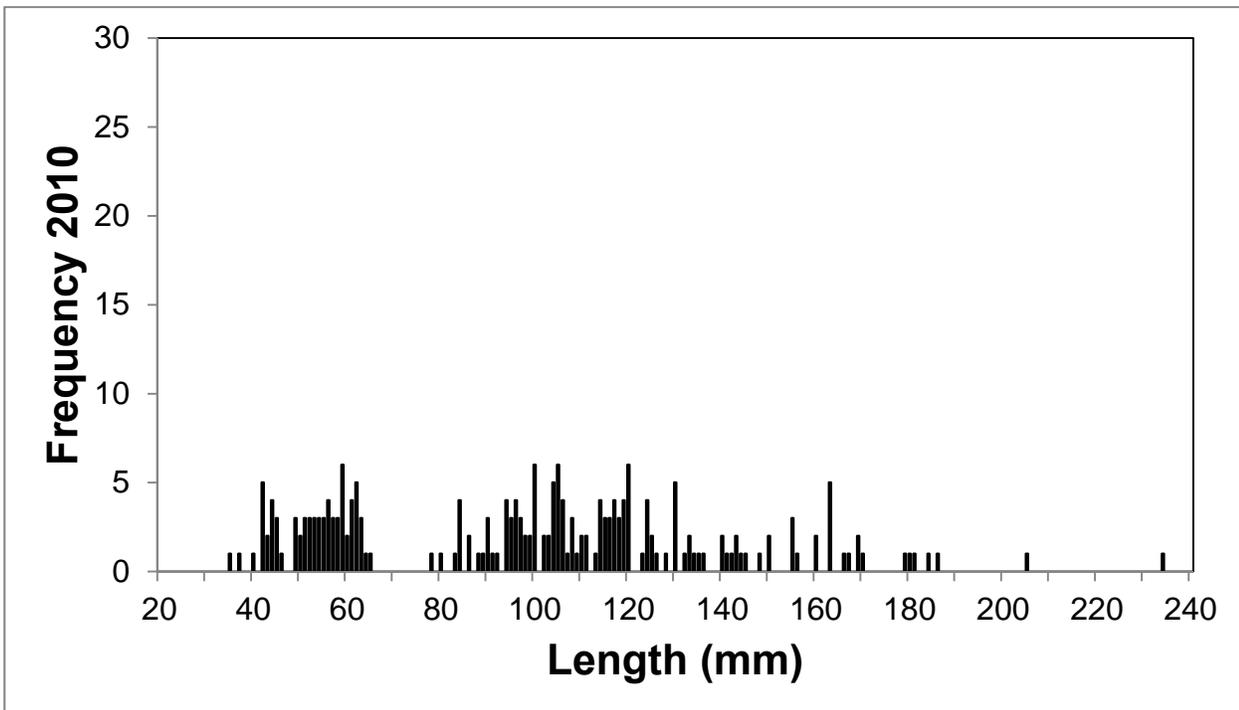
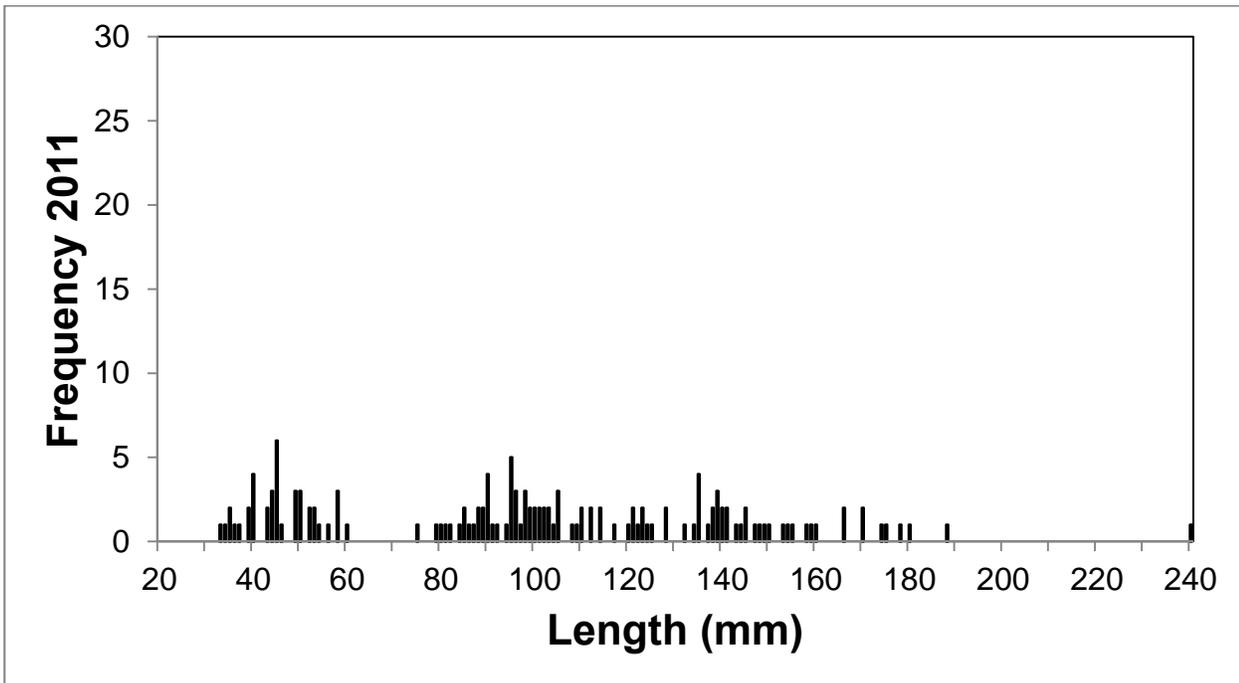


Figure 5: Mixed distribution fit to the 2011 Cheakamus River rainbow trout data. The blue line represents the grouped length-frequency data, the green line represents the summed mixed distributions, and the red triangles are the mean lengths for each age class (0, 1, 2 and 3+). The red lines represent the probability density distribution for each age class.

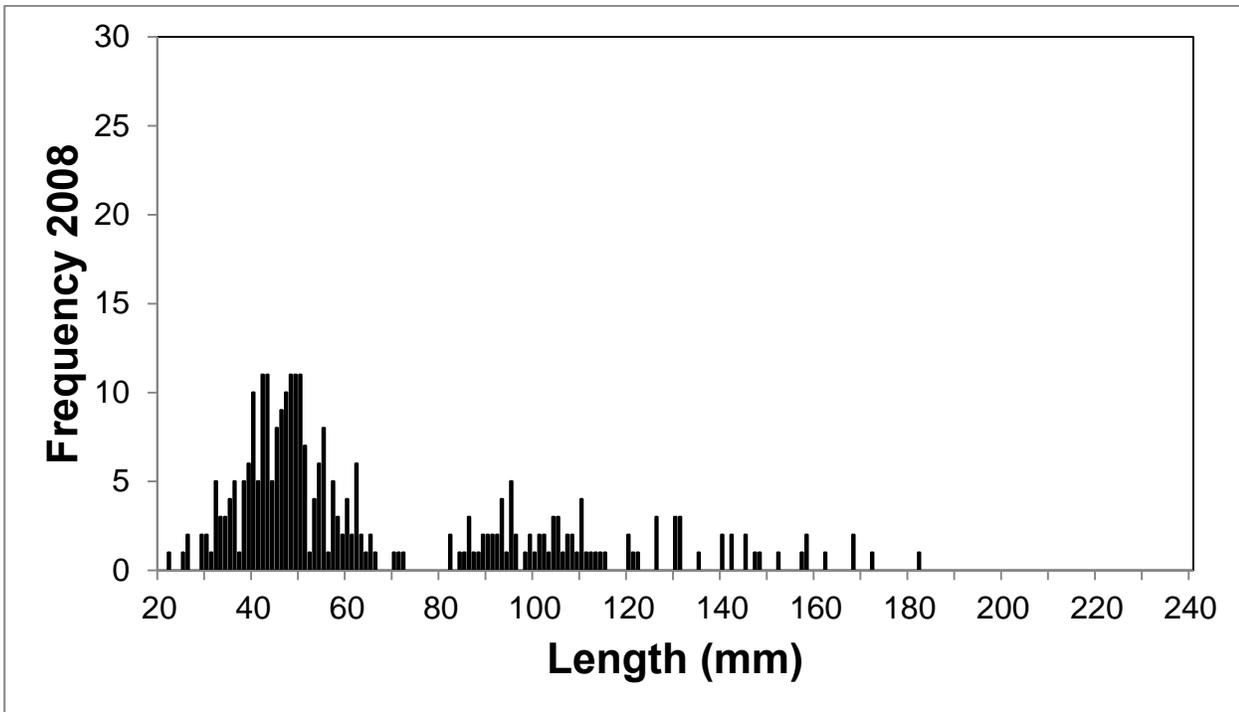
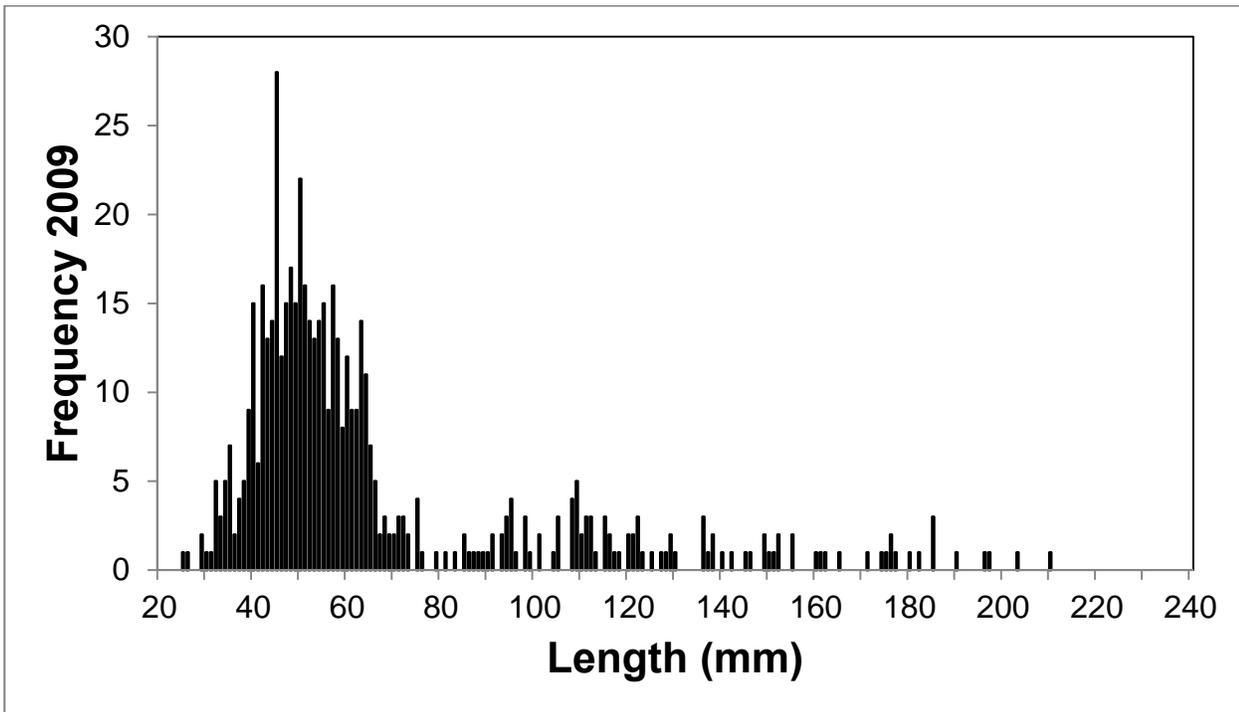


FIGURES
Trout Monitor 2007-2011





FIGURES
Trout Monitor 2007-2011





FIGURES

Trout Monitor 2007-2011

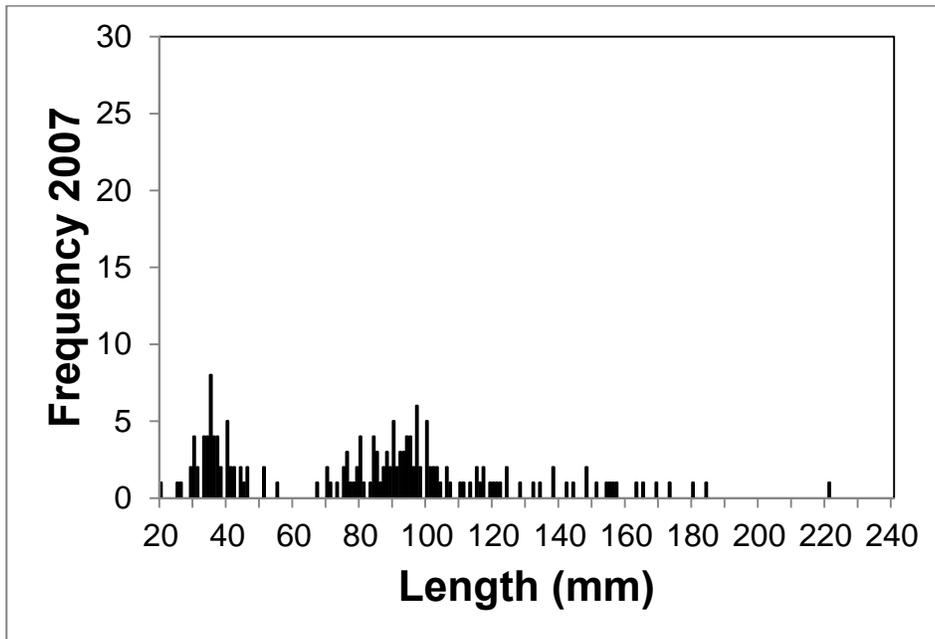


Figure 6: Length Frequency distribution for all rainbow trout captured on the Cheakamus river in 2007, 2008, 2009 and 2010 by electrofishing.

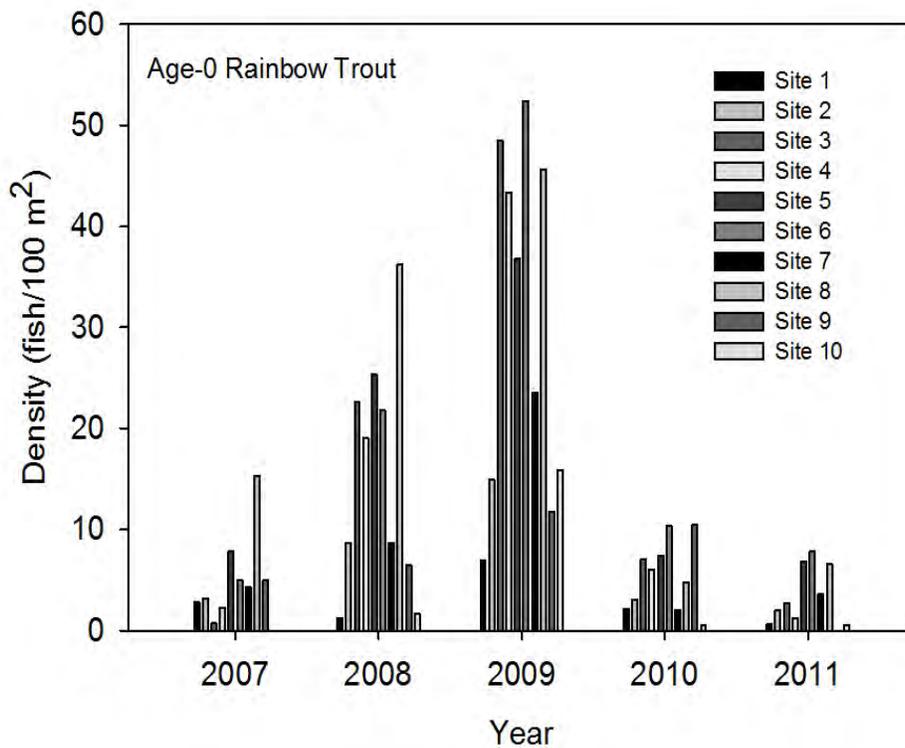


Figure 7: Density of age-0 rainbow trout estimated by multiple-pass removal electrofishing at 10 monitoring sites on the Cheakamus River, 2007-2011.



FIGURES

Trout Monitor 2007-2011

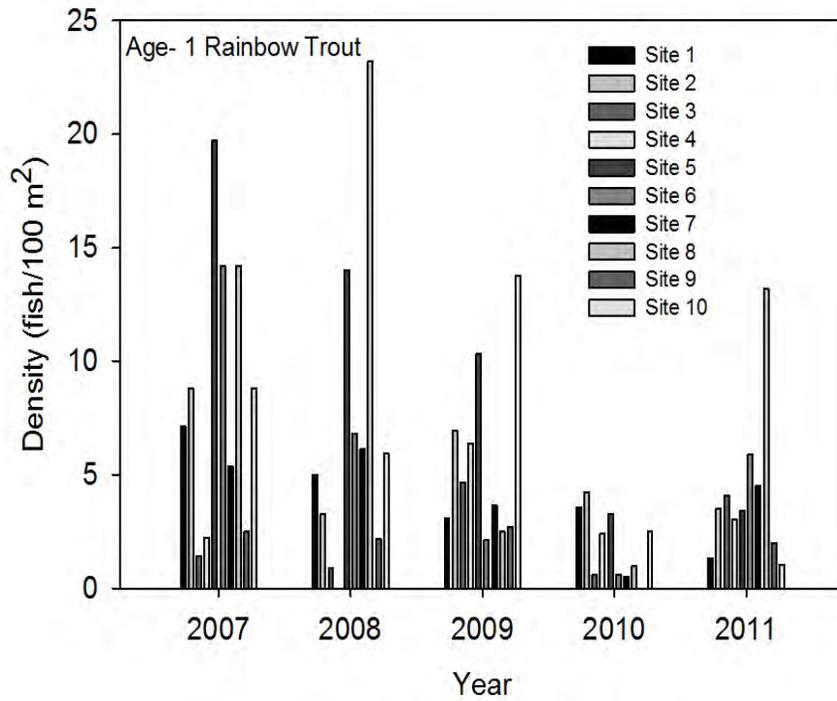


Figure 8: Density of age-1 rainbow trout estimated by multiple-pass removal electrofishing at 10 monitoring sites on the Cheakamus River 2007-2011.

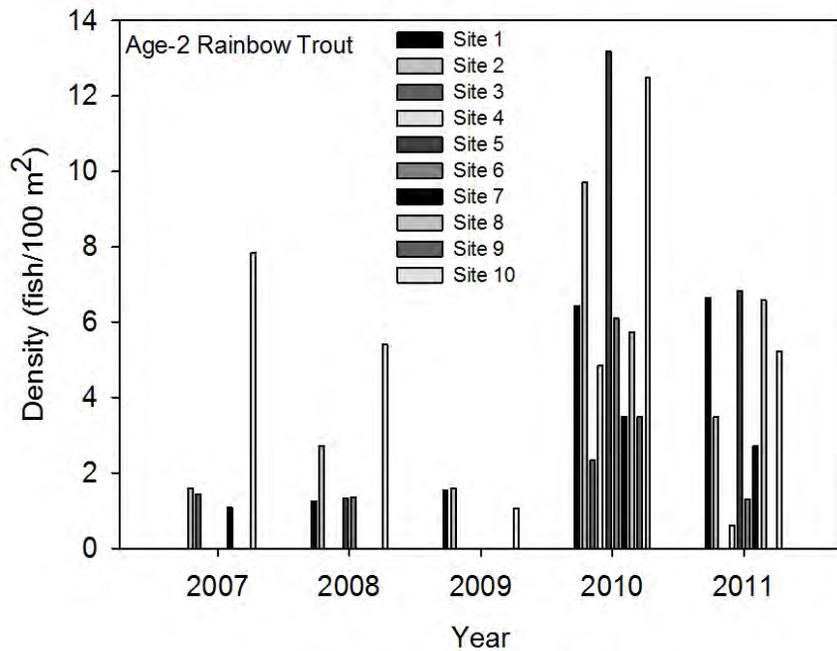


Figure 9: Density of age-2 rainbow trout estimated by multiple-pass removal electrofishing at 10 monitoring sites on the Cheakamus River 2007-2011.



FIGURES

Trout Monitor 2007-2011

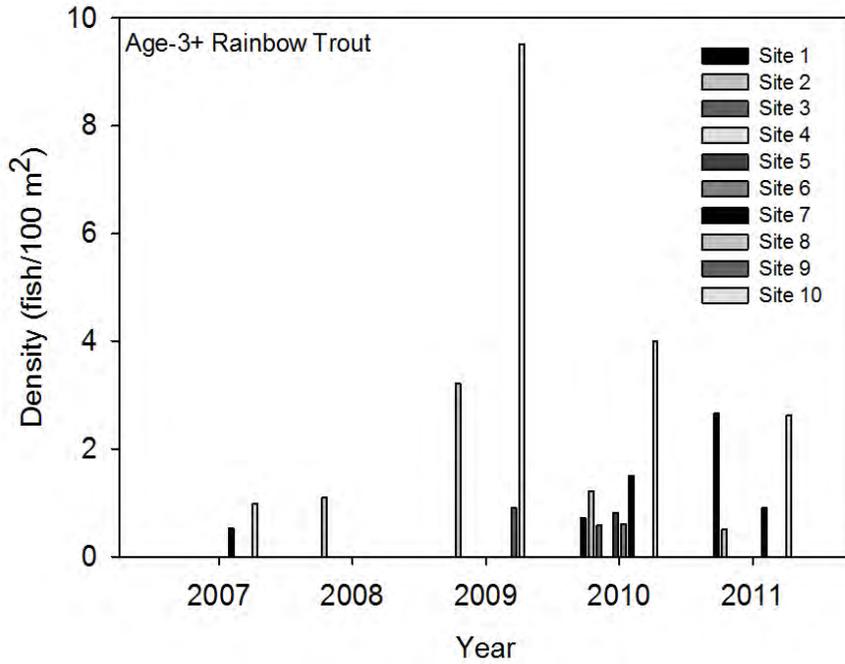


Figure 10: Density of age-3+ rainbow trout estimated by multiple-pass removal electrofishing at 10 monitoring sites on the Cheakamus River 2007-2011.

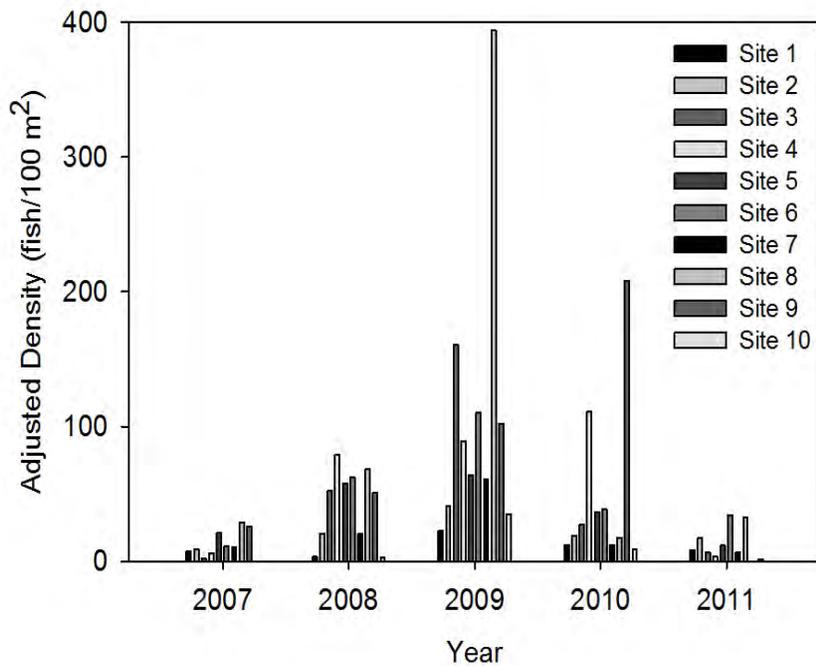


Figure 11: Adjusted density for age-0 rainbow trout estimated by multiple-pass removal electrofishing at 10 monitoring sites on the Cheakamus River 2007-2011.



FIGURES

Trout Monitor 2007-2011

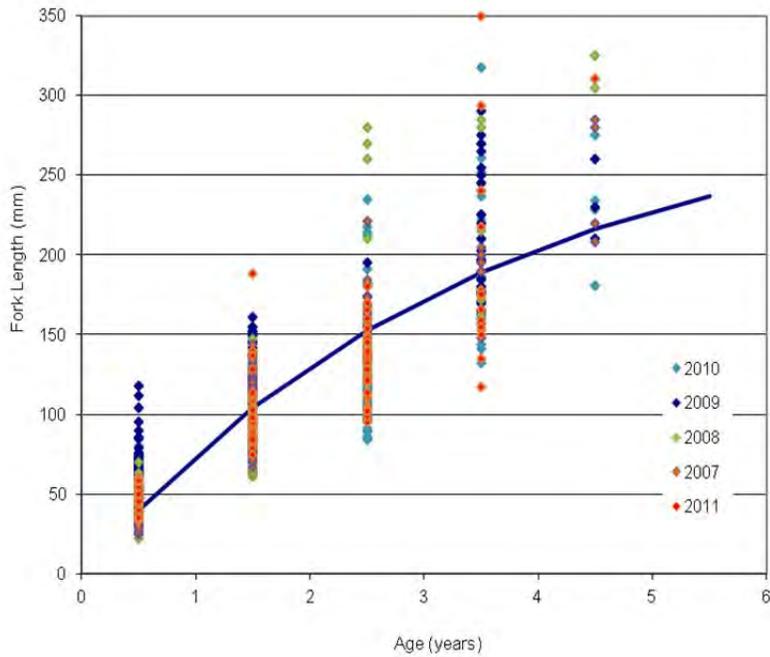


Figure 12: The von Bertalanffy growth curve for rainbow trout captured in the Cheakamus River. Estimates of parameters used $t_0=0$.

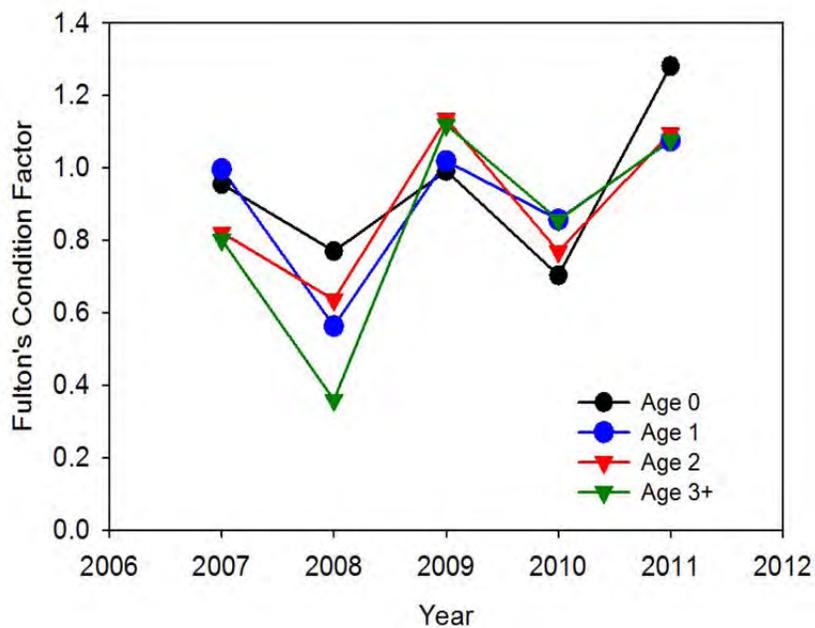


Figure 13: Condition factor of rainbow trout by year and age class in the Cheakamus River, 2007-2011.



FIGURES

Trout Monitor 2007-2011

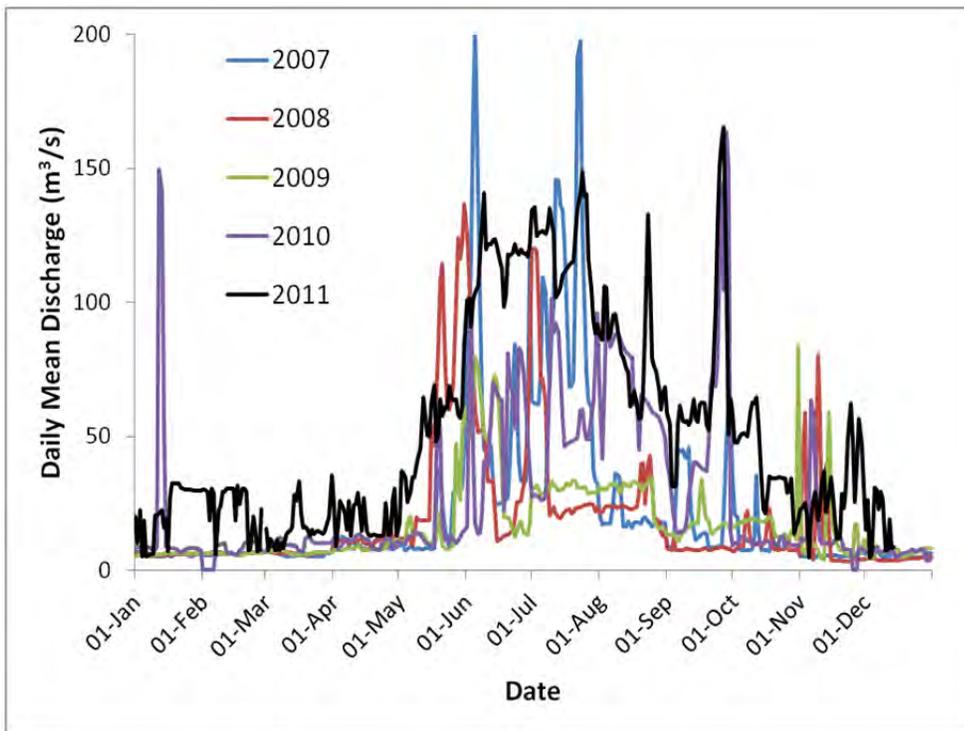


Figure 14: Mean daily discharge from Daisy Lake Dam into the Cheakamus River, 2007-2011.

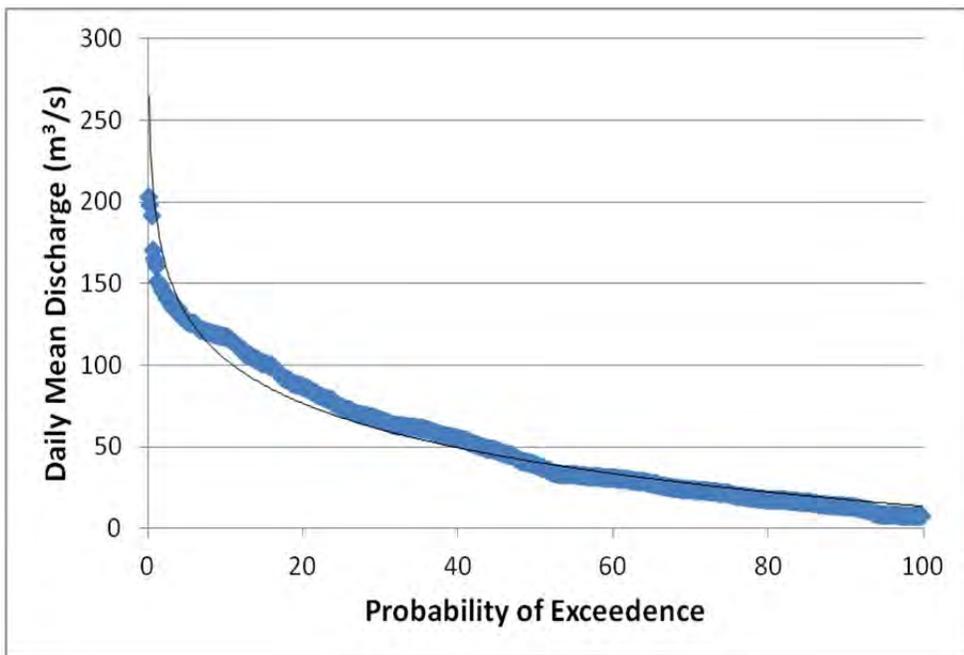


Figure 15: Flow duration curve for the Cheakamus River during the summer growth season (June through September), 2007-2011. Data are mean daily discharges from Daisy Lake Dam. The equation for the curve is $y = -39.2 \ln(x) + 194.0$ ($R^2 = 0.96$).



FIGURES

Trout Monitor 2007-2011

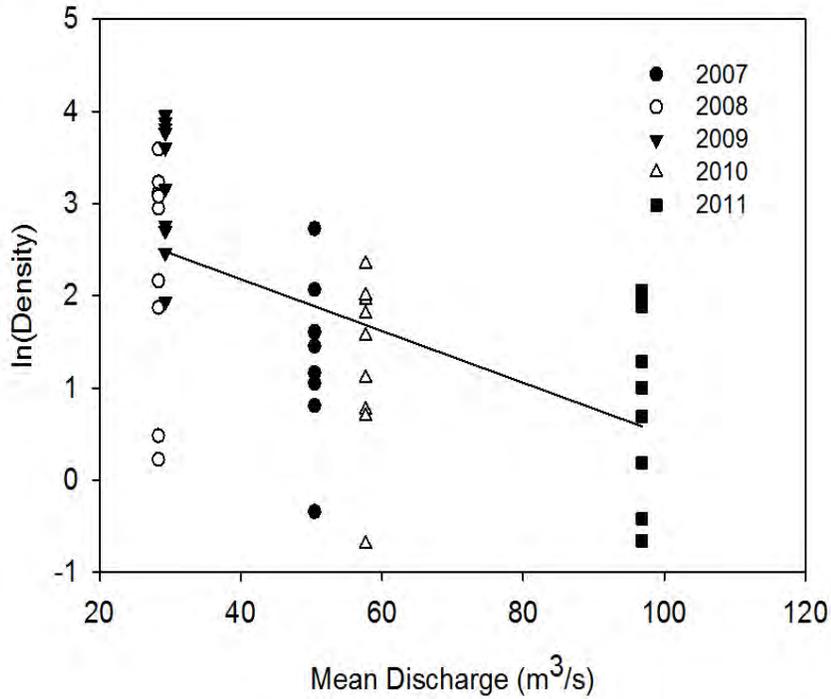


Figure 16: Relationship between natural logarithm of age-0 rainbow trout density and mean discharge during the summer growth season in the Cheakamus River.

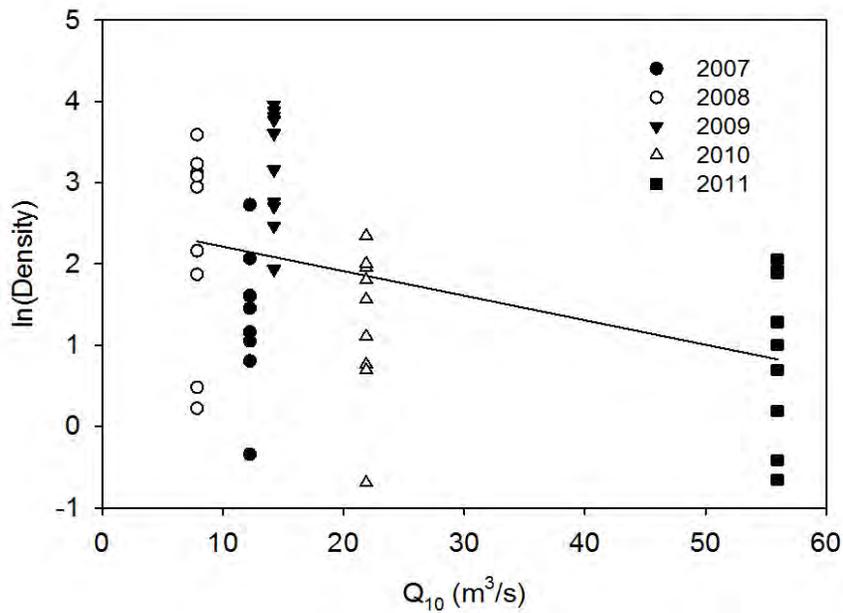


Figure 17: Relationship between natural logarithm of age-0 rainbow trout density and 10th percentile discharge (Q₁₀) during the summer growth season in the Cheakamus River.



FIGURES

Trout Monitor 2007-2011

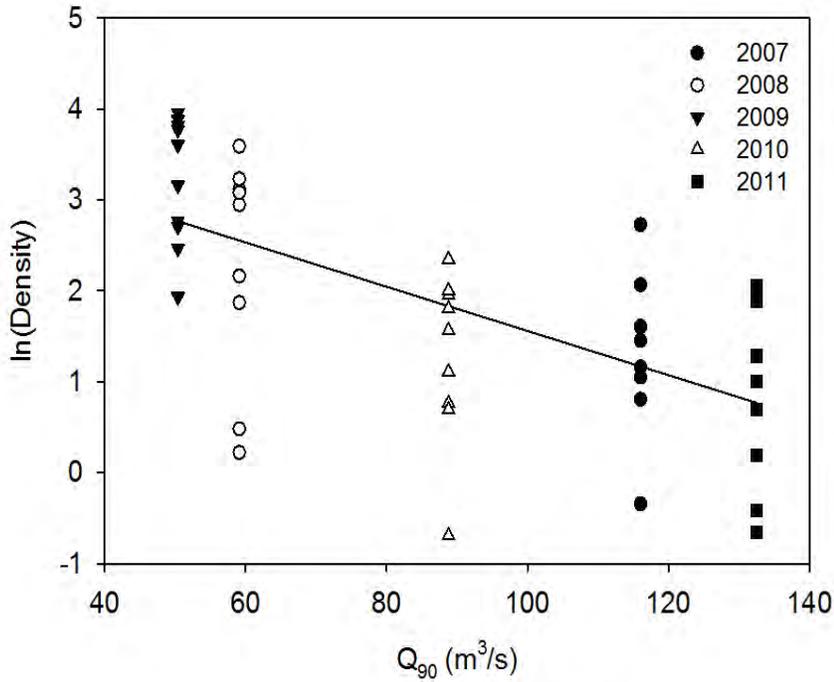


Figure 18: Relationship between natural logarithm of age-0 rainbow trout density and 90th percentile discharge (Q₉₀) during the summer growth season in the Cheakamus River.

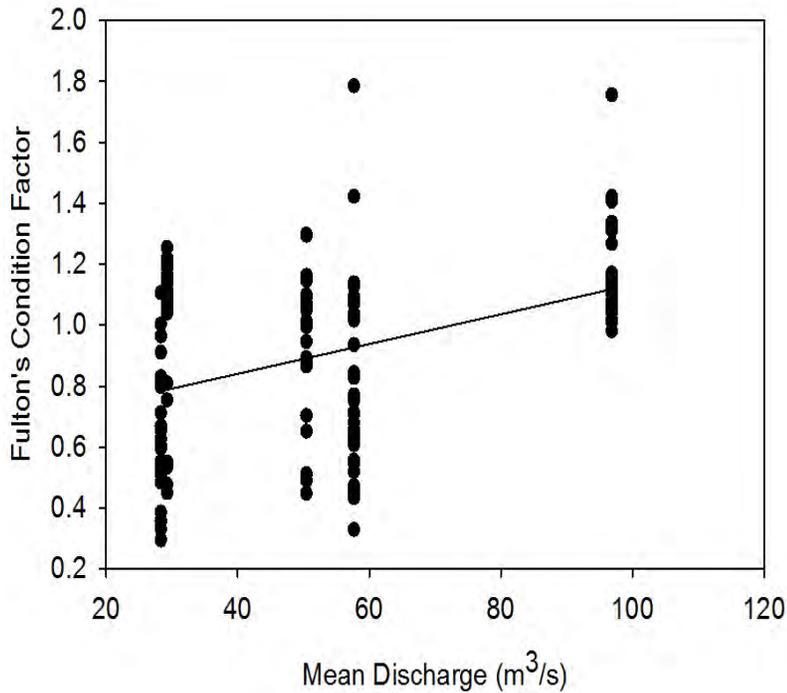


Figure 19: Relationship between Fulton's condition factor of rainbow trout and mean discharge in the Cheakamus River.



FIGURES

Trout Monitor 2007-2011

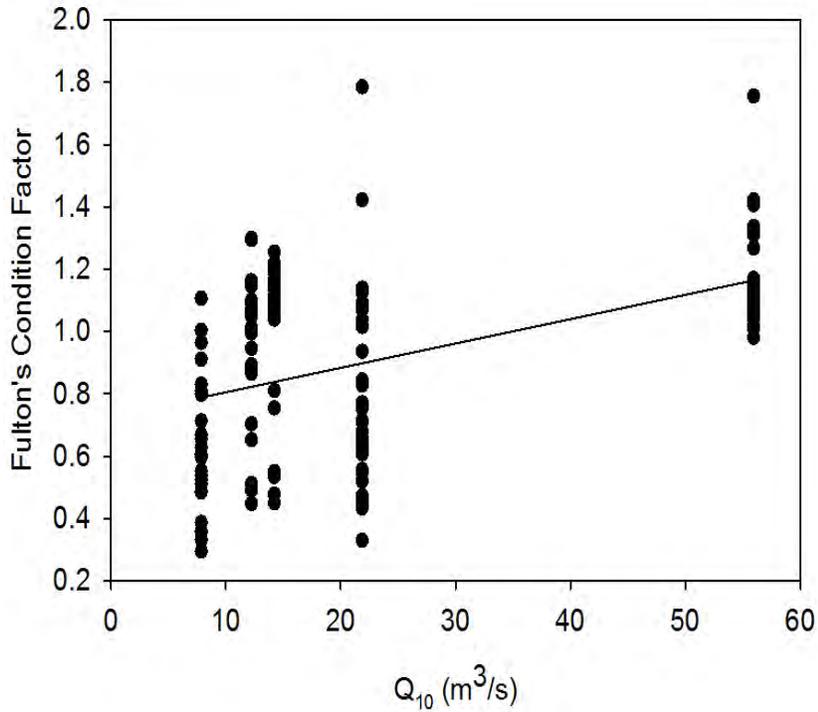


Figure 20: Relationship between Fulton's condition factor of rainbow trout and 10th percentile discharge (Q₁₀) in the Cheakamus River.

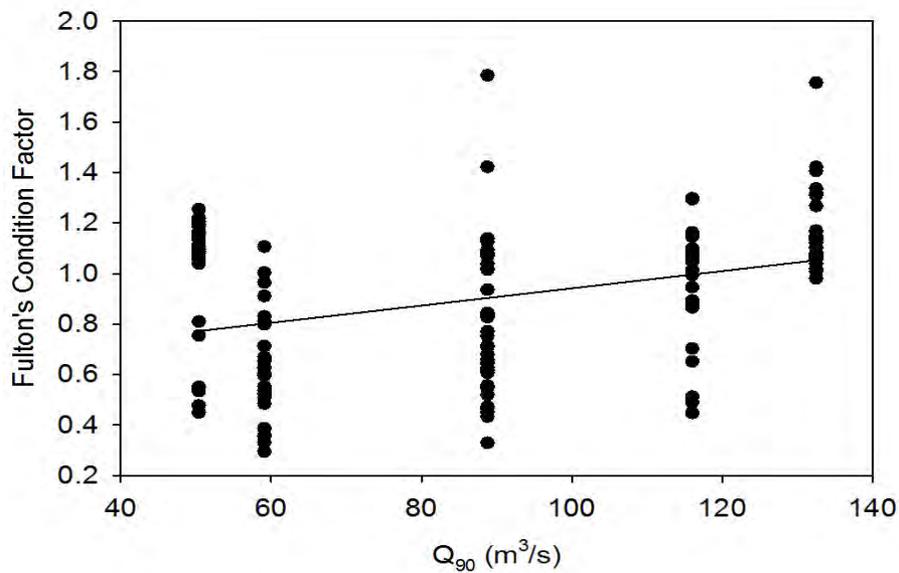


Figure 21: Relationship between Fulton's condition factor of rainbow trout and 90th percentile discharge (Q₉₀) in the Cheakamus River.



FIGURES

Trout Monitor 2007-2011

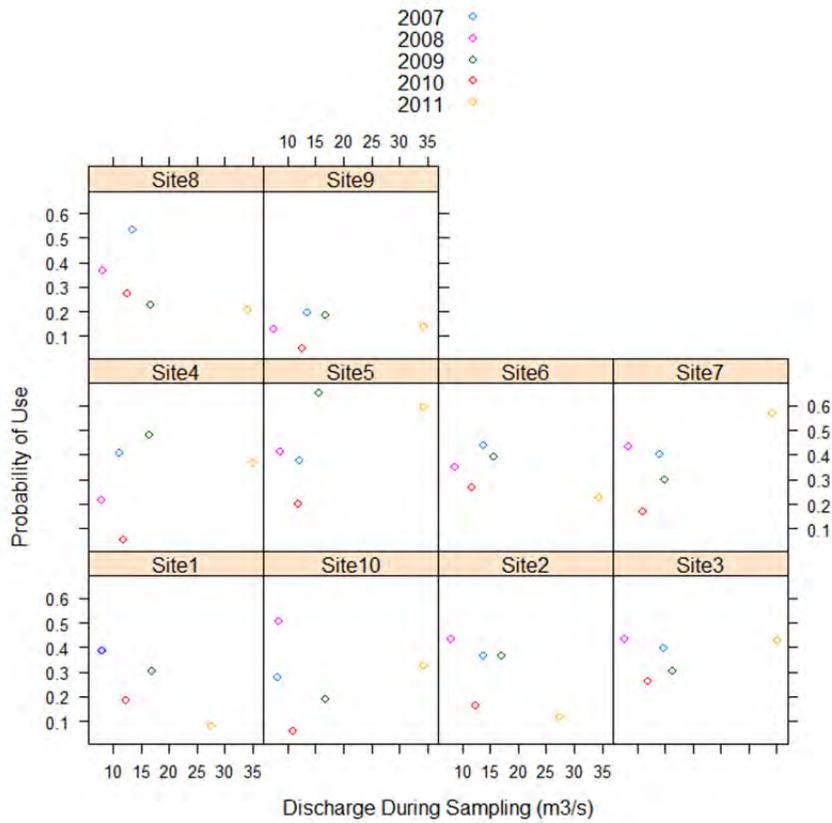


Figure 22: Relationship between probability of use and discharge during the sampling periods by electrofishing site from 2007 to 2011.



FIGURES

Trout Monitor 2007-2011

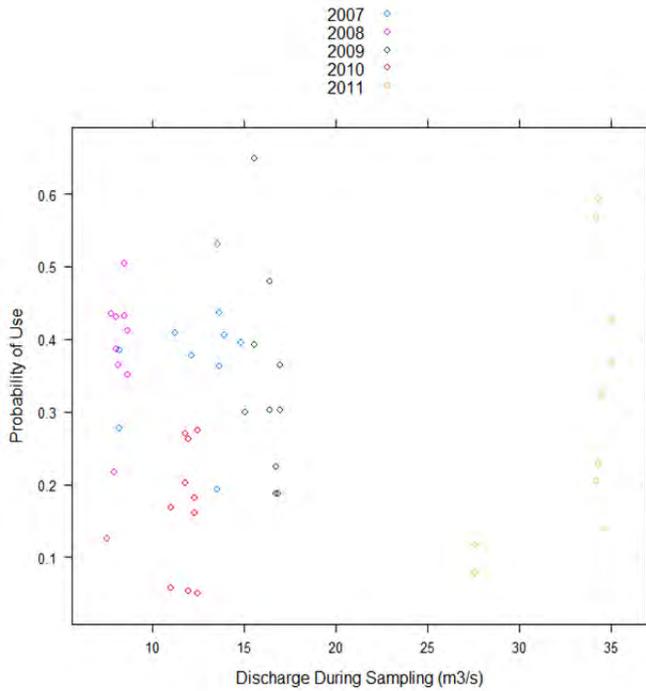


Figure 23: Relationship between probability of use and discharge during the electrofishing sampling periods from 2007 to 2011.

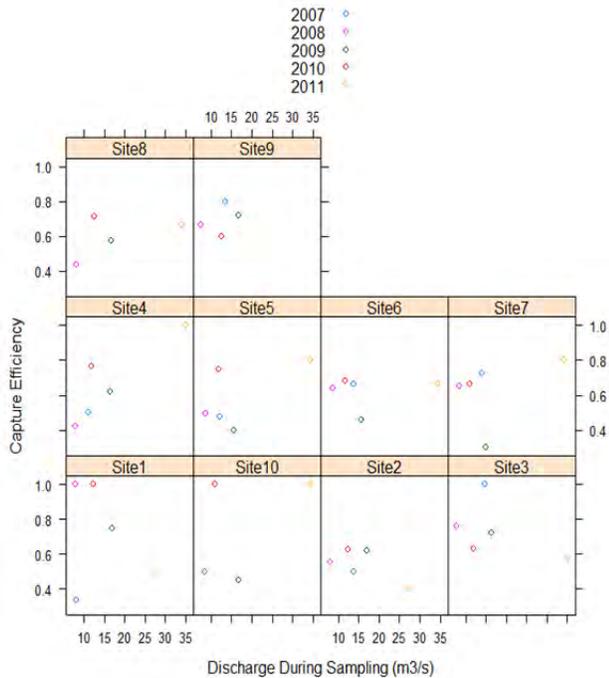


Figure 24: Relationship between capture efficiency and discharge during the sampling periods by electrofishing site from 2007 to 2011.



APPENDIX A

Site Description, Depth-Velocity Transect and Fish Capture Data 2007

ELECTROFISHING SITE DESCRIPTION FORM

SITE 001 Cheakamus

Stream:	Cheakamus
Watershed code:	90009760012900

Site number:	001
Date:	20/09/2007
Surveyed by:	AL/AL/HL
UTM:	0489643 5535553

Hydraulic type:	riffle
Mainstem/sidechannel (m/s,s/c):	s/c
Field gradient:	3.0 %
Stream width:	45.0 m
Channel width:	90.0 m
Mean depth:	0.35 m
Maximum depth:	0.60 m
Mean velocity:	0.06 m*s ⁻¹
Maximum velocity:	0.38 m*s ⁻¹

Turbidity:	Med
Temperature (°C @ time):	11 @ 0930

Stream Stage:	Low
Conductivity:	- mS*cm ⁻¹

COVER:		
log:	0	%
boulder:	70	%
instream vegetation:	2	%
overstream vegetation:	90	%
cutbank:	0	%

SUBSTRATE:		
finer:	2	%
small gravel:	2	%
large gravel:	2	%
cobble:	70	%
boulder:	24	%
bedrock:	0	%

Compaction:	Med
Sand (% of area):	10 %
d90:	0.55 m
dMax:	0.60 m

Site length:	10.0 m
Site width:	7.0 m
Site area*:	70.0 m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



**APPENDIX A
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2007**

**DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)**

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.
This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 001 Cheakamus

Stream:	Cheakamus	
Date:	20/09/2007	
Mainstem/side-channel:	s/c	
Meter:	Flow Meter	
Metered at*:	40%	dfb
Transect width:	7.0	m

UTM:	489643 5535553	
Watershed code:	90009760012900	
Site number:	001	
Transect #:	1	

Hydraulic type:	riffle	
Width:Mean Depth Ratio:	32.16	

Site length:	10.0	m
Site width:	7.0	m
Site area**:	70.0	m ²
Discharge:	0.142	m ³ *s ⁻¹

Transect type:	EF site	
Stream width:	90	m
Number of stations:	15	

NOTES: * dfb = depth from bottom.
** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.2	m
Mean Velocity:	0.1	m*s ⁻¹
Cross-sectional area :	1.5	m ²
Mean Probability (Fry):	38.5	%
Mean Probability (Parr):	26.3	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	2.7	m
%Transect Usable by Fry	38.5	%
Usable Area for Fry	27.0	m ²
Usable Width Parr:	1.8	m
%Transect Usable by Parr	26.3	%
Usable Area for Parr	18.4	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.12	0.00
1.00	0.05	0.00
1.50	0.14	0.00
2.00	0.11	0.00
2.50	0.04	0.00
3.00	0.19	0.38
3.50	0.32	0.07
4.00	0.30	0.15
4.50	0.21	0.00
5.00	0.42	0.16
5.50	0.47	0.12
6.00	0.25	0.08
6.50	0.31	0.00
7.00	0.04	0.00

Ptolemy WUP HSI curves, February 12, 2001.

APPENDIX A
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2007

Cheakamus River Rainbow Trout Survey, 2007
FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 001 Cheakamus

Stream:	Cheakamus
Site number:	001
Site length:	10.0 m
Site width:	7.0 m
Site area:	70.0 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	0950	1005	700	J5	390
Pass 2	1023	1035	700	J5	285
Pass 3	1051	1111	700	J5	583

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	0	0	2	2	0.7	42.0	2	2.9	0.39	7	1.433	2.867
<i>O. mykiss</i>	1+	4	0	1	5	8.9	91.0	5	7.1			0.089	0.444
<i>Cottus</i>		7	2	3	12			13				0.180	2.332

ELECTROFISHING SITE DESCRIPTION FORM

SITE 002 Cheakamus

Stream:	Cheakamus
Watershed code:	90009760012900

Site number:	002
Date:	19/09/2007
Surveyed by:	AL/AL/HL
UTM:	0489645 5535547

Hydraulic type:	riffle
Mainstem/sidechannel (m/s,s/c):	s/c
Field gradient:	4.0 %
Stream width:	80.0 m
Channel width:	100.0 m
Mean depth:	0.35 m
Maximum depth:	0.75 m
Mean velocity:	0.18 m*s ⁻¹
Maximum velocity:	0.55 m*s ⁻¹

Turbidity:	Med
Temperature (°C @ time):	13 @ 1500

Stream Stage:	Low
Conductivity:	- mS*cm ⁻¹

COVER:		
log:	0	%
boulder:	33	%
instream vegetation:	2	%
overstream vegetation:	65	%
cutbank:	0	%

SUBSTRATE:		
finer:	0	%
small gravel:	0	%
large gravel:	2	%
cobble:	88	%
boulder:	10	%
bedrock:	0	%

Compaction:	Med
Sand (% of area):	2 %
d90:	0.75 m
dMax:	1.30 m

Site length:	16.0 m
Site width:	7.8 m
Site area*:	124.8 m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



**DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)**

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.
This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 002 Cheakamus

Stream:	Cheakamus	
Date:	19/09/2007	
Mainstem/side-channel:	s/c	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	7.0	m

UTM:	489645 5535547	
Watershed code:	90009760012900	
Site number:	002	
Transect #:	1	

Site length:	16.0	m
Site width:	7.8	m
Site area**:	124.8	m ²
Discharge:	0.462	m ³ *s ⁻¹

Hydraulic type:	riffle	
Width:Mean Depth Ratio:	23.32	

Transect type:	EF site	
Stream width:	100	m
Number of stations:	15	

NOTES: * dfb = depth from bottom.
** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.3	m
Mean Velocity:	0.2	m*s ⁻¹
Cross-sectional area :	2.1	m ²
Mean Probability (Fry):	36.3	%
Mean Probability (Parr):	57.0	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	2.5	m
%Transect Usable by Fry	36.3	%
Usable Area for Fry	45.2	m ²
Usable Width Parr:	4.0	m
%Transect Usable by Parr	57.0	%
Usable Area for Parr	71.1	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.05	0.00
1.00	0.27	0.00
1.50	0.30	0.10
2.00	0.56	0.11
2.50	0.54	0.13
3.00	0.44	0.23
3.50	0.41	0.39
4.00	0.32	0.34
4.50	0.35	0.55
5.00	0.26	0.14
5.50	0.31	0.38
6.00	0.16	0.29
6.50	0.17	0.00
7.00	0.03	0.00

Ptolemy WUP HSI curves, February 12, 2001.

APPENDIX A
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2007

Cheakamus River Rainbow Trout Survey, 2007
FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 002 Cheakamus

Stream:	Cheakamus
Site number:	002
Site length:	16.0 m
Site width:	7.8 m
Site area:	124.8 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1445	1508	700	J5	566
Pass 2	1530	1555	700	J5	430
Pass 3	1635	1710	700	J5	

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	1	2	1	4	0.3	36.5	4	3.2	0.36	9	0.370	1.468
<i>O. mykiss</i>	1+	9	2		11	7.1	109.5	11	8.8			0.020	0.218
<i>O. mykiss</i>	2+	2			2	10.1	145.0	2	1.6			0.000	0
<i>Cottus</i>		10						10				0.000	0
<i>Gasterosteus aculeatus</i>		3						3				0.000	0

ELECTROFISHING SITE DESCRIPTION FORM

SITE 003 Cheakamus

Stream:	Cheakamus
Watershed code:	

Site number:	003
Date:	13/09/2007
Surveyed by:	AL/AL/HL
UTM:	0489121 5535128

Hydraulic type:	rapid
Mainstem/sidechannel (m/s,s/c):	m/s
Field gradient:	3.0 %
Stream width:	40.0 m
Channel width:	40.0 m
Mean depth:	0.35 m
Maximum depth:	0.60 m
Mean velocity:	0.43 m*s ⁻¹
Maximum velocity:	1.21 m*s ⁻¹

Turbidity:	Med
Temperature (°C @ time):	11 @ 1200

Stream Stage:	Low
Conductivity:	- mS*cm ⁻¹

COVER:		
log:	0	%
boulder:	100	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
fines:	15	%
small gravel:	5	%
large gravel:	10	%
cobble:	25	%
boulder:	45	%
bedrock:	0	%

Compaction:	low
Sand (% of area):	%
d90:	1.10 m
dMax:	1.60 m

Site length:	16.5	m
Site width:	8.5	m
Site area*:	140.3	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 003 Cheakamus

Stream:	Cheakamus	
Date:	13/09/2007	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity	
Metered at*:	40%	dfb
Transect width:	7.0	m

Site length:	16.5	m
Site width:	8.5	m
Site area**:	140.3	m ²
Discharge:	1.467	m ³ *s ⁻¹

UTM:	489121 5535128
Watershed code:	0
Site number:	003
Transect #:	1

Hydraulic type:	rapid
Width:Mean Depth Ratio:	15.98

Transect type:	EF site	
Stream width:	40	m
Number of stations:	22	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.4	m
Mean Velocity:	0.5	m*s ⁻¹
Cross-sectional area :	3.1	m ²
Mean Probability (Fry):	39.6	%
Mean Probability (Parr):	82.8	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	2.8	m
%Transect Usable by Fry	39.6	%
Usable Area for Fry	55.5	m ²
Usable Width Parr:	5.8	m
%Transect Usable by Parr	82.8	%
Usable Area for Parr	116.1	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.05	0.00
1.00	0.13	0.00
1.50	0.14	0.00
2.00	0.21	0.12
2.50	0.26	0.15
3.00	0.28	0.54
3.50	0.21	0.66
4.00	0.12	0.90
4.50	0.13	0.57
5.00	0.19	0.67
5.50	0.23	0.60
6.00	0.31	1.21
6.50	0.30	0.08
7.00	0.32	0.24
7.50	0.39	0.17
8.00	0.52	0.72
8.50	0.46	0.79
9.00	0.42	0.24
9.50	0.58	0.77
10.00	0.58	0.25
10.50	0.58	0.85

**APPENDIX A
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2007**

**Cheakamus River Rainbow Trout Survey, 2007
FISH CAPTURE SUMMARY FORM**

Golder Associates Ltd.

SITE 003 Cheakamus

Stream:	Cheakamus
Site number:	003
Site length:	16.5 m
Site width:	8.5 m
Site area:	140.3 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1218	1247	700	J6	718
Pass 2	1350	1417	700	J6	729
Pass 3	1500	1525	700	J6	529
Pass 4	1533	1546	700	J6	503

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	1			1	0.5	36.0	1	0.7	0.40	2	0.000	0
<i>O. mykiss</i>	1+		2		2	11.7	108.5	2	1.4			0.278	1.038
<i>O. mykiss</i>	2+	1		1	2	50.6	164.0	2	1.4			0.278	1.038
<i>Cottus</i>		1	1	1	3			3	2.1			0.227	1.271

ELECTROFISHING SITE DESCRIPTION FORM

SITE 004 Cheakamus

Stream:	Cheakamus
Watershed code:	90009760012900

Site number:	004
Date:	14/09/2007
Surveyed by:	AL/AL/HL
UTM:	10U 0489105 5534957

Hydraulic type:	riffle and pool
Mainstem/sidechannel (m/s,s/c):	m/s
Field gradient:	2.0 %
Stream width:	45.0 m
Channel width:	65.0 m
Mean depth:	0.40 m
Maximum depth:	0.95 m
Mean velocity:	0.14 m*s ⁻¹
Maximum velocity:	0.63 m*s ⁻¹

Turbidity:	Med
Temperature (°C @ time):	10 @ 1200

Stream Stage:	Low
Conductivity:	- mS*cm ⁻¹

COVER:		
log:	0	%
boulder:	20	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	30	%
small gravel:	15	%
large gravel:	15	%
cobble:	20	%
boulder:	20	%
bedrock:	0	%

Compaction:	Med
Sand (% of area):	10 %
d90:	0.82 m
dMax:	2.00 m

Site length:	17.0 m
Site width:	10.5 m
Site area*:	178.5 m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



**DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)**

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.
This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 004 Cheakamus

Stream:	Cheakamus	
Date:	14/09/2007	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	7.0	m

Site length:	17.0	m
Site width:	10.5	m
Site area**:	178.5	m ²
Discharge:	0.461	m ³ *s ⁻¹

UTM:	10U 0489105 5534957	
Watershed code:	90009760012900	
Site number:	004	
Transect #:	1	

Hydraulic type:	riffle and pool	
Width:Mean Depth Ratio:	14.18	

Transect type:	EF site	
Stream width:	65	m
Number of stations:	22	

NOTES: * dfb = depth from bottom.
** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.5	m
Mean Velocity:	0.1	m*s ⁻¹
Cross-sectional area :	3.5	m ²
Mean Probability (Fry):	40.8	%
Mean Probability (Parr):	58.8	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	2.9	m
%Transect Usable by Fry:	40.8	%
Usable Area for Fry:	72.8	m ²
Usable Width Parr:	4.1	m
%Transect Usable by Parr:	58.8	%
Usable Area for Parr:	104.9	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.09	0.00
1.00	0.22	0.00
1.50	0.35	0.00
2.00	0.40	0.00
2.50	0.54	0.00
3.00	0.50	0.00
3.50	0.34	0.00
4.00	0.44	0.00
4.50	0.31	0.00
5.00	0.23	0.04
5.50	0.20	0.42
6.00	0.28	0.24
6.50	0.36	0.27
7.00	0.39	0.29
7.50	0.42	0.35
8.00	0.44	0.34
8.50	0.43	0.25
9.00	0.36	0.00
9.50	0.00	0.00
10.00	0.38	0.17
10.50	0.45	0.63

Ptolemy WUP HSI curves.

**APPENDIX A
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2007**

**Cheakamus River Rainbow Trout Survey, 2007
FISH CAPTURE SUMMARY FORM**

Golder Associates Ltd.

SITE 004 Cheakamus

Stream:	Cheakamus
Site number:	004
Site length:	17.0 m
Site width:	10.5 m
Site area:	178.5 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1300	1330	700	G5	1090
Pass 2	1420	1420	700	G5	600
Pass 3	1500	1500	800	G5	840

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	1	2	1	4	0.5	30.5	4	2	0.41	5	0.367	0.443
<i>O. mykiss</i>	1+	4	0	0	4	12.2	102.8	4	2			0.000	0.47
<i>Cottus</i>		2	0	0	2			2	1			0.000	1.615
<i>Gasterosteus aculeatus</i>		0	0	2	2			2	1			1.433	2.866

ELECTROFISHING SITE DESCRIPTION FORM

SITE 005 Cheakamus

Stream:	Cheakamus
Watershed code:	90009760012900

Site number:	005
Date:	15/09/2007
Surveyed by:	AL/AL/HL
UTM:	0488166 5533036

Hydraulic type:	riffle/rapid
Mainstem/sidechannel (m/s,s/c):	m/s
Field gradient:	4.0 %
Stream width:	40.0 m
Channel width:	55.0 m
Mean depth:	0.38 m
Maximum depth:	0.73 m
Mean velocity:	0.05 m*s ⁻¹
Maximum velocity:	0.30 m*s ⁻¹

Turbidity:	Med
Temperature (°C @ time):	11 @ 1020

Stream Stage:	Low
Conductivity:	- mS*cm ⁻¹

COVER:		
log:	19	%
boulder:	40	%
instream vegetation:	1	%
overstream vegetation:	20	%
cutbank:	20	%

SUBSTRATE:		
finer:	10	%
small gravel:	5	%
large gravel:	5	%
cobble:	70	%
boulder:	10	%
bedrock:	0	%

Compaction:	Med
Sand (% of area):	10 %
d90:	0.80 m
dMax:	0.90 m

Site length:	16.0	m
Site width:	9.5	m
Site area*:	152.0	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



**DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)**

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.
This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 005 Cheakamus

Stream:	Cheakamus	
Date:	15/09/2007	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	7.0	m

UTM:	488166 5533036	
Watershed code:	90009760012900	
Site number:	005	
Transect #:	1	

Hydraulic type:	riffle/rapid	
Width:Mean Depth Ratio:	16.64	

Site length:	16.0	m
Site width:	9.5	m
Site area**:	152.0	m ²
Discharge:	0.177	m ³ *s ⁻¹

Transect type:	EF site	
Stream width:	55	m
Number of stations:	21	

NOTES: * dfb = depth from bottom.
** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.4	m
Mean Velocity:	0.1	m*s ⁻¹
Cross-sectional area :	2.9	m ²
Mean Probability (Fry):	37.7	%
Mean Probability (Parr):	26.3	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	2.6	m
%Transect Usable by Fry	37.7	%
Usable Area for Fry	57.3	m ²
Usable Width Parr:	1.8	m
%Transect Usable by Parr	26.3	%
Usable Area for Parr	40.0	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.25	0.00
1.00	0.27	0.00
1.50	0.36	0.00
2.00	0.50	0.00
2.50	0.53	0.00
3.00	0.42	0.00
3.50	0.40	0.00
4.00	0.45	0.00
4.50	0.36	0.30
5.00	0.57	0.20
5.50	0.31	0.00
6.00	0.37	0.00
6.50	0.00	0.00
7.00	0.00	0.00
7.50	0.05	0.00
8.00	0.05	0.06
8.50	0.27	0.00
9.00	0.36	0.25
9.50	0.23	0.12
10.00	0.08	0.16

Ptolemy WUP HSI curves.

APPENDIX A
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2007

Cheakamus River Rainbow Trout Survey, September 2007
FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 005 Cheakamus

Stream:	Cheakamus
Site number:	005
Site length:	16.0 m
Site width:	9.5 m
Site area:	152.0 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1028	1117	600	15	1111
Pass 2	1216	1248	500	15	851
Pass 3	1308	1336	500	14	771

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	4	5	2	11	0.6	37.5	12	7.9	0.38	21	0.240	2.884
<i>O. mykiss</i>	1+	24	5	1	30	9.3	91.2	30	19.7			0.017	0.51
<i>Cottus</i>		1	0	0	1			1	0.7			0.000	0
<i>Gasterosteus aculeatus</i>		2	0	1	3			3	2.0			0.236	1.038

ELECTROFISHING SITE DESCRIPTION FORM

SITE 006 Cheakamus

Stream:	Cheakamus
Watershed code:	90009760012900

Site number:	006
Date:	19/09/2007
Surveyed by:	AL/AL/HL
UTM:	0488048 5532890

Hydraulic type:	run/riffle
Mainstem/sidechannel (m/s,s/c):	m/s
Field gradient:	3.0 %
Stream width:	20.0 m
Channel width:	75.0 m
Mean depth:	0.40 m
Maximum depth:	0.73 m
Mean velocity:	0.17 m*s ⁻¹
Maximum velocity:	0.56 m*s ⁻¹

Turbidity:	Low
Temperature (°C @ time):	9 @ 0900

Stream Stage:	Low
Conductivity:	- mS*cm ⁻¹

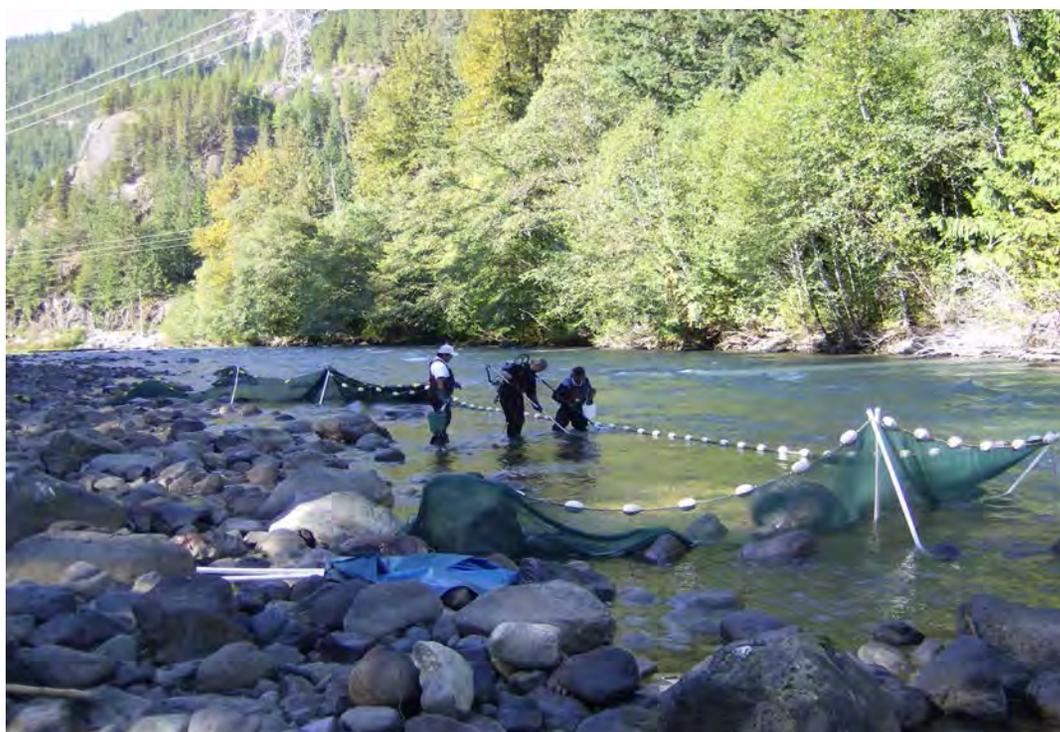
COVER:		
log:	0	%
boulder:	100	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	2	%
small gravel:	2	%
large gravel:	2	%
cobble:	60	%
boulder:	34	%
bedrock:	0	%

Compaction:	high
Sand (% of area):	10 %
d90:	0.75 m
dMax:	0.83 m

Site length:	20.0 m
Site width:	6.0 m
Site area*:	120.0 m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 006 Cheakamus

Stream:	Cheakamus	
Date:	19/09/2007	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	6.5	m

Site length:	20.0	m
Site width:	6.0	m
Site area**:	120.0	m ²
Discharge:	0.446	m ³ *s ⁻¹

UTM:	488048 5532890	
Watershed code:	90009760012900	
Site number:	006	
Transect #:	1	

Hydraulic type:	run/riffle	
Width:Mean Depth Ratio:	22.53	

Transect type:	EF site	
Stream width:	75	m
Number of stations:	14	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.3	m
Mean Velocity:	0.2	m*s ⁻¹
Cross-sectional area :	1.9	m ²
Mean Probability (Fry):	43.7	%
Mean Probability (Parr):	48.6	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	2.8	m
%Transect Usable by Fry	43.7	%
Usable Area for Fry	52.4	m ²
Usable Width Parr:	3.2	m
%Transect Usable by Parr	48.6	%
Usable Area for Parr	58.3	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.01	0.00
1.00	0.05	0.00
1.50	0.10	0.00
2.00	0.24	0.04
2.50	0.24	0.11
3.00	0.36	0.00
3.50	0.26	0.19
4.00	0.11	0.21
4.50	0.37	0.28
5.00	0.36	0.21
5.50	0.50	0.44
6.00	0.76	0.29
6.50	0.79	0.56

**APPENDIX A
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2007**

**Cheakamus River Rainbow Trout Survey, September 2007
FISH CAPTURE SUMMARY FORM**

Golder Associates Ltd.

SITE 006 Cheakamus

Stream:	Cheakamus
Site number:	006
Site length:	20.0 m
Site width:	6.0 m
Site area:	120.0 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	0950	1010	700	J4	575
Pass 2	1030	1100	700	J5	542
Pass 3	1115	1130	700	J6	450

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	3	3	0	6	0.6	39.2	6	5.0	0.44	11	0.083	1.468
<i>O. mykiss</i>	1+	11	6	0	17	9.2	93.6	17	14.2			0.045	0.218
<i>Cottus</i>		1	1	1	3			3	2.5			0.420	0
<i>Gasterosteus aculeatus</i>		0	0	1	1			1	0.8			2.020	0

ELECTROFISHING SITE DESCRIPTION FORM

SITE 007 Cheakamus

Stream:	Cheakamus
Watershed code:	90009760012900

Site number:	007
Date:	18/09/2007
Surveyed by:	AL/AL/HL
UTM:	0487949 5532607

Hydraulic type:	riffle/rapid
Mainstem/sidechannel (m/s,s/c):	m/s
Field gradient:	4.0 %
Stream width:	60.0 m
Channel width:	55.0 m
Mean depth:	0.30 m
Maximum depth:	0.60 m
Mean velocity:	0.35 m*s ⁻¹
Maximum velocity:	0.65 m*s ⁻¹

Turbidity:	Med
Temperature (°C @ time):	10.5 @ 0900

Stream Stage:	Low
Conductivity:	- mS*cm ⁻¹

COVER:		
log:	0	%
boulder:	20	%
instream vegetation:	2	%
overstream vegetation:	80	%
cutbank:	0	%

SUBSTRATE:		
finer:	0	%
small gravel:	0	%
large gravel:	10	%
cobble:	80	%
boulder:	10	%
bedrock:	0	%

Compaction:	High
Sand (% of area):	10 %
d90:	0.60 m
dMax:	0.70 m

Site length:	17.0 m
Site width:	11.0 m
Site area*:	187.0 m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



**DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)**

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.
This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 007 Cheakamus

Stream:	Cheakamus	
Date:	18/09/2007	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	7.0	m

UTM:	487949 5532607	
Watershed code:	90009760012900	
Site number:	007	
Transect #:	1	

Hydraulic type:	riffle/rapid	
Width:Mean Depth Ratio:	12.11	

Site length:	17.0	m
Site width:	11.0	m
Site area**:	187.0	m ²
Discharge:	1.546	m ³ *s ⁻¹

Transect type:	EF site	
Stream width:	55	m
Number of stations:	22	

NOTES: * dfb = depth from bottom.
** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.6	m
Mean Velocity:	0.4	m*s ⁻¹
Cross-sectional area :	4.0	m ²
Mean Probability (Fry):	40.5	%
Mean Probability (Parr):	127.2	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	2.8	m
%Transect Usable by Fry	40.5	%
Usable Area for Fry	75.8	m ²
Usable Width Parr:	8.9	m
%Transect Usable by Parr	127.2	%
Usable Area for Parr	237.8	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.80	0.00
1.00	0.00	0.00
1.50	0.23	0.20
2.00	0.34	0.29
2.50	0.29	0.28
3.00	0.28	0.28
3.50	0.31	0.21
4.00	0.37	0.34
4.50	0.40	0.48
5.00	0.36	0.65
5.50	0.48	0.61
6.00	0.48	0.50
6.50	0.48	0.50
7.00	0.44	0.50
7.50	0.40	0.51
8.00	0.46	0.45
8.50	0.44	0.44
9.00	0.45	0.44
9.50	0.45	0.55
10.00	0.29	0.33
10.50	0.27	0.13

Ptolemy WUP HSI curves.

APPENDIX A
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2007

Cheakamus River Rainbow Trout Survey, 2007
FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 007 Cheakamus

Stream:	Cheakamus	
Site number:	007	
Site length:	17.0	m
Site width:	11.0	m
Site area:	187.0	m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1000	1030	700	J4	902
Pass 2	1100	1130	700	J4	666
Pass 3	1140	1200	700	J4	591

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	6	1	1	8	0.7	39.3	8	4.3	0.41	11	0.064	0.512
<i>O. mykiss</i>	1+	8	2		10	8.2	90.0	10	5.3			0.023	0.237
<i>O. mykiss</i>	2+		2		2	41.5	147.0	2	1.1			0.519	1.038
<i>O. mykiss</i>	3+	1			1	42.2	157.0	1	0.5			0.000	0
<i>Cottus</i>		4	2		6			6	3.2			0.063	0.376

ELECTROFISHING SITE DESCRIPTION FORM

SITE 008 Cheakamus

Stream:	Cheakamus
Watershed code:	90009760012900

Site number:	008
Date:	17/09/2007
Surveyed by:	AL/AL/HL
UTM:	487949 5532607

Hydraulic type:	riffle/rapid
Mainstem/sidechannel (m/s,s/c):	m/s
Field gradient:	4.0 %
Stream width:	20.0 m
Channel width:	35.0 m
Mean depth:	0.45 m
Maximum depth:	0.83 m
Mean velocity:	0.12 m*s ⁻¹
Maximum velocity:	0.89 m*s ⁻¹

Turbidity:	Med
Temperature (°C @ time):	11 @ 1000

Stream Stage:	Low
Conductivity:	- mS*cm ⁻¹

COVER:		
log:	0	%
boulder:	75	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	0	%
small gravel:	2	%
large gravel:	3	%
cobble:	15	%
boulder:	80	%
bedrock:	0	%

Compaction:	Med
Sand (% of area):	10 %
d90:	0.85 m
dMax:	1.00 m

Site length:	16.0 m
Site width:	14.0 m
Site area*:	70.0 m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



**DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)**

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.
This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 008 Cheakamus

Stream:	Cheakamus	
Date:	17/09/2007	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	7.0	m

UTM:	487949 5532607	
Watershed code:	90009760012900	
Site number:	008	
Transect #:	1	

Hydraulic type:	riffle/rapid	
Width:Mean Depth Ratio:	12.08	

Site length:	16.0	m
Site width:	14.0	m
Site area**:	183.3	m ²
Discharge:	0.664	m ³ *s ⁻¹

Transect type:	EF site	
Stream width:	35	m
Number of stations:	26	

NOTES: * dfb = depth from bottom.
** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

ADJUSTED USABLE AREAS

Mean Depth:	0.6	m
Mean Velocity:	0.2	m*s ⁻¹
Cross-sectional area :	4.1	m ²
Mean Probability (Fry):	53.1	%
Mean Probability (Parr):	62.1	%

Usable Width for Fry:	3.7	m
%Transect Usable by Fry	53.1	%
Usable Area for Fry	97.4	m ²
Usable Width Parr:	4.3	m
%Transect Usable by Parr	62.1	%
Usable Area for Parr	113.9	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.00	0.00
1.00	0.12	0.00
1.50	0.19	0.05
2.00	0.24	0.00
2.50	0.18	0.09
3.00	0.05	0.00
3.50	0.20	0.00
4.00	0.00	0.00
4.50	0.15	0.30
5.00	0.10	0.00
5.50	0.22	0.00
6.00	0.26	0.00
6.50	0.37	0.10
7.00	0.53	0.14
7.50	0.55	0.12
8.00	0.40	0.13
8.50	0.54	0.09
9.00	0.51	0.09
9.50	0.58	0.09
10.00	0.55	0.10
10.50	0.43	0.11
11.00	0.38	0.11
11.50	0.60	0.12
12.00	0.64	0.65
12.50	0.65	0.89

Ptolemy WUP HSI curves.

**APPENDIX A
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2007**

**Cheakamus River Rainbow Trout Survey, 2007
FISH CAPTURE SUMMARY FORM**

Golder Associates Ltd.

SITE 008 Cheakamus

Stream:	Cheakamus
Site number:	008
Site length:	16.0 m
Site width:	14.0 m
Site area:	70.0 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1410	1440			738
Pass 2	1500	1525			548
Pass 3	1535	1552			546

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	9		4	13	0.4	34.8	13	18.6	0.53	35	0.154	2.156
<i>O. mykiss</i>	1+		10	1	11	7.4	88.0	11	15.7			0.418	5.435
<i>Cottus</i>		1	1		2			2	2.9			0.192	0.384
<i>Gasterosteus aculeatus</i>		1			1			1	1.4			0.000	0.738

ELECTROFISHING SITE DESCRIPTION FORM

SITE 009 Cheakamus

Stream:	Cheakamus
Watershed code:	90009760012900

Site number:	009
Date:	17/09/2007
Surveyed by:	AL/AL/HL
UTM:	488028 5532370

Hydraulic type:	riffle/rapid
Mainstem/sidechannel (m/s,s/c):	m/s
Field gradient:	3.0 %
Stream width:	45.0 m
Channel width:	60.0 m
Mean depth:	0.40 m
Maximum depth:	0.60 m
Mean velocity:	0.37 m*s ⁻¹
Maximum velocity:	0.53 m*s ⁻¹

Turbidity:	Med
Temperature (°C @ time):	

Stream Stage:	Low
Conductivity:	- mS*cm ⁻¹

COVER:		
log:	25	%
boulder:	5	%
instream vegetation:	0	%
overstream vegetation:	20	%
cutbank:	5	%

SUBSTRATE:		
finer:	0	%
small gravel:	5	%
large gravel:	10	%
cobble:	80	%
boulder:	5	%
bedrock:	0	%

Compaction:	Med
Sand (% of area):	10 %
d90:	0.55 m
dMax:	0.70 m

Site length:	23.0 m
Site width:	3.5 m
Site area*:	80.5 m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



**DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)**

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.
This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 009 Cheakamus

Stream:	Cheakamus	
Date:	17/09/2007	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	7.0	m

UTM:	488028 5532370	
Watershed code:	90009760012900	
Site number:	009	
Transect #:	1	

Site length:	23.0	m
Site width:	3.5	m
Site area**:	80.5	m ²
Discharge:	1.059	m ³ *s ⁻¹

Hydraulic type:	riffle/rapid	
Width:Mean Depth Ratio:	21.04	

Transect type:	EF site	
Stream width:	60	m
Number of stations:	11	

NOTES: * dfb = depth from bottom.
** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.3	m
Mean Velocity:	0.5	m*s ⁻¹
Cross-sectional area :	2.3	m ²
Mean Probability (Fry):	19.4	%
Mean Probability (Parr):	58.2	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	1.4	m
%Transect Usable by Fry	19.4	%
Usable Area for Fry	15.6	m ²
Usable Width Parr:	4.1	m
%Transect Usable by Parr	58.2	%
Usable Area for Parr	46.8	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.20	0.08
1.00	0.27	0.05
1.50	0.32	0.43
2.00	0.41	0.51
2.50	0.46	0.50
3.00	0.48	0.50
3.50	0.63	0.50
4.00	0.74	0.51
4.50	0.74	0.53
5.00	0.69	0.51

APPENDIX A
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2007

Cheakamus River Rainbow Trout Survey, 2007
FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 009 Cheakamus

Stream:	Cheakamus
Site number:	009
Site length:	23.0 m
Site width:	3.5 m
Site area:	80.5 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1100	1128	600	J4	330
Pass 2	1145	1204	600	J4	332
Pass 3	1210	1223	700	J6	373

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	3	1	0	4	0.5	38.3	4	5.0	0.19	26	0.051	0.205
<i>O. mykiss</i>	1+	2	0	0	2	9.7	95.5	2	2.5			0.000	0
<i>Gasterosteus aculeatus</i>		0	0	1	1			1	1.2			2.020	2.027
<i>Salvelinus confluentus</i>		1	0	0	1	117.7	220.0	1	1.2			0.000	0

ELECTROFISHING SITE DESCRIPTION FORM

SITE 010 Cheakamus

Stream:	Cheakamus
Watershed code:	90009760012900

Site number:	010
Date:	20/09/2007
Surveyed by:	AL/AL/HL
UTM:	0487932 5532083

Hydraulic type:	run/rapid/pool
Mainstem/sidechannel (m/s,s/c):	m/s
Field gradient:	6.0 %
Stream width:	60.0 m
Channel width:	80.0 m
Mean depth:	0.60 m
Maximum depth:	1.60 m
Mean velocity:	0.20 m*s ⁻¹
Maximum velocity:	1.12 m*s ⁻¹

Turbidity:	Low
Temperature (°C @ time):	11 @1400

Stream Stage:	Low
Conductivity:	- mS*cm ⁻¹

COVER:		
log:	0	%
boulder:	100	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	2	%
small gravel:	1	%
large gravel:	1	%
cobble:	5	%
boulder:	91	%
bedrock:	0	%

Compaction:	Med
Sand (% of area):	0 %
d90:	1.65 m
dMax:	2.90 m

Site length:	14.0 m
Site width:	7.0 m
Site area*:	98.0 m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



**DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)**

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This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 010 Cheakamus

Stream:	Cheakamus	
Date:	20/09/2007	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	7.0	m

UTM:	487932 5532083	
Watershed code:	90009760012900	
Site number:	010	
Transect #:	1	

Hydraulic type:	run/rapid/pool	
Width:Mean Depth Ratio:	30.65	

Site length:	14.0	m
Site width:	7.0	m
Site area**:	98.0	m ²
Discharge:	0.397	m ³ *s ⁻¹

Transect type:	EF site	
Stream width:	80	m
Number of stations:	21	

NOTES: * dfb = depth from bottom.
** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.2	m
Mean Velocity:	0.2	m*s ⁻¹
Cross-sectional area :	1.6	m ²
Mean Probability (Fry):	27.8	%
Mean Probability (Parr):	35.8	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	1.9	m
%Transect Usable by Fry	27.8	%
Usable Area for Fry	27.2	m ²
Usable Width Parr:	2.5	m
%Transect Usable by Parr	35.8	%
Usable Area for Parr	35.1	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.00	0.00
1.00	0.00	0.00
1.50	0.00	0.00
2.00	0.36	0.00
2.50	0.35	0.00
3.00	0.25	0.78
3.50	0.17	0.34
4.00	0.00	0.00
4.50	0.00	0.00
5.00	0.18	0.18
5.50	0.13	0.52
6.00	0.18	0.36
6.50	0.36	0.10
7.00	0.40	0.00
7.50	0.00	0.00
8.00	0.00	0.00
8.50	0.15	1.12
9.00	0.23	0.00
9.50	0.29	0.38
10.00	0.30	0.45

APPENDIX A
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2007

Cheakamus River Rainbow Trout Survey, 2007
FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 010 Cheakamus

Stream:	Cheakamus
Site number:	010
Site length:	14.0 m
Site width:	7.0 m
Site area:	98.0 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1345	1405	700	J5	499
Pass 2	1420	1441	700	J5	423
Pass 3	1453	1517	500-700	J5	404

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	0	0	0	0			0	0	0.28	0		
<i>O. mykiss</i>	1+	6	3	0	9	10.8	113.7	9	8.8			0.051	0.461
<i>O. mykiss</i>	2+	4	3	1	8	40.1	173.4	8	7.8			0.132	1.056
<i>O. mykiss</i>	3+	0	1	0	1	16.6	148.0	1	1.0			0.734	0.734



APPENDIX B

Site Description, Depth-Velocity Transect and Fish Capture Data 2008

ELECTROFISHING SITE DESCRIPTION FORM

SITE 001 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	001
Date:	29/09/2008
Surveyed by:	RH/AL/MS
UTM:	0489612 5535547

Hydraulic type:	riffle
Mainstem/sidechannel (m/s,s/c):	mstm
Field gradient:	- %
Stream width:	3.5 m
Channel width:	60.0 m
Mean depth:	0.35 m
Maximum depth:	0.50 m
Mean velocity:	0.10 m*s ⁻¹
Maximum velocity:	0.51 m*s ⁻¹

Turbidity:	med
Temperature (°C @ time):	11.3 @ 1330

Stream Stage:	Low
Conductivity:	- mS*cm ⁻¹

COVER:		
log:	2	%
boulder:	68	%
instream vegetation:	0	%
overstream vegetation:	30	%
cutbank:	0	%

SUBSTRATE:		
finer:	0	%
small gravel:	10	%
large gravel:	10	%
cobble:	30	%
boulder:	50	%
bedrock:	0	%

Compaction:	Med
Sand (% of area):	0 %
d90:	1.00 m
dMax:	1.00 m

Site length:	10.0 m
Site width:	8.0 m
Site area*:	80.0 m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Robert Harrison, Golder Associates Limited, from one provided by Ron Ptolemy.

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Golder Associates Ltd.

SITE 001 Cheakamus

Stream:	Cheakamus	
Date:	29/09/2008	
Mainstem/side-channel:	side	
Meter:	Flow Meter	
Metered at*:	40%	dfb
Transect width:	10.0	m

Site length:	10.0	m
Site width:	8.0	m
Site area**:	80.0	m ²
Discharge:	0.304	m ³ *s ⁻¹

UTM:	489612 5535547	
Watershed code:	900-097600-12900	
Site number:	001	
Transect #:	1	

Hydraulic type:	riffle	
Width:Mean Depth Ratio:	28.57	

Transect type:	CS	
Stream width:	60	m
Number of stations:	1	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.4	m
Mean Velocity:	0.1	m*s ⁻¹
Cross-sectional area :	2.3	m ²
Mean Probability (Fry):	38.7	%
Mean Probability (Parr):	31.5	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	3.9	m
%Transect Usable by Fry	38.7	%
Usable Area for Fry	31.0	m ²
Usable Width Parr:	3.2	m
%Transect Usable by Parr	31.5	%
Usable Area for Parr	25.2	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.39	0.00
1.00	0.31	0.00
1.50	0.41	0.11
2.00	0.26	0.19
2.50	0.33	0.22
3.00	0.40	0.51
3.50	0.31	0.11
4.00	0.33	0.15
4.50	0.16	0.06
5.00	0.10	0.14
5.50	0.20	0.09
6.00	0.10	0.00
6.50	0.10	0.00
7.00	0.00	0.00
7.50	0.80	0.11
8.00	0.26	0.07

APPENDIX B
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2008

Cheakamus River Rainbow Trout Survey, 2008
FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 001 Cheakamus

Stream:	Cheakamus	
Site number:	001	
Site length:	10.0	m
Site width:	8.0	m
Site area:	80.0	m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1359	1405	700	H6	342
Pass 2	1350	1350	700	H6	313
Pass 3	1446	1523	700	H6	313
Pass 4	1500	1507	700	H6	316

Species	Age	Pass 1	Pass 2	Pass 3	Pass 4	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	1	0	0	0	1	0.8	53.0	1	1.3	0.39	3.2	0.000	0
<i>O. mykiss</i>	1+	4	0	0	0	4	4.6	116.0	4	5.0			0.000	0
<i>O. mykiss</i>	2+	1	0	0	0	1	5.9	126.0	1	1.3			0.000	0
<i>Cottus</i>		5	9	7	1	22	6.2	91.5						

ELECTROFISHING SITE DESCRIPTION FORM

SITE 002 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	002
Date:	29/09/2008
Surveyed by:	RH/AL/MS
UTM:	0489602 5535535

Hydraulic type:	riffle
Mainstem/sidechannel (m/s,s/c):	s/c
Field gradient:	- %
Stream width:	25.0 m
Channel width:	60.0 m
Mean depth:	0.21 m
Maximum depth:	0.73 m
Mean velocity:	0.06 m*s ⁻¹
Maximum velocity:	0.24 m*s ⁻¹

Turbidity:	Med
Temperature (°C @ time):	11 @ 0950

Stream Stage:	Low
Conductivity:	39 mS*cm ⁻¹

COVER:		
log:	15	%
boulder:	70	%
instream vegetation:	0	%
overstream vegetation:	15	%
cutbank:	0	%

SUBSTRATE:		
finer:	0	%
small gravel:	5	%
large gravel:	20	%
cobble:	30	%
boulder:	45	%
bedrock:	0	%

Compaction:	low
Sand (% of area):	0 %
d90:	89.00 m
dMax:	120.00 m

Site length:	23.0 m
Site width:	8.0 m
Site area*:	184.0 m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Robert Harrison, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 002 Cheakamus

Stream:	Cheakamus	
Date:	29/09/2008	
Mainstem/side-channel:	s/c	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	7.0	m

Site length:	23.0	m
Site width:	8.0	m
Site area**:	184.0	m ²
Discharge:	0.115	m ³ *s ⁻¹

UTM:	489602 5535535	
Watershed code:	900-097600-12900	
Site number:	002	
Transect #:	1	

Hydraulic type:	riffle	
Width:Mean Depth Ratio:	30.43	

Transect type:	EF site	
Stream width:	60	m
Number of stations:	1	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.2	m
Mean Velocity:	0.1	m*s ⁻¹
Cross-sectional area :	1.6	m ²
Mean Probability (Fry):	43.0	%
Mean Probability (Parr):	24.6	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	3.0	m
%Transect Usable by Fry	43.0	%
Usable Area for Fry	79.2	m ²
Usable Width Parr:	1.7	m
%Transect Usable by Parr	24.6	%
Usable Area for Parr	45.2	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.12	0.00
1.00	0.21	0.00
1.50	0.00	0.00
2.00	0.36	0.00
2.50	0.34	0.10
3.00	0.73	0.07
3.50	0.25	0.24
4.00	0.20	0.17
4.50	0.16	0.00
5.00	0.21	0.16
5.50	0.26	0.00
6.00	0.20	0.09
6.50	0.12	0.00
7.00	0.00	0.00

APPENDIX B
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2008

Cheakamus River Rainbow Trout Survey, 2008
FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 002 Cheakamus

Stream:	Cheakamus
Site number:	002
Site length:	23.0 m
Site width:	8.0 m
Site area:	184.0 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1115	1145	700	H6	1004
Pass 2	1125	1145	700	H6	604
Pass 3	1202	1215	700	H6	305
Pass 4	1330	1345	700	H6	578

Species	Age	Pass 1	Pass 2	Pass 3	Pass 4	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	10	2	1	3	16	0.3	45.4	16	12.8	0.43	29.8	0.070	1.13
<i>O. mykiss</i>	1+	2	4	0	0	6	2.5	90.8	6	4.8			0.080	0.51
<i>O. mykiss</i>	2+	4	1	0	0	5	7.9	129.2	5	4.0			0.010	0.06
<i>O. mykiss</i>	3+	2	0	0	0	2	17.1	167.0	2	1.6			0.000	0
<i>Cottus</i>		4	9	8	11	32	4.2	88.7						
<i>Gasterosteus aculeatus</i>		1	0	2	1	4	1.2	58.5						

ELECTROFISHING SITE DESCRIPTION FORM

SITE 003 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	003
Date:	12/09/2008
Surveyed by:	RH/AL/MS
UTM:	0489199 5535149

Hydraulic type:	rapid
Mainstem/sidechannel (m/s,s/c):	m/s
Field gradient:	- %
Stream width:	40.0 m
Channel width:	40.0 m
Mean depth:	0.35 m
Maximum depth:	0.60 m
Mean velocity:	0.39 m*s ⁻¹
Maximum velocity:	0.81 m*s ⁻¹

Turbidity:	low
Temperature (°C @ time):	na

Stream Stage:	Low
Conductivity:	- mS*cm ⁻¹

COVER:		
log:	10	%
boulder:	90	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	10	%
small gravel:	10	%
large gravel:	10	%
cobble:	20	%
boulder:	50	%
bedrock:	0	%

Compaction:	low
Sand (% of area):	- %
d90:	na m
dMax:	na m

Site length:	17.0	m
Site width:	6.5	m
Site area*:	110.5	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Robert Harrison, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 003 Cheakamus

Stream:	Cheakamus	
Date:	12/09/2008	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity	
Metered at*:	40%	dfb
Transect width:	5.5	m

Site length:	17.0	m
Site width:	6.5	m
Site area**:	110.5	m ²
Discharge:	0.593	m ³ *s ⁻¹

UTM:	489199 5535149	
Watershed code:	900-097600-12900	
Site number:	003	
Transect #:	1	

Hydraulic type:	rapid	
Width:Mean Depth Ratio:	24.40	

Transect type:	EF site	
Stream width:	40	m
Number of stations:	14	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.2	m
Mean Velocity:	0.5	m*s ⁻¹
Cross-sectional area :	1.2	m ²
Mean Probability (Fry):	43.5	%
Mean Probability (Parr):	64.8	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	2.4	m
%Transect Usable by Fry	43.5	%
Usable Area for Fry	48.1	m ²
Usable Width Parr:	3.6	m
%Transect Usable by Parr	64.8	%
Usable Area for Parr	71.6	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.03	0.00
1.00	0.18	0.35
1.50	0.15	0.26
2.00	0.10	0.19
2.50	0.15	0.46
3.00	0.15	0.81
3.50	0.20	0.33
4.00	0.25	0.45
4.50	0.35	0.80
5.00	0.20	0.79
5.50	0.25	0.12
6.00	0.30	0.52
6.50	0.35	0.37

**APPENDIX B
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2008**

**Cheakamus River Rainbow Trout Survey, 2008
FISH CAPTURE SUMMARY FORM**

Golder Associates Ltd.

SITE 003 Cheakamus

Stream:	Cheakamus
Site number:	003
Site length:	17.0 m
Site width:	6.5 m
Site area:	110.5 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1210	1231	700	H5	751
Pass 2	1336	1353	700	H5	593
Pass 3	1419	1431	700	H5	442

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	19	4	2	25	0.8	39.6	25	17.8	0.44	41.0	0.010	0.32
<i>O. mykiss</i>	1+	1	0	0	1	12.8	112.0	1	0.7			0.000	0

ELECTROFISHING SITE DESCRIPTION FORM

SITE 004 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	004
Date:	11/09/2008
Surveyed by:	RH/AL/AL/MS
UTM:	10U 0489091 5534948

Hydraulic type:	riffle and pool
Mainstem/sidechannel (m/s,s/c):	m/s
Field gradient:	- %
Stream width:	35.0 m
Channel width:	65.0 m
Mean depth:	0.35 m
Maximum depth:	0.80 m
Mean velocity:	0.24 m*s ⁻¹
Maximum velocity:	1.00 m*s ⁻¹

Turbidity:	Med
Temperature (°C @ time):	@ 1300

Stream Stage:	Low
Conductivity:	- mS*cm ⁻¹

COVER:		
log:	0	%
boulder:	20	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	15	%
small gravel:	15	%
large gravel:	20	%
cobble:	30	%
boulder:	20	%
bedrock:	0	%

Compaction:	low
Sand (% of area):	- %
d90:	1.15 m
dMax:	0.35 m

Site length:	15.0 m
Site width:	10.5 m
Site area*:	157.5 m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 004 Cheakamus

Stream:	Cheakamus	
Date:	11/09/2008	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	10.5	m

Site length:	15.0	m
Site width:	10.5	m
Site area**:	157.5	m ²
Discharge:	0.699	m ³ *s ⁻¹

UTM:	10U 0489091 5534948
Watershed code:	900-097600-12900
Site number:	004
Transect #:	1

Hydraulic type:	riffle and pool
Width:Mean Depth Ratio:	31.52

Transect type:	EF site	
Stream width:	65	m
Number of stations:	20	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.3 m
Mean Velocity:	0.2 m*s ⁻¹
Cross-sectional area :	3.5 m ²
Mean Probability (Fry):	21.7 %
Mean Probability (Parr):	44.0 %

ADJUSTED USABLE AREAS

Usable Width for Fry:	2.3 m
%Transect Usable by Fry	21.7 %
Usable Area for Fry	34.2 m ²
Usable Width Parr:	4.6 m
%Transect Usable by Parr	44.0 %
Usable Area for Parr	69.3 m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.15	0.00
1.00	0.30	1.00
1.50	0.35	0.00
2.00	0.55	0.16
2.50	0.52	0.22
3.00	0.60	0.00
3.50	0.72	0.00
4.00	0.46	0.00
4.50	0.35	0.00
5.00	0.24	0.00
5.50	0.15	0.35
6.00	0.25	0.62
6.50	0.30	0.31
7.00	0.38	0.30
7.50	0.30	0.52
8.00	0.30	0.24
8.50	0.45	0.36
9.00	0.40	0.08
9.50	0.35	0.55

**APPENDIX B
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2008**

**Cheakamus River Rainbow Trout Survey, 2008
FISH CAPTURE SUMMARY FORM**

Golder Associates Ltd.

SITE 004 Cheakamus

Stream:	Cheakamus
Site number:	004
Site length:	15.0 m
Site width:	10.5 m
Site area:	157.5 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1310	1345	700	H5	835
Pass 2	1408	1431	700	H5	895
Pass 3	1500	1523	800	H5	600
Pass 4	1540	1600	800	H5	610

Species	Age	Pass 1	Pass 2	Pass 3	Pass 4	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	12	7	6	2	27	0.9	44.2	27	15	0.22	69.7	0.120	3.53
<i>Gasterosteus aculeatus</i>		2	3	2	0	7	2.6	63.3						

ELECTROFISHING SITE DESCRIPTION FORM

SITE 005 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	005
Date:	26/09/2008
Surveyed by:	AL/AL/RH
UTM:	0488160 5532967

Hydraulic type:	riffle
Mainstem/sidechannel (m/s,s/c):	m/s
Field gradient:	- %
Stream width:	40.0 m
Channel width:	50.0 m
Mean depth:	0.50 m
Maximum depth:	0.90 m
Mean velocity:	0.12 m*s ⁻¹
Maximum velocity:	0.66 m*s ⁻¹

Turbidity:	low-med
Temperature (°C @ time):	10.3 @ 0900

Stream Stage:	Low
Conductivity:	47 mS*cm ⁻¹

COVER:		
log:	20	%
boulder:	40	%
instream vegetation:	0	%
overstream vegetation:	20	%
cutbank:	20	%

SUBSTRATE:		
finer:	20	%
small gravel:	5	%
large gravel:	5	%
cobble:	40	%
boulder:	30	%
bedrock:	0	%

Compaction:	-
Sand (% of area):	- %
d90:	0.90 m
dMax:	0.35 m

Site length:	15.0	m
Site width:	10.0	m
Site area*:	150.0	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Robert Harrison, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 005 Cheakamus

Stream:	Cheakamus	
Date:	26/09/2008	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	10.0	m

Site length:	15.0	m
Site width:	10.0	m
Site area**:	150.0	m ²
Discharge:	0.229	m ³ *s ⁻¹

UTM:	488160	5532967
Watershed code:	900-097600-12900	
Site number:	005	
Transect #:	1	

Hydraulic type:	riffle	
Width:Mean Depth Ratio:	69.03	

Transect type:	EF site	
Stream width:	50	m
Number of stations:	21	

NOTES: * dfb = depth from bottom.

 ** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.1	m
Mean Velocity:	0.2	m*s ⁻¹
Cross-sectional area :	1.4	m ²
Mean Probability (Fry):	41.2	%
Mean Probability (Parr):	24.3	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	4.1	m
%Transect Usable by Fry	41.2	%
Usable Area for Fry	61.8	m ²
Usable Width Parr:	2.4	m
%Transect Usable by Parr	24.3	%
Usable Area for Parr	36.5	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.19	0.00
1.00	0.29	0.00
1.50	0.27	0.00
2.00	0.19	0.00
2.50	0.19	0.37
3.00	0.24	0.30
3.50	0.29	0.33
4.00	0.00	0.00
4.50	0.00	0.00
5.00	0.05	0.12
5.50	0.07	0.00
6.00	0.17	0.12
6.50	0.17	0.17
7.00	0.00	0.00
7.50	0.11	0.14
8.00	0.12	0.00
8.50	0.20	0.04
9.00	0.20	0.66
9.50	0.00	0.00
10.00	0.40	0.19

**APPENDIX B
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2008**

**Cheakamus River Rainbow Trout Survey, 2008
FISH CAPTURE SUMMARY FORM**

Golder Associates Ltd.

SITE 005 Cheakamus

Stream:	Cheakamus
Site number:	005
Site length:	15.0 m
Site width:	10.0 m
Site area:	150.0 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	0950	1015	700	H5	922
Pass 2	1135	1155	700	H5	783
Pass 3	1220	1240	700	H5	673
Pass 4	1250	1310	700	H5	597

Species	Age	Pass 1	Pass 2	Pass 3	Pass 4	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	17	12	4	3	36	0.7	44.3	36	23.7	0.41	57	0.070	2.53
<i>O. mykiss</i>	1+	20	0	1	0	21	4.2	91.8	21	13.8			0.000	0.03
<i>O. mykiss</i>	2+	2	0	0	0	2	16.4	135.0	2	1.3			0.000	0
<i>Cottus</i>		0	0	1	0	1	2.9	82.0						
<i>Gasterosteus aculeatus</i>		2	1	0	0	3	2.3	61.0						
<i>Salvelinus malma</i>		1	0	0	1	2	8.9	126.5						

ELECTROFISHING SITE DESCRIPTION FORM

SITE 006 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	006
Date:	26/09/2008
Surveyed by:	AL/AL/RH
UTM:	0488037 5532884

Hydraulic type:	run
Mainstem/sidechannel (m/s,s/c):	m/s
Field gradient:	- %
Stream width:	25.0 m
Channel width:	50.0 m
Mean depth:	0.40 m
Maximum depth:	1.00 m
Mean velocity:	0.09 m*s ⁻¹
Maximum velocity:	0.38 m*s ⁻¹

Turbidity:	mod
Temperature (°C @ time):	11.34 @ 1545

Stream Stage:	Low
Conductivity:	32 mS*cm ⁻¹

COVER:		
log:	1	%
boulder:	99	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	0	%
small gravel:	5	%
large gravel:	10	%
cobble:	45	%
boulder:	40	%
bedrock:	0	%

Compaction:	mod
Sand (% of area):	- %
d90:	0.80 m
dMax:	0.01 m

Site length:	21.0	m
Site width:	7.0	m
Site area*:	147.0	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Robert Harrison, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 006 Cheakamus

Stream:	Cheakamus	
Date:	26/09/2008	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	7.0	m

Site length:	21.0	m
Site width:	7.0	m
Site area**:	147.0	m ²
Discharge:	0.382	m ³ *s ⁻¹

UTM:	488037 5532884	
Watershed code:	900-097600-12900	
Site number:	006	
Transect #:	1	

Hydraulic type:	run	
Width:Mean Depth Ratio:	24.06	

Transect type:	EF site	
Stream width:	50	m
Number of stations:	16	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.3 m
Mean Velocity:	0.2 m*s ⁻¹
Cross-sectional area :	2.0 m ²
Mean Probability (Fry):	35.1 %
Mean Probability (Parr):	35.3 %

ADJUSTED USABLE AREAS

Usable Width for Fry:	2.5 m
%Transect Usable by Fry	35.1 %
Usable Area for Fry	51.5 m ²
Usable Width Parr:	2.5 m
%Transect Usable by Parr	35.3 %
Usable Area for Parr	51.8 m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.09	0.00
1.00	0.12	0.00
1.50	0.10	0.00
2.00	0.10	0.00
2.50	0.25	0.00
3.00	0.16	0.00
3.50	0.24	0.11
4.00	0.30	0.14
4.50	0.02	0.01
5.00	0.21	0.15
5.50	0.00	0.00
6.00	0.53	0.15
6.50	0.69	0.19
7.00	0.81	0.38
7.50	0.91	0.30

**APPENDIX B
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2008**

**Cheakamus River Rainbow Trout Survey, 2008
FISH CAPTURE SUMMARY FORM**

Golder Associates Ltd.

SITE 006 Cheakamus

Stream:	Cheakamus
Site number:	006
Site length:	21.0 m
Site width:	7.0 m
Site area:	147.0 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	0016	1630	700	H5	779
Pass 2	0017	1721	700	H5	687
Pass 3	1735	1752	700	H5	565
Pass 4	1800	1815	700	H5	528

Species	Age	Pass 1	Pass 2	Pass 3	Pass 4	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	22	4	4	2	32	0.5	46.7	32	26.7	0.35	76	0.030	0.89
<i>O. mykiss</i>	1+	7	1	2	0	10	4.4	84.0	10	8.3			0.040	0.41
<i>O. mykiss</i>	2+	1	1	0	0	2	23.3	150.0	2	1.7			0.090	0.19
<i>Cottus</i>		1	0	0	0	1	3.6	75.0						
<i>Gasterosteus aculeatus</i>		3	0	0	0	3	1.7	58.0						

ELECTROFISHING SITE DESCRIPTION FORM

SITE 007 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	007
Date:	27/09/2008
Surveyed by:	AL/AL/RH
UTM:	0487955 5532760

Hydraulic type:	riffle
Mainstem/sidechannel (m/s,s/c):	m/s
Field gradient:	- %
Stream width:	45.0 m
Channel width:	55.0 m
Mean depth:	0.30 m
Maximum depth:	0.50 m
Mean velocity:	0.21 m*s ⁻¹
Maximum velocity:	0.53 m*s ⁻¹

Turbidity:	low
Temperature (°C @ time):	10.39 @ 1050

Stream Stage:	low
Conductivity:	31 mS*cm ⁻¹

COVER:		
log:	0	%
boulder:	95	%
instream vegetation:	0	%
overstream vegetation:	5	%
cutbank:	0	%

SUBSTRATE:		
finer:	5	%
small gravel:	10	%
large gravel:	10	%
cobble:	50	%
boulder:	25	%
bedrock:	0	%

Compaction:	mod
Sand (% of area):	- %
d90:	80.00 m
dMax:	95.00 m

Site length:	19.6	m
Site width:	10.0	m
Site area*:	196.0	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Robert Harrison, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 007 Cheakamus

Stream:	Cheakamus	
Date:	27/09/2008	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	10.0	m

Site length:	19.6	m
Site width:	10.0	m
Site area**:	196.0	m ²
Discharge:	0.635	m ³ *s ⁻¹

UTM:	487955 5532760
Watershed code:	900-097600-12900
Site number:	007
Transect #:	1

Hydraulic type:	riffle
Width:Mean Depth Ratio:	44.57

Transect type:	EF site	
Stream width:	55	m
Number of stations:	22	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.2	m
Mean Velocity:	0.3	m*s ⁻¹
Cross-sectional area :	2.2	m ²
Mean Probability (Fry):	43.2	%
Mean Probability (Parr):	60.3	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	4.3	m
%Transect Usable by Fry	43.2	%
Usable Area for Fry	84.6	m ²
Usable Width Parr:	6.0	m
%Transect Usable by Parr	60.3	%
Usable Area for Parr	118.2	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.05	0.00
1.00	0.10	0.08
1.50	0.15	0.00
2.00	0.33	0.16
2.50	0.28	0.02
3.00	0.37	0.29
3.50	0.28	0.38
4.00	0.25	0.24
4.50	0.15	0.53
5.00	0.33	0.21
5.50	0.27	0.28
6.00	0.38	0.37
6.50	0.24	0.49
7.00	0.28	0.46
7.50	0.00	0.00
8.00	0.36	0.26
8.50	0.37	0.42
9.00	0.23	0.29
9.50	0.00	0.00
10.00	0.00	0.00
10.50	0.22	0.09

**APPENDIX B
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2008**

**Cheakamus River Rainbow Trout Survey, 2008
FISH CAPTURE SUMMARY FORM**

Golder Associates Ltd.

SITE 007 Cheakamus

Stream:	Cheakamus
Site number:	007
Site length:	19.6 m
Site width:	10.0 m
Site area:	196.0 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1100	1131	500	H5	823
Pass 2	1240	1257	500	H5	639
Pass 3	1318	1330	500	H5	592
Pass 4	1342	1356	500	H5	445

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	11	3	3	17	0.6	45.4	17	9.1	0.43	21	0.030	0.59
<i>O. mykiss</i>	1+	11	0	1	12	5.9	104.3	12	6.4			0.010	0.07
<i>Cottus</i>		2	0	0	2	12.3	93.5						

ELECTROFISHING SITE DESCRIPTION FORM

SITE 008 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	008
Date:	30/09/2008
Surveyed by:	AL/RH/MS
UTM:	487918 5532698

Hydraulic type:	riffle
Mainstem/sidechannel (m/s,s/c):	m/s
Field gradient:	- %
Stream width:	35.0 m
Channel width:	40.0 m
Mean depth:	0.30 m
Maximum depth:	0.70 m
Mean velocity:	0.07 m*s ⁻¹
Maximum velocity:	1.13 m*s ⁻¹

Turbidity:	Med
Temperature (°C @ time):	11.4 @ 1300

Stream Stage:	Low
Conductivity:	38 mS*cm ⁻¹

COVER:		
log:	0	%
boulder:	100	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	15	%
small gravel:	10	%
large gravel:	15	%
cobble:	25	%
boulder:	35	%
bedrock:	0	%

Compaction:	high
Sand (% of area):	- %
d90:	1.00 m
dMax:	1.50 m

Site length:	12x14.5x12 m
Site width:	triangle m
Site area*:	92.5 m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Robert Harrison, Golder Associates Limited, from one provided by Ron Ptolemy.
This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 008 Cheakamus

Stream:	Cheakamus	
Date:	30/09/2008	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	7.0	m

UTM:	487918 5532698	
Watershed code:	900-097600-12900	
Site number:	008	
Transect #:	1	

Hydraulic type:	riffle	
Width:Mean Depth Ratio:	12.54	

Site length:	12x14.5x12	m
Site width:	triangle	m
Site area**:	92.5	m ²
Discharge:	0.668	m ³ *s ⁻¹

Transect type:	EF site	
Stream width:	40	m
Number of stations:	27	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.6	m
Mean Velocity:	0.2	m*s ⁻¹
Cross-sectional area :	3.9	m ²
Mean Probability (Fry):	36.5	%
Mean Probability (Parr):	16.9	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	2.6	m
%Transect Usable by Fry	36.5	%
Usable Area for Fry	33.8	m ²
Usable Width Parr:	1.2	m
%Transect Usable by Parr	16.9	%
Usable Area for Parr	15.6	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.09	0.00
1.00	0.12	0.00
1.50	0.14	0.00
2.00	0.15	0.00
2.50	0.11	0.00
3.00	0.09	0.00
3.50	0.06	0.00
4.00	0.15	0.13
4.50	0.09	0.05
5.00	0.14	0.00
5.50	0.22	0.00
6.00	0.32	0.00
6.50	0.42	0.00
7.00	0.34	0.00
7.50	0.37	0.00
8.00	0.41	0.00
8.50	0.43	0.00
9.00	0.59	0.00
9.50	0.00	0.00
10.00	0.06	0.00
10.50	0.60	0.00
11.00	0.56	0.03
11.50	0.59	0.05
12.00	0.62	0.23
12.50	0.74	1.13
13.00	0.79	0.37

**APPENDIX B
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2008**

**Cheakamus River Rainbow Trout Survey, 2008
FISH CAPTURE SUMMARY FORM**

Golder Associates Ltd.

SITE 008 Cheakamus

Stream:	Cheakamus
Site number:	008
Site length:	12x14.5x12 m
Site width:	triangle m
Site area:	92.5 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	0952	1015	700	H5	558
Pass 2	1039	1115	700	H5	542
Pass 3	1135	1150	700	H5	517
Pass 4	1215	1225	700	H5	414

Species	Age	Pass 1	Pass 2	Pass 3	Pass 4	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	6	13	3	1	23	0.8	48.1	23	32.9	0.37	90	0.120	2.98
<i>O. mykiss</i>	1+	10	5	0	1	16	4.5	87.8	16	22.9			0.030	0.52
<i>Gasterosteus aculeatus</i>		4	3	0	0	7	0.8	56.0						
<i>Salvelinus malma</i>		0	0	1	0	1	12.3	122.0						

ELECTROFISHING SITE DESCRIPTION FORM

SITE 009 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	009
Date:	20/09/2008
Surveyed by:	AL/RH/MS
UTM:	487954 5532638

Hydraulic type:	run
Mainstem/sidechannel (m/s,s/c):	m/s
Field gradient:	- %
Stream width:	40.0 m
Channel width:	40.0 m
Mean depth:	0.45 m
Maximum depth:	0.70 m
Mean velocity:	0.47 m*s ⁻¹
Maximum velocity:	0.81 m*s ⁻¹

Turbidity:	mod
Temperature (°C @ time):	11.0 @ 1600

Stream Stage:	Low
Conductivity:	41 mS*cm ⁻¹

COVER:		
log:	2	%
boulder:	95	%
instream vegetation:	0	%
overstream vegetation:	3	%
cutbank:	0	%

SUBSTRATE:		
finer:	5	%
small gravel:	5	%
large gravel:	5	%
cobble:	10	%
boulder:	75	%
bedrock:	0	%

Compaction:	mod
Sand (% of area):	- %
d90:	0.70 m
dMax:	1.20 m

Site length:	18.5	m
Site width:	5.0	m
Site area*:	92.5	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Robert Harrison, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 009 Cheakamus

Stream:	Cheakamus	
Date:	20/09/2008	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	7.0	m

Site length:	18.5	m
Site width:	5.0	m
Site area**:	92.5	m ²
Discharge:	1.336	m ³ s ⁻¹

UTM:	487954 5532638	
Watershed code:	900-097600-12900	
Site number:	009	
Transect #:	1	

Hydraulic type:	run	
Width:Mean Depth Ratio:	19.04	

Transect type:	EF site	
Stream width:	40	m
Number of stations:	11	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.4	m
Mean Velocity:	0.5	m*s ⁻¹
Cross-sectional area :	2.6	m ²
Mean Probability (Fry):	12.6	%
Mean Probability (Parr):	62.6	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	0.9	m
%Transect Usable by Fry	12.6	%
Usable Area for Fry	11.7	m ²
Usable Width Parr:	4.4	m
%Transect Usable by Parr	62.6	%
Usable Area for Parr	57.9	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.25	0.18
1.00	0.55	0.39
1.50	0.56	0.34
2.00	0.48	0.56
2.50	0.47	0.64
3.00	0.55	0.58
3.50	0.58	0.41
4.00	0.62	0.64
4.50	0.68	0.65
5.00	0.70	0.81

APPENDIX B
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2008

Cheakamus River Rainbow Trout Survey, 2008
FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 009 Cheakamus

Stream:	Cheakamus
Site number:	009
Site length:	18.5 m
Site width:	5.0 m
Site area:	92.5 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1645	1704	500	H5	323
Pass 2	1720	1743	500	H5	496
Pass 3	1755	1808	500	H5	520

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	4	1	1	6	0.7	49.8	6	7.5	0.13	59	0.110	0.67
<i>O. mykiss</i>	1+	2	0	0	2	8.0	98.5	2	2.5			0.000	0
<i>Gasterosteus aculeatus</i>		0	1	0	0	0.7	60.0						
<i>Salvelinus malma</i>		1	0	0	0	12.3	122.0						

ELECTROFISHING SITE DESCRIPTION FORM

SITE 010 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	010
Date:	25/09/2008
Surveyed by:	AL/AL/RH
UTM:	0487930 5532077

Hydraulic type:	riffle/rapid
Mainstem/sidechannel (m/s,s/c):	m/s
Field gradient:	- %
Stream width:	40.0 m
Channel width:	65.0 m
Mean depth:	0.65 m
Maximum depth:	1.20 m
Mean velocity:	0.20 m*s ⁻¹
Maximum velocity:	0.58 m*s ⁻¹

Turbidity:	Med
Temperature (°C @ time):	10.5 @ 1030

Stream Stage:	Low
Conductivity:	37 mS*cm ⁻¹

COVER:		
log:	5	%
boulder:	95	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	0	%
small gravel:	1	%
large gravel:	1	%
cobble:	3	%
boulder:	95	%
bedrock:	0	%

Compaction:	Med
Sand (% of area):	0 %
d90:	1.60 m
dMax:	2.90 m

Site length:	18.5	m
Site width:	10.0	m
Site area*:	185.0	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Robert Harrison, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 010 Cheakamus

Stream:	Cheakamus	
Date:	25/09/2008	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	7.0	m

Site length:	18.5	m
Site width:	10.0	m
Site area**:	185.0	m ²
Discharge:	0.480	m ³ *s ⁻¹

UTM:	487930 5532077	
Watershed code:	900-097600-12900	
Site number:	010	
Transect #:	1	

Hydraulic type:	riffle/rapid	
Width:Mean Depth Ratio:	22.05	

Transect type:	EF site	
Stream width:	65	m
Number of stations:	21	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.3	m
Mean Velocity:	0.2	m*s ⁻¹
Cross-sectional area :	2.2	m ²
Mean Probability (Fry):	50.5	%
Mean Probability (Parr):	57.1	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	3.5	m
%Transect Usable by Fry	50.5	%
Usable Area for Fry	93.4	m ²
Usable Width Parr:	4.0	m
%Transect Usable by Parr	57.1	%
Usable Area for Parr	105.6	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.15	0.50
1.00	0.00	0.00
1.50	0.00	0.00
2.00	0.05	0.17
2.50	0.92	0.08
3.00	0.35	0.11
3.50	0.00	0.00
4.00	0.27	0.19
4.50	0.00	0.00
5.00	0.10	0.15
5.50	0.52	0.03
6.00	0.52	0.18
6.50	0.52	0.44
7.00	0.22	0.48
7.50	0.28	0.25
8.00	0.20	0.05
8.50	0.05	0.44
9.00	0.00	0.00
9.50	0.17	0.58
10.00	0.18	0.45

**APPENDIX B
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2008**

**Cheakamus River Rainbow Trout Survey, 2008
FISH CAPTURE SUMMARY FORM**

Golder Associates Ltd.

SITE 010 Cheakamus

Stream:	Cheakamus
Site number:	010
Site length:	18.5 m
Site width:	10.0 m
Site area:	185.0 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1057	1100	800	H5	1205
Pass 2	1258	1345	800	H5	914
Pass 3	1335	1350	800	H5	686
Pass 4	1425	1443	800	H5	667

Species	Age	Pass 1	Pass 2	Pass 3	Pass 4	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	0	3	0	0	3	2.0	57.3	3	2.9	0.51	6	0.230	0.68
<i>O. mykiss</i>	1+	7	3	0	1	11	9.4	105.3	11	10.8			0.050	0.5
<i>O. mykiss</i>	2+	5	4	0	1	10	31.3	155.8	10	9.8			0.070	0.71
<i>S. fontinalis</i>		1	0	0	0	1	29.0	170.0						



APPENDIX C

Site Description, Depth-Velocity Transect and Fish Capture Data 2009

ELECTROFISHING SITE DESCRIPTION FORM

SITE 001 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	001
Date:	28/09/2009
Surveyed by:	RH/RH/AL/AL
UTM:	10 U 489638 5535581

Hydraulic type:	Run & riffle
Mainstem/sidechannel (m/s,s/c):	mstm
Field gradient:	1.0 %
Stream width:	55.0 m
Channel width:	65.0 m
Mean depth:	0.50 m
Maximum depth:	0.90 m
Mean velocity:	0.14 m*s ⁻¹
Maximum velocity:	0.31 m*s ⁻¹

Turbidity:	med
Temperature (°C @ time):	9.57 @ 1530

Stream Stage:	Low
Conductivity:	49.0 mS*cm ⁻¹

COVER:		
log:	10	%
boulder:	50	%
instream vegetation:	0	%
overstream vegetation:	40	%
cutbank:	0	%

SUBSTRATE:		
finer:	5	%
small gravel:	5	%
large gravel:	10	%
cobble:	30	%
boulder:	50	%
bedrock:	0	%

Compaction:	low
Sand (% of area):	%
d90:	0.70 m
dMax:	0.90 m

Site length:	20.0	m
Site width:	6.5	m
Site area*:	130.0	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Robert Harrison, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 001 Cheakamus

Stream:	Cheakamus	
Date:	28/09/2009	
Mainstem/side-channel:	side	
Meter:	Flow Meter	
Metered at*:	40%	dfb
Transect width:	6.5	m

Site length:	20.0	m
Site width:	6.5	m
Site area**:	130.0	m ²
Discharge:	0.488	m ³ *s ⁻¹

UTM:	10 U 489638 5535581	
Watershed code:	900-097600-12900	
Site number:	001	
Transect #:	1	

Hydraulic type:	Run & riffle	
Width:Mean Depth Ratio:	13.00	

Transect type:	CS	
Stream width:	65	m
Number of stations:	14	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.5	m
Mean Velocity:	0.2	m*s ⁻¹
Cross-sectional area :	2.8	m ²
Mean Probability (Fry):	30.3	%
Mean Probability (Parr):	55.1	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	2.0	m
%Transect Usable by Fry	30.3	%
Usable Area for Fry	39.4	m ²
Usable Width Parr:	3.6	m
%Transect Usable by Parr	55.1	%
Usable Area for Parr	71.7	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.17	0.00
1.00	0.21	0.00
1.50	0.24	0.11
2.00	0.17	0.31
2.50	0.61	0.26
3.00	0.73	0.27
3.50	0.73	0.17
4.00	0.76	0.10
4.50	0.68	0.13
5.00	0.62	0.28
5.50	0.36	0.21
6.00	0.25	0.00
6.50	0.06	0.07

**APPENDIX C
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2009**

**Cheakamus River Rainbow Trout Survey, 2009
FISH CAPTURE SUMMARY FORM**

Golder Associates Ltd.

SITE 001 Cheakamus

Stream:	Cheakamus
Site number:	001
Site length:	20.0 m
Site width:	6.5 m
Site area:	130.0 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1615	1645	700	I6	754
Pass 2	1710	1745	700	I6	779
Pass 3	1800	1820	700	I6	548

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	6	3	0	9	1.4	48.7	9	6.9	0.30	22.8	0.023	0.20278658
<i>O. mykiss</i>	1+	4	0	0	4	21.5	122.3	4	3.1			0.000	0
<i>O. mykiss</i>	2+	2	0	0	2	43.2	155.0	2	1.5			0.000	0
<i>Cottus</i>		10	8	8	26	9.9	83.2						
<i>Gasterosteus aculeatus</i>		1	0	0	1	1.5	52.0						

ELECTROFISHING SITE DESCRIPTION FORM

SITE 002 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	002
Date:	28/09/2009
Surveyed by:	RH/RH/AL/AL
UTM:	0489649 5535497

Hydraulic type:	Riffle & pool
Mainstem/sidechannel (m/s,s/c):	s/c
Field gradient:	2.5 %
Stream width:	30.0 m
Channel width:	65.0 m
Mean depth:	0.40 m
Maximum depth:	0.70 m
Mean velocity:	0.25 m*s ⁻¹
Maximum velocity:	0.50 m*s ⁻¹

Turbidity:	Med
Temperature (°C @ time):	10.15 @ 0930

Stream Stage:	Low
Conductivity:	61 mS*cm ⁻¹

COVER:		
log:	10	%
boulder:	80	%
instream vegetation:	0	%
overstream vegetation:	10	%
cutbank:	0	%

SUBSTRATE:		
finer:	5	%
small gravel:	10	%
large gravel:	15	%
cobble:	35	%
boulder:	35	%
bedrock:	0	%

Compaction:	low
Sand (% of area):	0 %
d90:	0.70 m
dMax:	1.20 m

Site length:	22.0 m
Site width:	8.5 m
Site area*:	187.0 m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Robert Harrison, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 002 Cheakamus

Stream:	Cheakamus	
Date:	28/09/2009	
Mainstem/side-channel:	s/c	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	8.1	m

Site length:	22.0	m
Site width:	8.5	m
Site area**:	187.0	m ²
Discharge:	0.565	m ³ *s ⁻¹

UTM:	489649 5535497	
Watershed code:	900-097600-12900	
Site number:	002	
Transect #:	1	

Hydraulic type:	Riffle & pool	
Width:Mean Depth Ratio:	29.95	

Transect type:	EF site	
Stream width:	65	m
Number of stations:	18	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.3	m
Mean Velocity:	0.3	m*s ⁻¹
Cross-sectional area :	2.2	m ²
Mean Probability (Fry):	36.4	%
Mean Probability (Parr):	61.7	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	2.9	m
%Transect Usable by Fry	36.4	%
Usable Area for Fry	68.0	m ²
Usable Width Parr:	5.0	m
%Transect Usable by Parr	61.7	%
Usable Area for Parr	115.4	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.13	0.00
1.00	0.27	0.10
1.50	0.32	0.24
2.00	0.54	0.12
2.50	0.53	0.31
3.00	0.07	0.41
3.50	0.28	0.50
4.00	0.45	0.33
4.50	0.35	0.31
5.00	0.28	0.38
5.50	0.32	0.30
6.00	0.24	0.40
6.50	0.24	0.30
7.00	0.19	0.00

**APPENDIX C
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2009**

**Cheakamus River Rainbow Trout Survey, 2009
FISH CAPTURE SUMMARY FORM**

Golder Associates Ltd.

SITE 002 Cheakamus

Stream:	Cheakamus
Site number:	002
Site length:	22.0 m
Site width:	8.5 m
Site area:	187.0 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1042	1120	700	15	1105
Pass 2	1220	1250	700	15	878
Pass 3	1320	1338	700	15	835
Pass 4	1350	1415	700	15	791

Species	Age	Pass 1	Pass 2	Pass 3	Pass 4	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	19	4	2	3	28	2.0	51.5	28	15.0	0.36	41.1	0.034	0.94493175
<i>O. mykiss</i>	1+	12	1	0	0	13	16.2	112.5	13	7.0			0.001	0.01844234
<i>O. mykiss</i>	2+	3	0	0	0	3	50.1	164.0	3	1.6			0.000	0
<i>O. mykiss</i>	3+	3	3	0	0	6	73.5	189.5	6	3.2			0.053	0.32053035
<i>Cottus</i>		9	3	4	3	19	10.5	86.6						
<i>Gasterosteus aculeatus</i>		0	2	1	0	3	3.6	61.0						

ELECTROFISHING SITE DESCRIPTION FORM

SITE 003 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	003
Date:	25/09/2009
Surveyed by:	RH/RH/AL/AL
UTM:	0489122 5534130

Hydraulic type:	riffle
Mainstem/sidechannel (m/s,s/c):	m/s
Field gradient:	- %
Stream width:	45.0 m
Channel width:	50.0 m
Mean depth:	0.25 m
Maximum depth:	0.70 m
Mean velocity:	0.50 m*s ⁻¹
Maximum velocity:	1.11 m*s ⁻¹

Turbidity:	low
Temperature (°C @ time):	11.0 @ 1500

Stream Stage:	Low
Conductivity:	- mS*cm ⁻¹

COVER:		
log:	5	%
boulder:	95	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	5	%
small gravel:	15	%
large gravel:	20	%
cobble:	30	%
boulder:	30	%
bedrock:	0	%

Compaction:	low
Sand (% of area):	0 %
d90:	0.70 m
dMax:	1.70 m

Site length:	16.5	m
Site width:	6.5	m
Site area*:	107.3	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Robert Harrison, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 003 Cheakamus

Stream:	Cheakamus	
Date:	25/09/2009	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity	
Metered at*:	40%	dfb
Transect width:	6.0	m

Site length:	16.5	m
Site width:	6.5	m
Site area**:	107.3	m ²
Discharge:	0.613	m ³ *s ⁻¹

UTM:	489122 5534130
Watershed code:	900-097600-12900
Site number:	003
Transect #:	1

Hydraulic type:	riffle
Width:Mean Depth Ratio:	35.29

Transect type:	EF site	
Stream width:	50	m
Number of stations:	13	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.2 m
Mean Velocity:	0.6 m*s ⁻¹
Cross-sectional area :	1.0 m ²
Mean Probability (Fry):	30.2 %
Mean Probability (Parr):	46.0 %

ADJUSTED USABLE AREAS

Usable Width for Fry:	1.8 m
%Transect Usable by Fry	30.2 %
Usable Area for Fry	32.4 m ²
Usable Width Parr:	2.8 m
%Transect Usable by Parr	46.0 %
Usable Area for Parr	49.3 m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.07	0.15
1.00	0.07	0.37
1.50	0.20	0.36
2.00	0.13	0.17
2.50	0.16	0.75
3.00	0.22	0.87
3.50	0.27	0.85
4.00	0.28	0.54
4.50	0.33	0.73
5.00	0.22	0.55
5.50	0.00	0.00
6.00	0.29	1.11

**APPENDIX C
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2009**

**Cheakamus River Rainbow Trout Survey, 2009
FISH CAPTURE SUMMARY FORM**

Golder Associates Ltd.

SITE 003 Cheakamus

Stream:	Cheakamus
Site number:	003
Site length:	16.5 m
Site width:	6.5 m
Site area:	107.3 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1510	1535	600	I6	669
Pass 2	1607	1630	600	I6	747
Pass 3	1648	1705	600	I6	605
Pass 4	1720	1738	600	I6	649

Species	Age	Pass 1	Pass 2	Pass 3	Pass 4	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	39	7	5	1	52	1.7	47.8	52	48.5	0.30	160.5	0.012	0.61667788
<i>O. mykiss</i>	1+	4	1	0	0	5	12.2	103.6	5	4.7			0.013	0.06380226

ELECTROFISHING SITE DESCRIPTION FORM

SITE 004 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	004
Date:	25/09/2009
Surveyed by:	RH/RH/AL/AL
UTM:	10U 0489061 5535980

Hydraulic type:	riffle and pool
Mainstem/sidechannel (m/s,s/c)	m/s
Field gradient:	2.0 %
Stream width:	30.0 m
Channel width:	55.0 m
Mean depth:	0.40 m
Maximum depth:	1.90 m
Mean velocity:	0.20 m*s ⁻¹
Maximum velocity:	0.53 m*s ⁻¹

Turbidity:	Med
Temperature (°C @ time):	9.0 @ 1115

Stream Stage:	Low
Conductivity:	- mS*cm ⁻¹

COVER:		
log:	0	%
boulder:	100	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	5	%
small gravel:	5	%
large gravel:	15	%
cobble:	45	%
boulder:	30	%
bedrock:	0	%

Compaction:	low
Sand (% of area):	5 %
d90:	1.20 m
dMax:	0.28 m

Site length:	16.5	m
Site width:	9.5	m
Site area*:	156.8	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 004 Cheakamus

Stream:	Cheakamus	
Date:	25/09/2009	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	9.0	m

UTM:	10U 0489061 5535980	
Watershed code:	900-097600-12900	
Site number:	004	
Transect #:	1	

Hydraulic type:	riffle and pool	
Width:Mean Depth Ratio:	28.09	

Site length:	16.5	m
Site width:	9.5	m
Site area**:	156.8	m ²
Discharge:	0.573	m ³ s ⁻¹

Transect type:	EF site	
Stream width:	55	m
Number of stations:	19	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.3	m
Mean Velocity:	0.2	m*s ⁻¹
Cross-sectional area :	2.9	m ²
Mean Probability (Fry):	48.0	%
Mean Probability (Parr):	60.3	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	4.3	m
%Transect Usable by Fry	48.0	%
Usable Area for Fry	75.3	m ²
Usable Width Parr:	5.4	m
%Transect Usable by Parr	60.3	%
Usable Area for Parr	94.5	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.07	0.07
1.00	0.15	0.09
1.50	0.08	0.12
2.00	0.32	0.13
2.50	0.51	0.17
3.00	0.55	0.17
3.50	0.59	0.11
4.00	0.40	0.12
4.50	0.39	0.15
5.00	0.07	0.35
5.50	0.15	0.39
6.00	0.38	0.23
6.50	0.36	0.28
7.00	0.45	0.32
7.50	0.24	0.53
8.00	0.40	0.00
8.50	0.42	0.29
9.00	0.46	0.25

APPENDIX C
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2009

Cheakamus River Rainbow Trout Survey, 2009
FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 004 Cheakamus

Stream:	Cheakamus
Site number:	004
Site length:	16.5 m
Site width:	9.5 m
Site area:	156.8 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1020	1107	600	I6	876
Pass 2	1130	1157	600	I6	736
Pass 3	1215	1239	600	I6	711
Pass 4	1258	1320	600	I6	672

Species	Age	Pass 1	Pass 2	Pass 3	Pass 4	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	43	15	5	4	67	1.8	50.8	68	43	0.48	89.0	0.022	1.49116337
<i>O. mykiss</i>	1+	5	3	0	2	10	13.0	101.7	10	6			0.105	1.05349469
<i>Cottus</i>		0	1	0	0	1	4.3	63.0	1					
<i>Gasterosteus aculeatus</i>		1	1	0	0	2	1.4	48.0	2					

ELECTROFISHING SITE DESCRIPTION FORM

SITE 005 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	005
Date:	24/09/2009
Surveyed by:	RH/RH/AL/AL
UTM:	10U 488115 5532998

Hydraulic type:	rifle and pool
Mainstem/sidechannel (m/s,s/c)	m/s
Field gradient:	1.0 %
Stream width:	45.0 m
Channel width:	55.0 m
Mean depth:	0.30 m
Maximum depth:	0.70 m
Mean velocity:	0.14 m*s ⁻¹
Maximum velocity:	0.31 m*s ⁻¹

Turbidity:	low-med
Temperature (°C @ time):	11.0 @ 1600

Stream Stage:	Low
Conductivity:	- mS*cm ⁻¹

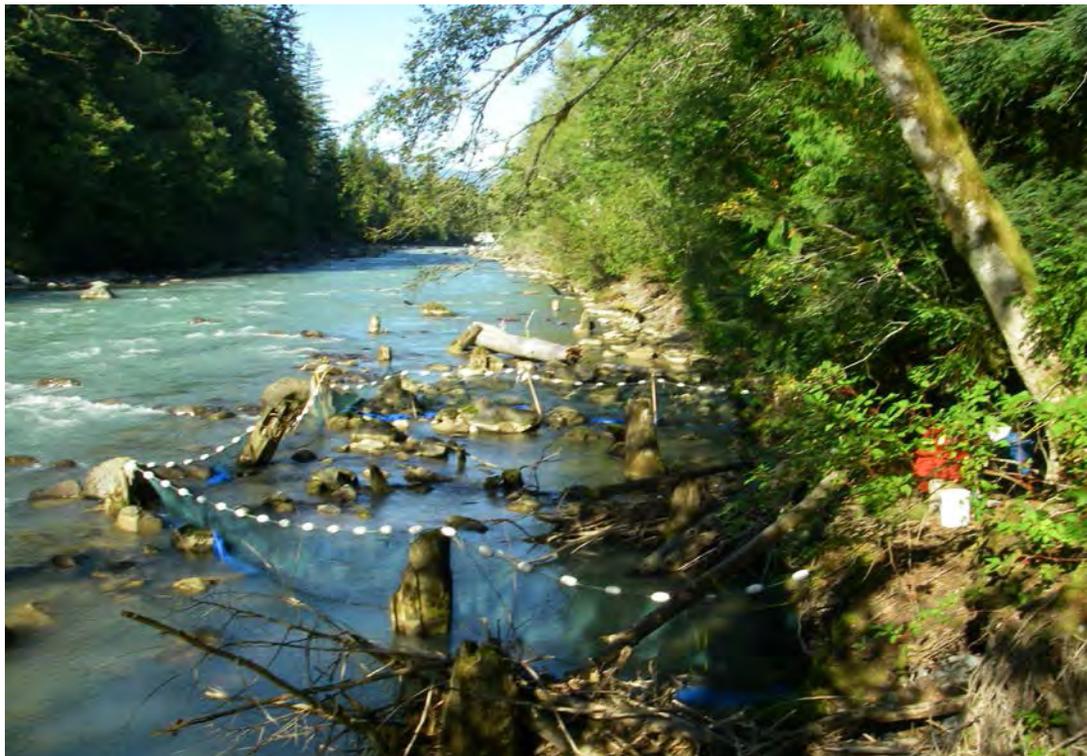
COVER:		
log:	25	%
boulder:	60	%
instream vegetation:	0	%
overstream vegetation:	5	%
cutbank:	10	%

SUBSTRATE:		
finer:	5	%
small gravel:	5	%
large gravel:	10	%
cobble:	60	%
boulder:	20	%
bedrock:	0	%

Compaction:	low
Sand (% of area):	0 %
d90:	- m
dMax:	- m

Site length:	12.0	m
Site width:	10.0	m
Site area*:	120.0	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



APPENDIX C
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2009

DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Robert Harrison, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 005 Cheakamus

Stream:	Cheakamus	
Date:	24/09/2009	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	10.0	m

Site length:	12.0	m
Site width:	10.0	m
Site area**:	120.0	m ²
Discharge:	0.330	m ³ *s ⁻¹

UTM:	10U 488115 5532998
Watershed code:	900-097600-12900
Site number:	005
Transect #:	1

Hydraulic type:	riffle and pool
Width:Mean Depth Ratio:	43.29

Transect type:	EF site	
Stream width:	55	m
Number of stations:	21	

NOTES: * dfb = depth from bottom.

 ** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.2	m
Mean Velocity:	0.1	m*s ⁻¹
Cross-sectional area :	2.3	m ²
Mean Probability (Fry):	64.9	%
Mean Probability (Parr):	46.6	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	6.5	m
%Transect Usable by Fry	64.9	%
Usable Area for Fry	77.9	m ²
Usable Width Parr:	4.7	m
%Transect Usable by Parr	46.6	%
Usable Area for Parr	55.9	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.08	0.01
1.00	0.12	0.01
1.50	0.16	0.29
2.00	0.22	0.26
2.50	0.35	0.08
3.00	0.32	0.11
3.50	0.33	0.31
4.00	0.24	0.28
4.50	0.25	0.24
5.00	0.23	0.18
5.50	0.23	0.15
6.00	0.20	0.16
6.50	0.15	0.19
7.00	0.04	0.00
7.50	0.22	0.10
8.00	0.08	0.28
8.50	0.12	0.00
9.00	0.49	0.07
9.50	0.53	0.06
10.00	0.43	0.06

APPENDIX C
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2009

Cheakamus River Rainbow Trout Survey, 2009
FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 005 Cheakamus

Stream:	Cheakamus	
Site number:	005	
Site length:	12.0	m
Site width:	10.0	m
Site area:	120.0	m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1600	1626	600	I6	738
Pass 2	1700	1725	700	I6	716
Pass 3	1750	1815	700	I6	542
Pass 4	1835	1855	700	I6	581

Species	Age	Pass 1	Pass 2	Pass 3	Pass 4	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	23	15	4	8	50	2.2	53.6	57	41.7	0.65	64	0.098	5.6054225
<i>O. mykiss</i>	1+	3	7	0	5	15	12.4	103.5	16	12.5			0.233	3.72193575
<i>Salvelinus fontinalis</i>		1	1	1	0	3	15.6	106.7	3					
<i>Gasterosteus aculeatus</i>		1	0	0	0	1	2.1	50.0	1					

ELECTROFISHING SITE DESCRIPTION FORM

SITE 006 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	006
Date:	24/09/2009
Surveyed by:	RH/RH/AL/AL
UTM:	10U 488047 5532897

Hydraulic type:	cascade / pool	
Mainstem/sidechannel (m/s,s/c)	m/s	
Field gradient:	1.5	%
Stream width:	25.0	m
Channel width:	50.0	m
Mean depth:	0.50	m
Maximum depth:	1.00	m
Mean velocity:	0.11	m*s ⁻¹
Maximum velocity:	0.41	m*s ⁻¹

Turbidity:	mod
Temperature (°C @ time):	11.0 @ 0935

Stream Stage:	Low
Conductivity:	- mS*cm ⁻¹

COVER:		
log:	0	%
boulder:	100	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	0	%
small gravel:	5	%
large gravel:	5	%
cobble:	70	%
boulder:	20	%
bedrock:	0	%

Compaction:	mod
Sand (% of area):	0 %
d90:	0.90 m
dMax:	1.60 m

Site length:	22.0	m
Site width:	9.5	m
Site area*:	209.0	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Robert Harrison, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 006 Cheakamus

Stream:	Cheakamus	
Date:	24/09/2009	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	9.5	m

UTM:	10U 488047 5532897
Watershed code:	900-097600-12900
Site number:	006
Transect #:	1

Hydraulic type:	cascade / pool
Width:Mean Depth Ratio:	30.58

Site length:	22.0	m
Site width:	9.5	m
Site area**:	209.0	m ²
Discharge:	0.562	m ³ *s ⁻¹

Transect type:	EF site	
Stream width:	50	m
Number of stations:	20	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.3	m
Mean Velocity:	0.2	m*s ⁻¹
Cross-sectional area :	3.0	m ²
Mean Probability (Fry):	39.2	%
Mean Probability (Parr):	41.7	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	3.7	m
%Transect Usable by Fry	39.2	%
Usable Area for Fry	81.9	m ²
Usable Width Parr:	4.0	m
%Transect Usable by Parr	41.7	%
Usable Area for Parr	87.2	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.07	0.00
1.00	0.05	0.00
1.50	0.04	0.00
2.00	0.08	0.00
2.50	0.16	0.00
3.00	0.11	0.00
3.50	0.00	0.00
4.00	0.31	0.08
4.50	0.22	0.11
5.00	0.30	0.14
5.50	0.35	0.16
6.00	0.32	0.18
6.50	0.29	0.14
7.00	0.33	0.15
7.50	0.33	0.00

**APPENDIX C
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2009**

**Cheakamus River Rainbow Trout Survey, 2009
FISH CAPTURE SUMMARY FORM**

Golder Associates Ltd.

SITE 006 Cheakamus

Stream:	Cheakamus
Site number:	006
Site length:	22.0 m
Site width:	9.5 m
Site area:	209.0 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1105	1130	500	I6	801
Pass 2	1210	1245	600	I6	946
Pass 3	1320	1345	600	I6	753
Pass 4	1355	1412	600	I6	583

Species	Age	Pass 1	Pass 2	Pass 3	Pass 4	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	37	31	22	0	90	1.9	52.7	98	43.1	0.39	110	0.052	5.1080856
<i>O. mykiss</i>	1+	3	0	1	0	4	15.8	120.0	4	1.9			0.065	0.2617119

ELECTROFISHING SITE DESCRIPTION FORM

SITE 007 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	007
Date:	23/09/2009
Surveyed by:	RH/RH/AL/AL
UTM:	10U 487864 5532705

Hydraulic type:	riffle
Mainstem/sidechannel (m/s,s/c)	m/s
Field gradient:	2.5 %
Stream width:	50.0 m
Channel width:	60.0 m
Mean depth:	0.40 m
Maximum depth:	0.60 m
Mean velocity:	0.36 m*s ⁻¹
Maximum velocity:	0.63 m*s ⁻¹

Turbidity:	mod
Temperature (°C @ time):	10.0 @ 1200

Stream Stage:	low
Conductivity:	- mS*cm ⁻¹

COVER:		
log:	0	%
boulder:	98	%
instream vegetation:	0	%
overstream vegetation:	2	%
cutbank:	0	%

SUBSTRATE:		
finer:	2	%
small gravel:	3	%
large gravel:	15	%
cobble:	50	%
boulder:	30	%
bedrock:	0	%

Compaction:	mod
Sand (% of area):	0 %
d90:	0.80 m
dMax:	0.95 m

Site length:	19.7	m
Site width:	11.2	m
Site area*:	220.6	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Robert Harrison, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 007 Cheakamus

Stream:	Cheakamus	
Date:	23/09/2009	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	11.5	m

UTM:	10U 487864 5532705	
Watershed code:	900-097600-12900	
Site number:	007	
Transect #:	1	

Hydraulic type:	riffle	
Width:Mean Depth Ratio:	40.17	

Site length:	19.7	m
Site width:	11.2	m
Site area**:	220.6	m ²
Discharge:	1.346	m ³ s ⁻¹

Transect type:	EF site	
Stream width:	60	m
Number of stations:	24	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.3	m
Mean Velocity:	0.4	m*s ⁻¹
Cross-sectional area :	3.3	m ²
Mean Probability (Fry):	29.9	%
Mean Probability (Parr):	80.4	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	3.4	m
%Transect Usable by Fry	29.9	%
Usable Area for Fry	66.0	m ²
Usable Width Parr:	9.2	m
%Transect Usable by Parr	80.4	%
Usable Area for Parr	177.3	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.06	0.00
1.00	0.08	0.00
1.50	0.13	0.28
2.00	0.30	0.31
2.50	0.31	0.27
3.00	0.35	0.26
3.50	0.36	0.25
4.00	0.37	0.56
4.50	0.26	0.61
5.00	0.26	0.55
5.50	0.41	0.46
6.00	0.44	0.41
6.50	0.36	0.21
7.00	0.35	0.58
7.50	0.42	0.45
8.00	0.19	0.55
8.50	0.37	0.63
9.00	0.38	0.49
9.50	0.15	0.42
10.00	0.32	0.33
10.50	0.29	0.19

**APPENDIX II - SITE 7
TROUT ABUNDANCE MONITOR, CHEAKAMUS RIVER, 2009**

**Cheakamus River Rainbow Trout Survey, 2009
FISH CAPTURE SUMMARY FORM**

Golder Associates Ltd.

SITE 007 Cheakamus

Stream:	Cheakamus	
Site number:	007	
Site length:	19.7	m
Site width:	11.2	m
Site area:	220.6	m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1300	1338	500	I6	1387
Pass 2	1515	1543	1000	I6	1308
Pass 3	1620	1642	1000	I6	832
Pass 4	1650	1710	1000	I6	585

Species	Age	Pass 1	Pass 2	Pass 3	Pass 4	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	14	10	13	3	40	0.9	51.8	52	18.1	0.30	61	0.204	10.59854698
<i>O. mykiss</i>	1+	8	0	0	0	8	14.4	120.3	8	3.6			0.000	0
<i>Salvelinus fontinalis</i>		2	2	0	0	4	54.1	166.5	4					
<i>Cottus</i>		1	0	0	0	1	2.6	59.0	1					
<i>Gasterosteus aculeatus</i>		1	0	0	0	1	1.3	41.0	1					

ELECTROFISHING SITE DESCRIPTION FORM

SITE 008 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	008
Date:	29/09/2009
Surveyed by:	RH/RH/AL/AL
UTM:	10U 487923 553296

Hydraulic type:	riffle / pool
Mainstem/sidechannel (m/s,s/c):	m/s
Field gradient:	1.5 %
Stream width:	35.0 m
Channel width:	45.0 m
Mean depth:	0.40 m
Maximum depth:	0.90 m
Mean velocity:	0.06 m*s ⁻¹
Maximum velocity:	0.43 m*s ⁻¹

Turbidity:	Med
Temperature (°C @ time):	8.7 @ 1200

Stream Stage:	Low
Conductivity:	43 mS*cm ⁻¹

COVER:		
log:	0	%
boulder:	95	%
instream vegetation:	0	%
overstream vegetation:	5	%
cutbank:	0	%

SUBSTRATE:		
finer:	5	%
small gravel:	10	%
large gravel:	15	%
cobble:	40	%
boulder:	30	%
bedrock:	0	%

Compaction:	mod
Sand (% of area):	- %
d90:	0.65 m
dMax:	1.10 m

Site length:	16.0 m
Site width:	10.0 m
Site area*:	80.0 m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



APPENDIX C
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2009

DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Robert Harrison, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 008 Cheakamus

Stream:	Cheakamus	
Date:	29/09/2009	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	12.0	m

Site length:	16.0	m
Site width:	10.0	m
Site area**:	80.0	m ²
Discharge:	0.263	m ³ *s ⁻¹

UTM:	10U 487923	553296
Watershed code:	900-097600-12900	
Site number:	008	
Transect #:	1	

Hydraulic type:	riffle / pool	
Width:Mean Depth Ratio:	34.84	

Transect type:	EF site	
Stream width:	45	m
Number of stations:	25	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.3	m
Mean Velocity:	0.1	m*s ⁻¹
Cross-sectional area :	4.1	m ²
Mean Probability (Fry):	22.5	%
Mean Probability (Parr):	16.7	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	2.7	m
%Transect Usable by Fry	22.5	%
Usable Area for Fry	18.0	m ²
Usable Width Parr:	2.0	m
%Transect Usable by Parr	16.7	%
Usable Area for Parr	13.3	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.07	0.00
1.00	0.09	0.07
1.50	0.07	0.43
2.00	0.18	0.00
2.50	0.13	0.06
3.00	0.16	0.00
3.50	0.11	0.00
4.00	0.19	0.00
4.50	0.00	0.00
5.00	0.24	0.02
5.50	0.29	0.00
6.00	0.43	0.00
6.50	0.49	0.00
7.00	0.54	0.00
7.50	0.49	0.00
8.00	0.58	0.00
8.50	0.46	0.00
9.00	0.58	0.00
9.50	0.60	0.05
10.00	0.50	0.04
10.50	0.53	0.13
11.00	0.58	0.14
11.50	0.60	0.28
12.00	0.76	0.36

APPENDIX C
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2009

Cheakamus River Rainbow Trout Survey, 2009
FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 008 Cheakamus

Stream:	Cheakamus
Site number:	008
Site length:	16.0 m
Site width:	10.0 m
Site area:	80.0 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1050	1122	700	16	900
Pass 2	1210	1234	700	16	829
Pass 3	1250	1328	700	16	716
Pass 4	1347	1401	700	15	529

Species	Age	Pass 1	Pass 2	Pass 3	Pass 4	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	44	15	6	6	71	0.7	51.9	73	88.8	0.23	394	0.029	2.11843467
<i>O. mykiss</i>	1+	3	1	0	0	4	5.4	107.8	4	5.0			0.021	0.08357176
<i>Salvelinus fontinalis</i>		3	0	1	0	4	9.4	119.0	4					
<i>Cottus</i>		1	0	0	0	1	2.1	69.0	1					
<i>Gasterosteus aculeatus</i>		2	0	0	0	2	1.0	49.0	2					

ELECTROFISHING SITE DESCRIPTION FORM

SITE 009 Cheakamus

Stream:	Cheakamus	
Watershed code:	900-097600-12900	
Site number:	009	
Date:	29/09/2009	
Surveyed by:	RH/RH/AL/AL	
UTM:	10U 487954	5532638

Hydraulic type:	run / riffle	
Mainstem/sidechannel (m/s,s/c)	m/s	
Field gradient:	-	%
Stream width:	40.0	m
Channel width:	55.0	m
Mean depth:	0.62	m
Maximum depth:	0.86	m
Mean velocity:	0.28	m*s ⁻¹
Maximum velocity:	0.56	m*s ⁻¹

Turbidity:	mod	
Temperature (°C @ time):	9.07 @ 1730	

Stream Stage:	Low	
Conductivity:	46	mS*cm ⁻¹

COVER:		
log:	5	%
boulder:	90	%
instream vegetation:	0	%
overstream vegetation:	5	%
cutbank:	0	%

SUBSTRATE:		
finer:	0	%
small gravel:	10	%
large gravel:	15	%
cobble:	30	%
boulder:	45	%
bedrock:	0	%

Compaction:	high	
Sand (% of area):	0	%
d90:	0.70	m
dMax:	0.70	m

Site length:	10.5	m
Site width:	6.5	m
Site area*:	68.3	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Robert Harrison, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 009 Cheakamus

Stream:	Cheakamus	
Date:	29/09/2009	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	6.5	m

UTM:	10U 487954 5532638	
Watershed code:	900-097600-12900	
Site number:	009	
Transect #:	1	

Hydraulic type:	run / riffle	
Width:Mean Depth Ratio:	10.96	

Site length:	10.5	m
Site width:	6.5	m
Site area**:	68.3	m ²
Discharge:	1.561	m ³ *s ⁻¹

Transect type:	EF site	
Stream width:	55	m
Number of stations:	14	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.6	m
Mean Velocity:	0.4	m*s ⁻¹
Cross-sectional area :	3.9	m ²
Mean Probability (Fry):	18.7	%
Mean Probability (Parr):	89.2	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	1.2	m
%Transect Usable by Fry	18.7	%
Usable Area for Fry	12.8	m ²
Usable Width Parr:	5.8	m
%Transect Usable by Parr	89.2	%
Usable Area for Parr	60.9	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.26	0.13
1.00	0.48	0.17
1.50	0.59	0.19
2.00	0.67	0.32
2.50	0.59	0.25
3.00	0.46	0.33
3.50	0.64	0.29
4.00	0.63	0.48
4.50	0.65	0.41
5.00	0.76	0.56

APPENDIX C
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2009

Cheakamus River Rainbow Trout Survey, 2009
FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 009 Cheakamus

Stream:	Cheakamus
Site number:	009
Site length:	10.5 m
Site width:	6.5 m
Site area:	68.3 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1610	1635	700	l6	815
Pass 2	1700	1723	700	l6	738
Pass 3	1735	1750	700	l6	505

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	10	1	2	13	1.0	50.1	13	19.0	0.19	102	0.024	0.30833894
<i>O. mykiss</i>	1+	2	0	1	3	30.6	143.0	3	4.4			0.120	0.35894683
<i>O. mykiss</i>	3+	1	0	0	1	54.8	165.0	1	1.5			0.000	0
<i>Salvelinus fontinalis</i>		1	1	0	2	16.7	140.0	2					

ELECTROFISHING SITE DESCRIPTION FORM

SITE 010 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	010
Date:	30/09/2009
Surveyed by:	RH/RH/AL/AL
UTM:	10U 487935 5532080

Hydraulic type:	riffle
Mainstem/sidechannel (m/s,s/c)	m/s
Field gradient:	- %
Stream width:	45.0 m
Channel width:	65.0 m
Mean depth:	0.70 m
Maximum depth:	1.50 m
Mean velocity:	0.36 m*s ⁻¹
Maximum velocity:	1.06 m*s ⁻¹

Turbidity:	low
Temperature (°C @ time):	8.57 @ 1210

Stream Stage:	Low
Conductivity:	57 mS*cm ⁻¹

COVER:		
log:	5	%
boulder:	95	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	0	%
small gravel:	5	%
large gravel:	5	%
cobble:	20	%
boulder:	70	%
bedrock:		%

Compaction:	mod-high
Sand (% of area):	0 %
d90:	0.80 m
dMax:	1.70 m

Site length:	24.0	m
Site width:	9.0	m
Site area*:	216.0	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Robert Harrison, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 010 Cheakamus

Stream:	Cheakamus	
Date:	30/09/2009	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	9.0	m

UTM:	10U 487935 5532080	
Watershed code:	900-097600-12900	
Site number:	010	
Transect #:	1	

Hydraulic type:	riffle	
Width:Mean Depth Ratio:	33.91	

Site length:	24.0	m
Site width:	9.0	m
Site area**:	216.0	m ²
Discharge:	0.916	m ³ s ⁻¹

Transect type:	EF site	
Stream width:	65	m
Number of stations:	19	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.3	m
Mean Velocity:	0.4	m*s ⁻¹
Cross-sectional area :	2.4	m ²
Mean Probability (Fry):	18.7	%
Mean Probability (Parr):	40.1	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	1.7	m
%Transect Usable by Fry	18.7	%
Usable Area for Fry	40.4	m ²
Usable Width Parr:	3.6	m
%Transect Usable by Parr	40.1	%
Usable Area for Parr	86.5	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.26	0.00
1.00	0.20	0.46
1.50	1.04	0.15
2.00	0.81	0.13
2.50	0.12	0.16
3.00	0.36	0.60
3.50	0.07	0.87
4.00	0.07	0.06
4.50	0.02	0.00
5.00	0.00	0.00
5.50	0.45	0.36
6.00	0.43	0.83
6.50	0.00	0.00
7.00	0.13	0.44
7.50	0.21	0.76
8.00	0.19	1.06
8.50	0.23	0.79
9.00	0.26	0.18

APPENDIX C
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2009

Cheakamus River Rainbow Trout Survey, 2009
FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 010 Cheakamus

Stream:	Cheakamus
Site number:	010
Site length:	24.0 m
Site width:	9.0 m
Site area:	216.0 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1055	1125	700	I6	787
Pass 2	1145	1210	700	I6	769
Pass 3	1215	1300	700	I6	835
Pass 4	1325	1348	700	I6	619

Species	Age	Pass 1	Pass 2	Pass 3	Pass 4	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	5	5	4	0	14	3.0	61.3	15	6.5	0.19	35	0.138	2.06577086
<i>O. mykiss</i>	1+	6	4	2	1	13	27.7	134.3	13	6.0			0.084	1.08981919
<i>O. mykiss</i>	2+	0	1	0	0	1	39.9	149.0	1	0.5			0.393	0.39324188
<i>O. mykiss</i>	3+	4	5	0	0	9	69.0	181.2	9	4.2			0.052	0.46487826
<i>S. fontinalis</i>		1	0	0	0	1	45.2	152.0	1					



APPENDIX D

Site Description, Depth-Velocity Transect and Fish Capture Data 2010

ELECTROFISHING SITE DESCRIPTION FORM

SITE 001 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	001
Date:	06/10/2010
Surveyed by:	RH/AL/AL
UTM:	10 U 489644 5535677

Hydraulic type:	Run & riffle
Mainstem/sidechannel (m/s,s/c)	s/c
Field gradient:	1.0 %
Stream width:	55.0 m
Channel width:	67.0 m
Mean depth:	0.40 m
Maximum depth:	1.00 m
Mean velocity:	0.22 m*s ⁻¹
Maximum velocity:	0.96 m*s ⁻¹

Turbidity:	low
Temperature (°C @ time):	10.22 @ 14:05

Stream Stage:	Low
Conductivity:	28.0 mS*cm ⁻¹

COVER:		
log:	5	%
boulder:	90	%
instream vegetation:	0	%
overstream vegetation:	5	%
cutbank:	0	%

SUBSTRATE:		
finer:	0	%
small gravel:	5	%
large gravel:	5	%
cobble:	50	%
boulder:	40	%
bedrock:	0	%

Compaction:	high
Sand (% of area):	0 %
d90:	0.68 m
dMax:	0.73 m

Site length:	20.0	m
Site width:	7.0	m
Site area*:	140.0	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Robert Harrison, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 001 Cheakamus

Stream:	Cheakamus	
Date:	06/10/2010	
Mainstem/side-channel:	side	
Meter:	Flow Meter	
Metered at*:	40%	dfb
Transect width:	6.5	m

UTM:	10 U 489644 5535677	
Watershed code:	900-097600-12900	
Site number:	001	
Transect #:	1	

Hydraulic type:	Run & riffle	
Width:Mean Depth Ratio:	16.25	

Site length:	20.0	m
Site width:	7.0	m
Site area**:	140.0	m ²
Discharge:	0.850	m ³ *s ⁻¹

Transect type:	CS	
Stream width:	67	m
Number of stations:	16	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.4	m
Mean Velocity:	0.4	m*s ⁻¹
Cross-sectional area :	2.3	m ²
Mean Probability (Fry):	18.2	%
Mean Probability (Parr):	39.2	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	1.2	m
%Transect Usable by Fry	18.2	%
Usable Area for Fry	25.5	m ²
Usable Width Parr:	2.5	m
%Transect Usable by Parr	39.2	%
Usable Area for Parr	54.8	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.20	0.10	0.00
0.60	0.28	0.00
1.00	0.34	0.00
1.40	0.23	0.47
1.70	0.49	0.54
2.30	0.52	0.00
3.00	0.51	0.79
3.90	0.52	0.55
4.40	0.31	0.96
4.80	0.26	0.28
5.40	0.18	0.00
5.90	0.18	0.00
6.30	0.18	0.00
7.00	0.08	0.00
7.50	0.00	0.00

APPENDIX D
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2010

Cheakamus River Rainbow Trout Survey, 2010
FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 001 Cheakamus

Stream:	Cheakamus
Site number:	001
Site length:	20.0 m
Site width:	7.0 m
Site area:	140.0 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1606	1625	600	G6	584
Pass 2	1704	1735	600	G6	561
Pass 3	1752	1818	600	G6	527

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	3	0	0	3	1.4	54.0	3	2.1	0.18	11.8	0.000	0
<i>O. mykiss</i>	1+	4	1	0	5	7.2	99.6	5	3.6			0.034	0.167918831
<i>O. mykiss</i>	2+	5	4	0	9	13.3	114.6	9	6.4			0.077	0.69028008
<i>O. mykiss</i>	3+	1	0	0	1	52.3	205.0	1	0.7			0.000	0
<i>Cottus</i>		15	21	18	54	73.7	8.5						

ELECTROFISHING SITE DESCRIPTION FORM

SITE 002 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	002
Date:	06/10/2010
Surveyed by:	RH/AL/AL
UTM:	10U 0489617 5535496

Hydraulic type:	Riffle & pool
Mainstem/sidechannel (m/s,s/c):	s/c
Field gradient:	2.5 %
Stream width:	32.0 m
Channel width:	62.0 m
Mean depth:	0.40 m
Maximum depth:	1.20 m
Mean velocity:	0.23 m*s ⁻¹
Maximum velocity:	0.87 m*s ⁻¹

Turbidity:	Low
Temperature (°C @ time):	10.12 @ 0930

Stream Stage:	Low
Conductivity:	28 mS*cm ⁻¹

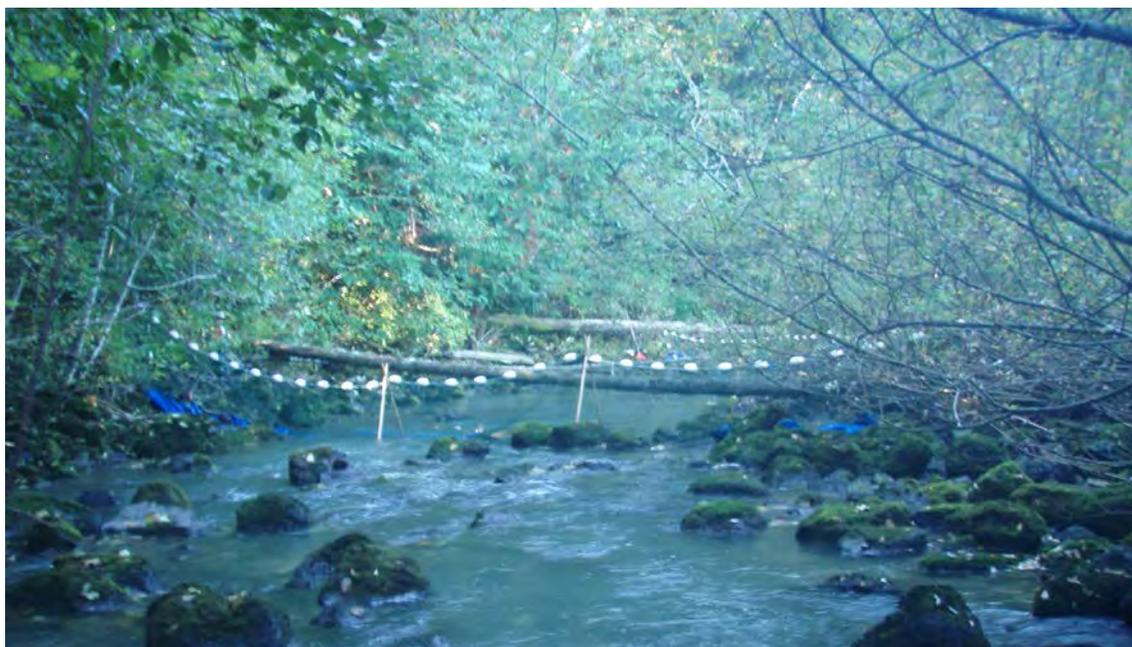
COVER:		
log:	0	%
boulder:	90	%
instream vegetation:	5	%
overstream vegetation:	5	%
cutbank:	0	%

SUBSTRATE:		
finer:	0	%
small gravel:	0	%
large gravel:	15	%
cobble:	50	%
boulder:	35	%
bedrock:	0	%

Compaction:	high
Sand (% of area):	0 %
d90:	0.89 m
dMax:	1.30 m

Site length:	22.0	m
Site width:	7.5	m
Site area*:	165.0	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Robert Harrison, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 002 Cheakamus

Stream:	Cheakamus	
Date:	06/10/2010	
Mainstem/side-channel:	s/c	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	7.2	m

UTM:	10U 0489617 5535496	
Watershed code:	900-097600-12900	
Site number:	002	
Transect #:	1	

Hydraulic type:	Riffle & pool	
Width:Mean Depth Ratio:	31.30	

Site length:	22.0	m
Site width:	7.5	m
Site area**:	165.0	m ²
Discharge:	0.586	m ³ *s ⁻¹

Transect type:	EF site	
Stream width:	62	m
Number of stations:	14	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.2	m
Mean Velocity:	0.4	m*s ⁻¹
Cross-sectional area :	1.7	m ²
Mean Probability (Fry):	16.1	%
Mean Probability (Parr):	28.1	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	1.2	m
%Transect Usable by Fry	16.1	%
Usable Area for Fry	26.5	m ²
Usable Width Parr:	2.0	m
%Transect Usable by Parr	28.1	%
Usable Area for Parr	46.3	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.20	0.08	0.00
0.70	0.23	0.00
1.00	0.25	0.21
1.60	0.00	0.00
2.20	0.36	0.87
2.70	0.33	0.00
3.60	0.23	0.79
4.00	0.37	0.61
4.70	0.31	0.68
5.40	0.25	0.00
6.00	0.25	0.00
6.60	0.13	0.00
7.20	0.07	0.00

**APPENDIX D
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2010**

**Cheakamus River Rainbow Trout Survey, 2010
FISH CAPTURE SUMMARY FORM**

Golder Associates Ltd.

SITE 002 Cheakamus

Stream:	Cheakamus
Site number:	002
Site length:	22.0 m
Site width:	7.5 m
Site area:	165.0 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1055	1135	600	G6	841
Pass 2	1210	1251	600	G6	715
Pass 3	1309	1342	600	G6	533

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	3	1	1	5	1.3	55.0	5	3.0	0.16	18.9	0.157	0.787325621
<i>O. mykiss</i>	1+	6	1	0	7	12.1	102.6	7	4.2			0.018	0.123930305
<i>O. mykiss</i>	2+	12	3	1	16	21.2	120.9	16	9.7			0.035	0.560965538
<i>O. mykiss</i>	3+	1	0	0	1	30.2	141.0	1	0.6			0.000	0
<i>O. mykiss</i>	4+	0	1	0	1	59.2	181.0	1	0.6			0.734	0.733799398
<i>Cottus</i>		10	11	6	27	10.6	74.1						

ELECTROFISHING SITE DESCRIPTION FORM

SITE 003 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	003
Date:	07/10/2010
Surveyed by:	RH/AL/AL
UTM:	10U 0489118 5534931

Hydraulic type:	riffle
Mainstem/sidechannel (m/s,s/c)	m/s
Field gradient:	3.0 %
Stream width:	42.0 m
Channel width:	54.0 m
Mean depth:	0.30 m
Maximum depth:	0.70 m
Mean velocity:	0.62 m*s ⁻¹
Maximum velocity:	3.05 m*s ⁻¹

Turbidity:	low
Temperature (°C @ time):	9.0 @ 13:27

Stream Stage:	Low
Conductivity:	30 mS*cm ⁻¹

COVER:		
log:	10	%
boulder:	90	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	5	%
small gravel:	5	%
large gravel:	15	%
cobble:	50	%
boulder:	25	%
bedrock:	0	%

Compaction:	high
Sand (% of area):	5 %
d90:	1.12 m
dMax:	1.82 m

Site length:	19.0	m
Site width:	9.0	m
Site area*:	171.0	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Robert Harrison, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 003 Cheakamus

Stream:	Cheakamus	
Date:	07/10/2010	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity	
Metered at*:	40%	dfb
Transect width:	6.0	m

UTM:	10U 0489118 5534931	
Watershed code:	900-097600-12900	
Site number:	003	
Transect #:	1	

Hydraulic type:	riffle	
Width:Mean Depth Ratio:	17.05	

Site length:	19.0	m
Site width:	9.0	m
Site area**:	171.0	m ²
Discharge:	2.502	m ³ s ⁻¹

Transect type:	EF site	
Stream width:	54	m
Number of stations:	19	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.4	m
Mean Velocity:	1.2	m*s ⁻¹
Cross-sectional area :	2.1	m ²
Mean Probability (Fry):	26.2	%
Mean Probability (Parr):	29.9	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	1.6	m
%Transect Usable by Fry	26.2	%
Usable Area for Fry	44.8	m ²
Usable Width Parr:	1.8	m
%Transect Usable by Parr	29.9	%
Usable Area for Parr	51.1	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.40	0.07	0.00
0.70	0.06	0.00
1.20	0.00	0.00
1.40	0.12	0.00
1.90	0.16	0.91
2.70	0.37	0.94
3.50	0.22	0.00
4.00	0.06	0.00
4.60	0.25	0.00
5.10	0.25	1.85
5.60	0.02	0.00
6.00	0.06	0.00
6.80	0.13	0.18

APPENDIX D
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2010

Cheakamus River Rainbow Trout Survey, 2010
FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 003 Cheakamus

Stream:	Cheakamus	
Site number:	003	
Site length:	19.0	m
Site width:	9.0	m
Site area:	171.0	m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1423	1450	600	G6	516
Pass 2	1503	1526	600	G6	524
Pass 3	1532	1551	600	G6	488

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	7	3	2	12	1.6	54.8	12	7.0	0.26	26.8	0.098	1.17176449
<i>O. mykiss</i>	1+	0	0	1	1	10.2	100.0	1	0.6			2.027	2.02684426
<i>O. mykiss</i>	2+	3	1	0	4	8.3	99.0	4	2.3			0.051	0.2052305
<i>O. mykiss</i>	3+	0	1	0	1	34.0	144.0	1	0.6			0.734	0.7337994

ELECTROFISHING SITE DESCRIPTION FORM

SITE 004 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	004
Date:	07/10/2010
Surveyed by:	RH/AL/AL
UTM:	10U 0489096 5534983

Hydraulic type:	pool
Mainstem/sidechannel (m/s,s/c)	m/s
Field gradient:	2.0 %
Stream width:	39.0 m
Channel width:	52.0 m
Mean depth:	0.45 m
Maximum depth:	0.86 m
Mean velocity:	0.78 m*s ⁻¹
Maximum velocity:	3.80 m*s ⁻¹

Turbidity:	Low
Temperature (°C @ time):	9.0 @ 10:11

Stream Stage:	Low
Conductivity:	30 mS*cm ⁻¹

COVER:		
log:	0	%
boulder:	100	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	5	%
small gravel:	5	%
large gravel:	10	%
cobble:	50	%
boulder:	30	%
bedrock:	0	%

Compaction:	high
Sand (% of area):	0 %
d90:	1.68 m
dMax:	1.85 m

Site length:	16.5 m
Site width:	10.0 m
Site area*:	165.0 m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 004 Cheakamus

Stream:	Cheakamus	
Date:	07/10/2010	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	13.0	m

UTM:	10U 0489096 5534983	
Watershed code:	900-097600-12900	
Site number:	004	
Transect #:	1	

Hydraulic type:	pool	
Width:Mean Depth Ratio:	33.28	

Site length:	16.5	m
Site width:	10.0	m
Site area**:	165.0	m ²
Discharge:	3.954	m ³ s ⁻¹

Transect type:	EF site	
Stream width:	39	m
Number of stations:	17	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.4	m
Mean Velocity:	0.8	m*s ⁻¹
Cross-sectional area :	5.1	m ²
Mean Probability (Fry):	5.4	%
Mean Probability (Parr):	35.1	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	0.7	m
%Transect Usable by Fry	5.4	%
Usable Area for Fry	9.0	m ²
Usable Width Parr:	4.6	m
%Transect Usable by Parr	35.1	%
Usable Area for Parr	57.9	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.30	0.16	0.00
1.10	0.38	0.00
2.00	0.50	0.36
3.00	0.57	0.26
3.80	0.64	0.00
4.50	0.48	0.00
5.30	0.40	0.00
6.30	0.25	0.76
7.00	0.33	1.00
8.00	0.36	0.79
9.00	0.35	0.54
9.80	0.00	0.00
10.40	0.58	0.70
11.00	0.53	1.47
12.00	0.26	3.50
13.00	0.81	3.80

**APPENDIX D
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2010**

**Cheakamus River Rainbow Trout Survey, 2010
FISH CAPTURE SUMMARY FORM**

Golder Associates Ltd.

SITE 004 Cheakamus

Stream:	Cheakamus
Site number:	004
Site length:	16.5 m
Site width:	10.0 m
Site area:	165.0 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1035	1103	600	G6	667
Pass 2	1135	1151	600	G6	617
Pass 3	1159	1227	600	G6	500

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	8	1	1	10	2.0	54.5	10	6	0.05	111.2	0.042	0.41883066
<i>O. mykiss</i>	1+	1	3	0	4	11.4	100.3	4	2			0.242	0.96892738
<i>O. mykiss</i>	2+	5	3	0	8	19.4	118.0	8	5			0.064	0.51231253

ELECTROFISHING SITE DESCRIPTION FORM

SITE 005 Cheakamus

Stream:	Cheakamus	
Watershed code:	900-097600-12900	
Site number:	005	
Date:	04/10/2010	
Surveyed by:	RH/AL/AL	
UTM:	10U 0488124	5532992

Hydraulic type:	riffle and pool	
Mainstem/sidechannel (m/s,s/c)	m/s	
Field gradient:	1.0	%
Stream width:	40.0	m
Channel width:	55.0	m
Mean depth:	0.20	m
Maximum depth:	0.50	m
Mean velocity:	0.46	m*s ⁻¹
Maximum velocity:	2.00	m*s ⁻¹

Turbidity:	Low	
Temperature (°C @ time):	10.0 @ 09:15	

Stream Stage:	Low	
Conductivity:	29	mS*cm ⁻¹

COVER:		
log:	5	%
boulder:	90	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	5	%

SUBSTRATE:		
finer:	0	%
small gravel:	5	%
large gravel:	5	%
cobble:	70	%
boulder:	20	%
bedrock:	0	%

Compaction:	Low	
Sand (% of area):	0	%
d90:	0.88	m
dMax:	0.97	m

Site length:	13.5	m
Site width:	9.0	m
Site area*:	121.5	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



APPENDIX D
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2010

Cheakamus River Rainbow Trout Survey, 2010
FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 005 Cheakamus

Stream:	Cheakamus
Site number:	005
Site length:	13.5 m
Site width:	9.0 m
Site area:	121.5 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	0937	1005	700	G6	722
Pass 2	1055	1113	700	G6	445
Pass 3	1125	1145	700	G6	410

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Mn Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100	CV Estimate	Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	6	3	0	9	1.0	51.0	9	7.4	0.20	36.6	0.051	0.4605662	
<i>O. mykiss</i>	1+	3	1	0	4	6.6	99.5	4	3.3			0.051	0.2052305	
<i>O. mykiss</i>	2+	11	2	3	16	7.4	108.5	16	13.2			0.068	1.0871145	
<i>O. mykiss</i>	3+	1	0	0	1	12.8	132.0	1	0.8			0.000	0	
<i>Salvelinus fontinalis</i>		1	0	0	1	13.2	129.0	1						

ELECTROFISHING SITE DESCRIPTION FORM

SITE 006 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	006
Date:	04/10/2010
Surveyed by:	RH/AL/AL
UTM:	10U 0488046 5532907

Hydraulic type:	cascade / pool	
Mainstem/sidechannel (m/s,s/c)	m/s	
Field gradient:	1.5	%
Stream width:	28.0	m
Channel width:	52.0	m
Mean depth:	0.30	m
Maximum depth:	0.80	m
Mean velocity:	0.51	m*s ⁻¹
Maximum velocity:	1.90	m*s ⁻¹

Turbidity:	Low
Temperature (°C @ time):	10.0 @ 17:28

Stream Stage:	Low
Conductivity:	28 mS*cm ⁻¹

COVER:		
log:	0	%
boulder:	100	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	5	%
small gravel:	0	%
large gravel:	20	%
cobble:	60	%
boulder:	15	%
bedrock:	0	%

Compaction:	Mod
Sand (% of area):	0 %
d90:	0.22 m
dMax:	0.51 m

Site length:	20.5	m
Site width:	8.0	m
Site area*:	164.0	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Robert Harrison, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 006 Cheakamus

Stream:	Cheakamus	
Date:	04/10/2010	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	8.3	m

UTM:	10U 0488046 5532907	
Watershed code:	900-097600-12900	
Site number:	006	
Transect #:	1	

Hydraulic type:	cascade / pool	
Width:Mean Depth Ratio:	25.71	

Site length:	20.5	m
Site width:	8.0	m
Site area**:	164.0	m ²
Discharge:	2.865	m ³ *s ⁻¹

Transect type:	EF site	
Stream width:	28	m
Number of stations:	12	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.3	m
Mean Velocity:	1.1	m*s ⁻¹
Cross-sectional area :	2.7	m ²
Mean Probability (Fry):	27.0	%
Mean Probability (Parr):	32.9	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	2.2	m
%Transect Usable by Fry	27.0	%
Usable Area for Fry	44.2	m ²
Usable Width Parr:	2.7	m
%Transect Usable by Parr	32.9	%
Usable Area for Parr	54.0	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.70	0.04	0.00
1.10	0.07	0.00
1.70	0.09	0.00
2.20	0.23	0.25
3.00	0.08	0.00
3.80	0.17	0.24
4.70	0.32	0.33
5.60	0.48	0.69
6.50	0.58	1.26
7.50	0.71	1.90
8.30	0.78	1.40

**APPENDIX D
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2010**

**Cheakamus River Rainbow Trout Survey, 2010
FISH CAPTURE SUMMARY FORM**

Golder Associates Ltd.

SITE 006 Cheakamus

Stream:	Cheakamus
Site number:	006
Site length:	20.5 m
Site width:	8.0 m
Site area:	164.0 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1445	1520	700	G6	665
Pass 2	1554	1621	700	G5	539
Pass 3	1640	1659	700	G5	546

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	12	2	3	17	0.8	53.8	17	10.4	0.27	38.4	0.060	1.0284652
<i>O. mykiss</i>	1+	1	0	0	1	12.2	95.0	1	0.6			0.000	0
<i>O. mykiss</i>	2+	8	2	0	10	10.3	111.5	10	6.1			0.024	0.2374731
<i>O. mykiss</i>	3+	1	0	0	1	86.2	169.0	1	0.6			0.000	0

ELECTROFISHING SITE DESCRIPTION FORM

SITE 007 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	007
Date:	08/10/2010
Surveyed by:	RH/AL/AL
UTM:	10U 0487916 5532724

Hydraulic type:	riffle
Mainstem/sidechannel (m/s,s/c)	m/s
Field gradient:	2.5 %
Stream width:	50.0 m
Channel width:	58.0 m
Mean depth:	0.20 m
Maximum depth:	0.42 m
Mean velocity:	0.75 m*s ⁻¹
Maximum velocity:	2.12 m*s ⁻¹

Turbidity:	Low
Temperature (°C @ time):	9.55 @ 10:33

Stream Stage:	Low
Conductivity:	30 mS*cm ⁻¹

COVER:		
log:	2	%
boulder:	91	%
instream vegetation:	0	%
overstream vegetation:	5	%
cutbank:	2	%

SUBSTRATE:		
finer:	5	%
small gravel:	5	%
large gravel:	10	%
cobble:	60	%
boulder:	20	%
bedrock:	0	%

Compaction:	High
Sand (% of area):	0 %
d90:	0.70 m
dMax:	0.96 m

Site length:	20.0	m
Site width:	10.0	m
Site area*:	200.0	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



APPENDIX D
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2010

Cheakamus River Rainbow Trout Survey, 2010
FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 007 Cheakamus

Stream:	Cheakamus	
Site number:	007	
Site length:	20.0	m
Site width:	10.0	m
Site area:	200.0	m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1150	1223	600	G6	756
Pass 2	1241	1308	600	G6	667
Pass 3	1319	1344	600	G6	542

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	3	0	1	4	0.8	52.5	4	2.0	0.17	11.9	0.136	0.543557227
<i>O. mykiss</i>	1+	1	0	0	1	4.8	90.0	1	0.5			0.000	0
<i>O. mykiss</i>	2+	3	3	1	7	13.1	118.0	7	3.5			0.171	1.195124388
<i>O. mykiss</i>	3+	3	0	0	3	54.4	172.3	3	1.5			0.000	0
<i>Salvelinus fontinalis</i>		0	2	0	2	10.7	116.5	2					

ELECTROFISHING SITE DESCRIPTION FORM

SITE 008 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	008
Date:	05/10/2010
Surveyed by:	RH/AL/AL
UTM:	10U 0487916 5532687

Hydraulic type:	riffle / pool
Mainstem/sidechannel (m/s,s/c):	m/s
Field gradient:	1.5 %
Stream width:	29.0 m
Channel width:	36.0 m
Mean depth:	0.20 m
Maximum depth:	0.70 m
Mean velocity:	0.14 m*s ⁻¹
Maximum velocity:	0.41 m*s ⁻¹

Turbidity:	Low
Temperature (°C @ time):	9.0 @ 09:05

Stream Stage:	Low
Conductivity:	29 mS*cm ⁻¹

COVER:		
log:	0	%
boulder:	100	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	5	%
small gravel:	5	%
large gravel:	5	%
cobble:	60	%
boulder:	25	%
bedrock:	0	%

Compaction:	High
Sand (% of area):	0 %
d90:	0.39 m
dMax:	0.52 m

Site length:	19.0 m
Site width:	11.0 m
Site area*:	104.5 m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



**APPENDIX D
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2010**

**Cheakamus River Rainbow Trout Survey, 2010
FISH CAPTURE SUMMARY FORM**

Golder Associates Ltd.

SITE 008 Cheakamus

Stream:	Cheakamus
Site number:	008
Site length:	19.0 m
Site width:	11.0 m
Site area:	104.5 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1028	1059	600	H6	589
Pass 2	1115	1137	600	H6	530
Pass 3	1158	1209	600	H6	436

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Mn Weight (g)	Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	3	2	0	5	1.1	58.4	5	4.8	0.27	17.5	0.089	0.44350556
<i>O. mykiss</i>	1+	1	0	0	1	2.8	84.0	1	1.0			0.000	0
<i>O. mykiss</i>	2+	2	3	1	6	10.3	116.5	6	5.7			0.230	1.38089681
<i>Salvelinus fontinalis</i>		1	0	1	2	10.2	124.0	2					
<i>Gasterosteus aculeatus</i>		1	0	0	1	1.5	59.0	1					

ELECTROFISHING SITE DESCRIPTION FORM

SITE 009 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	009
Date:	05/10/2010
Surveyed by:	RH/AL/AL
UTM:	10U 0487944 5532632

Hydraulic type:	rifle
Mainstem/sidechannel (m/s,s/c)	m/s
Field gradient:	3.0 %
Stream width:	50.0 m
Channel width:	52.0 m
Mean depth:	0.30 m
Maximum depth:	0.70 m
Mean velocity:	1.25 m*s ⁻¹
Maximum velocity:	2.55 m*s ⁻¹

Turbidity:	Low
Temperature (°C @ time):	11.0 @ 13:40

Stream Stage:	Low
Conductivity:	30 mS*cm ⁻¹

COVER:		
log:	0	%
boulder:	90	%
instream vegetation:	0	%
overstream vegetation:	5	%
cutbank:	5	%

SUBSTRATE:		
finer:	0	%
small gravel:	5	%
large gravel:	20	%
cobble:	55	%
boulder:	20	%
bedrock:	0	%

Compaction:	High
Sand (% of area):	0 %
d90:	0.48 m
dMax:	0.77 m

Site length:	11.5 m
Site width:	5.0 m
Site area*:	57.5 m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Robert Harrison, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 009 Cheakamus

Stream:	Cheakamus	
Date:	05/10/2010	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	6.0	m

UTM:	10U 0487944 5532632	
Watershed code:	900-097600-12900	
Site number:	009	
Transect #:	1	

Hydraulic type:	riffle	
Width:Mean Depth Ratio:	10.90	

Site length:	11.5	m
Site width:	5.0	m
Site area**:	57.5	m ²
Discharge:	4.404	m ³ *s ⁻¹

Transect type:	EF site	
Stream width:	52	m
Number of stations:	11	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.6	m
Mean Velocity:	1.3	m*s ⁻¹
Cross-sectional area :	3.3	m ²
Mean Probability (Fry):	5.0	%
Mean Probability (Parr):	22.3	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	0.3	m
%Transect Usable by Fry	5.0	%
Usable Area for Fry	2.9	m ²
Usable Width Parr:	1.3	m
%Transect Usable by Parr	22.3	%
Usable Area for Parr	12.8	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.40	0.18	0.44
0.90	0.49	0.75
1.90	0.59	1.19
2.70	0.55	1.08
3.30	0.44	1.75
4.00	0.66	0.88
4.50	0.73	1.60
5.00	0.70	1.68
5.50	0.69	1.83
6.00	0.73	2.55

**APPENDIX D
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2010**

**Cheakamus River Rainbow Trout Survey, 2010
FISH CAPTURE SUMMARY FORM**

Golder Associates Ltd.

SITE 009 Cheakamus

Stream:	Cheakamus
Site number:	009
Site length:	11.5 m
Site width:	5.0 m
Site area:	57.5 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1440	1505	600	G6	856
Pass 2	1530	1547	600	G6	599
Pass 3	1558	1619	600	G6	580

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	3	2	1	6	0.9	54.3	6	10.4	0.05	208.3	0.167	1.002412438
<i>O. mykiss</i>	2+	1	1	0	2	10.3	125.0	2	3.5			0.192	0.384352982

ELECTROFISHING SITE DESCRIPTION FOI

SITE 010 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	010
Date:	08/10/2010
Surveyed by:	RH/AL/AL
UTM:	10U 0487927 5532081

Hydraulic type:	riffle
Mainstem/sidechannel (m/s,s/c)	m/s
Field gradient:	5.5 %
Stream width:	47.0 m
Channel width:	65.0 m
Mean depth:	0.70 m
Maximum depth:	1.50 m
Mean velocity:	0.88 m*s ⁻¹
Maximum velocity:	2.60 m*s ⁻¹

Turbidity:	Low
Temperature (°C @ time):	10.0 @ 15:15

Stream Stage:	Low
Conductivity:	32 mS*cm ⁻¹

COVER:		
log:	0	%
boulder:	100	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	0	%
small gravel:	0	%
large gravel:	5	%
cobble:	15	%
boulder:	80	%
bedrock:		%

Compaction:	High
Sand (% of area):	0 %
d90:	0.84 m
dMax:	1.67 m

Site length:	20.0	m
Site width:	10.0	m
Site area*:	200.0	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



**APPENDIX D
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2010**

**Cheakamus River Rainbow Trout Survey, 2010
FISH CAPTURE SUMMARY FORM**

Golder Associates Ltd.

SITE 010 Cheakamus

Stream:	Cheakamus
Site number:	010
Site length:	20.0 m
Site width:	10.0 m
Site area:	200.0 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1620	1656	600	G6	591
Pass 2	1722	1748	600	G6	560
Pass 3	1805	1829	600	G6	456

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Estimate	Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	1	0	0	1	0.3	45.0	1	0.5	0.06	8.7	0.000	0	
<i>O. mykiss</i>	1+	2	0	3	5	9.2	111.8	5	2.5			0.428	2.13928175	
<i>O. mykiss</i>	2+	14	8	2	24	16.0	129.4	24	12.0			0.075	1.86600125	
<i>O. mykiss</i>	3+	5	2	0	7	32.7	171.0	7	3.5			0.047	0.32727715	
<i>O. mykiss</i>	4+	1	0	0	1	79.8	234.0	1	0.5			0.000	0	



APPENDIX E

Site Description, Depth-Velocity Transect and Fish Capture Data 2011

ELECTROFISHING SITE DESCRIPTION FORM

SITE 001 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900
Site number:	001
Date:	17/10/2011
Surveyed by:	RH/AL/AL
UTM:	10 U 489639 5535546

Hydraulic type:	Run
Mainstem/sidechannel (m/s,s/c)	s/c
Field gradient:	1.0 %
Stream width:	7.3 m
Channel width:	70.0 m
Mean depth:	0.21 m
Maximum depth:	0.51 m
Mean velocity:	1.01 m*s ⁻¹
Maximum velocity:	5.05 m*s ⁻¹

Turbidity:	clear
Temperature (°C @ time):	7.65 @ 16:57

Stream Stage:	Low
Conductivity:	28 mS*cm ⁻¹

COVER:		
log:	0	%
boulder:	90	%
instream vegetation:	10	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	5	%
small gravel:	5	%
large gravel:	10	%
cobble:	50	%
boulder:	30	%
bedrock:	0	%

Compaction:	high
Sand (% of area):	0 %
d90:	0.68 m
dMax:	0.74 m

Site length:	20.6	m
Site width:	7.3	m
Site area*:	150.4	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



**DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)**

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.
This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 001 Cheakamus

Stream:	Cheakamus
Date:	17/10/2011
Mainstem/side-channel:	s/c
Meter:	Flow Meter
Metered at*:	40% dfb
Transect width:	6.5 m

UTM:	10 U 489639 5535546
Watershed code:	900-097600-12900
Site number:	001
Transect #:	2

Hydraulic type:	Run
Width:Mean Depth Ratio:	27.17

Site length:	20.6 m
Site width:	7.3 m
Site area**:	150.4 m ²
Discharge:	3.388 m ³ *s ⁻¹

Transect type:	EF site
Stream width:	70 m
Number of stations:	11

NOTES: * dfb = depth from bottom.

Swoffer spindle bent, so velocities may be underestimates.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

ADJUSTED USABLE AREAS

Mean Depth:	0.2 m
Mean Velocity:	2.2 m*s ⁻¹
Cross-sectional area :	1.6 m ²
Mean Probability (Fry):	7.9 %
Mean Probability (Parr):	0.0 %

Usable Width for Fry:	0.5 m
%Transect Usable by Fry	7.9 %
Usable Area for Fry	11.9 m ²
Usable Width Parr:	0.0 m
%Transect Usable by Parr	0.0 %
Usable Area for Parr	0.0 m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.13	0.00
1.10	0.02	0.00
1.70	0.18	0.00
2.50	0.39	5.05
3.20	0.38	4.29
4.00	0.51	1.80
4.70	0.41	0.00
5.10	0.32	0.00
5.60	0.00	0.00
6.50	0.00	0.00

APPENDIX E
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2011

Cheakamus River Rainbow Trout Survey, 2011
FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 001 Cheakamus

Stream:	Cheakamus
Site number:	001
Site length:	20.6 m
Site width:	7.3 m
Site area:	150.4 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1452	1519	700	G6	666
Pass 2	1541	1609	700	G6	701
Pass 3	1624	1644	700	G6	716

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate
<i>O. mykiss</i>	0+	0	1	0	1	2.0	52.0	1	1	0.79	1	
<i>O. mykiss</i>	1+	2	0	0	2	9.4	95.0	2	1			
<i>O. mykiss</i>	2+	7	2	1	10	27.3	134.3	10	7			
<i>O. mykiss</i>	3+	4	0	0	4	34.4	144.8	4	3			
<i>O. mykiss</i>	4+	0	0	0	0			0	0			
cutthroat		0	0	0	0				0			
crayfish		0	0	0	0				0			
<i>Cottus</i>		21	12	5	38	9.5	104.3	38	25			
coho		0	0	0	0				0			

ELECTROFISHING SITE DESCRIPTION FORM

SITE 002 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	002
Date:	17/10/2011
Surveyed by:	RH/AL/AL
UTM:	10U 489609 553512

Hydraulic type:	Riffle & run
Mainstem/sidechannel (m/s,s/c)	s/c
Field gradient:	1.5 %
Stream width:	9.1 m
Channel width:	65.0 m
Mean depth:	0.22 m
Maximum depth:	0.90 m
Mean velocity:	0.41 m*s ⁻¹
Maximum velocity:	3.59 m*s ⁻¹

Turbidity:	clear
Temperature (°C @ time):	7.72 @ 1256

Stream Stage:	Low
Conductivity:	30 mS*cm ⁻¹

COVER:		
log:	5	%
boulder:	85	%
instream vegetation:	10	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	0	%
small gravel:	0	%
large gravel:	5	%
cobble:	55	%
boulder:	40	%
bedrock:	0	%

Compaction:	high
Sand (% of area):	0 %
d90:	1.24 m
dMax:	1.38 m

Site length:	22.0 m
Site width:	9.1 m
Site area*:	200.2 m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 002 Cheakamus

Stream:	Cheakamus	
Date:	17/10/2011	
Mainstem/side-channel:	s/c	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	7.8	m

UTM:	10U 489609 5535512	
Watershed code:	900-097600-12900	
Site number:	002	
Transect #:	1	

Hydraulic type:	Riffle & run	
Width:Mean Depth Ratio:	32.54	

Site length:	22.0	m
Site width:	9.1	m
Site area**:	200.2	m ²
Discharge:	1.309	m ³ *s ⁻¹

Transect type:	EF site	
Stream width:	65	m
Number of stations:	15	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

Swoffer spindle bent, so velocities may be underestimates.

SITE WEIGHTED MEANS

Mean Depth:	0.2	m
Mean Velocity:	0.7	m*s ⁻¹
Cross-sectional area :	1.9	m ²
Mean Probability (Fry):	11.7	%
Mean Probability (Parr):	0.0	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	0.9	m
%Transect Usable by Fry	11.7	%
Usable Area for Fry	23.4	m ²
Usable Width Parr:	0.0	m
%Transect Usable by Parr	0.0	%
Usable Area for Parr	0.0	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.10	0.00
1.00	0.22	0.00
1.30	0.28	0.00
1.90	0.00	0.00
2.30	0.41	0.00
3.10	0.20	0.00
3.50	0.17	0.00
4.20	0.33	3.59
5.00	0.22	2.55
5.70	0.17	0.00
6.30	0.90	0.00
7.00	0.02	0.00
7.30	0.03	0.00
7.80	0.00	0.00

APPENDIX E
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2011

Cheakamus River Rainbow Trout Survey, 2011
FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 002 Cheakamus

Stream:	Cheakamus
Site number:	002
Site length:	22.0 m
Site width:	9.1 m
Site area:	200.2 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1042	1112	700	G6	778
Pass 2	1141	1206	700	G7	767
Pass 3	1226	1242	700	G8	666

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate
<i>O. mykiss</i>	0+	0	2	2	4	0.9	43.0	4	2	0.12	17	
<i>O. mykiss</i>	1+	6	1	0	7	8.9	96.4	7	3			
<i>O. mykiss</i>	2+	6	1	0	7	27.5	136.6	7	3			
<i>O. mykiss</i>	3+	1	0	0	1	54.8	174.0	1	0			
<i>O. mykiss</i>	4+	0	0	0	0	0.0	0.0	0	0			
									0			
<i>G. aculeatus</i>		0	3	0	3	1.7	55.6	3	1			
<i>Cottus</i>		11	11	4	26	10.9	86.3	26	13			

ELECTROFISHING SITE DESCRIPTION FORM

SITE 003 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	003
Date:	18/10/2011
Surveyed by:	RH/AL/AL
UTM:	10U 489122 5535141

Hydraulic type:	riffle
Mainstem/sidechannel (m/s,s/c)	m/s
Field gradient:	0.5 %
Stream width:	8.0 m
Channel width:	55.0 m
Mean depth:	0.22 m
Maximum depth:	0.46 m
Mean velocity:	0.16 m*s ⁻¹
Maximum velocity:	0.84 m*s ⁻¹

Turbidity:	clear
Temperature (°C @ time):	7.64 @ 1653

Stream Stage:	Low
Conductivity:	27 mS*cm ⁻¹

COVER:		
log:	5	%
boulder:	35	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	15	%
small gravel:	10	%
large gravel:	30	%
cobble:	30	%
boulder:	15	%
bedrock:	0	%

Compaction:	high
Sand (% of area):	5 %
d90:	1.26 m
dMax:	1.61 m

Site length:	18.3	m
Site width:	8.0	m
Site area*:	146.4	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 003 Cheakamus

Stream:	Cheakamus	
Date:	18/10/2011	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity	
Metered at*:	40%	dfb
Transect width:	9.0	m

UTM:	10U 489122 5535141	
Watershed code:	900-097600-12900	
Site number:	003	
Transect #:	1	

Hydraulic type:	riffle	
Width:Mean Depth Ratio:	46.38	

Site length:	18.3	m
Site width:	8.0	m
Site area**:	146.4	m ²
Discharge:	0.368	m ³ *s ⁻¹

Transect type:	EF site	
Stream width:	55	m
Number of stations:	13	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

Swoffer spindle bent, so velocities may be underestimated.

SITE WEIGHTED MEANS

Mean Depth:	0.2	m
Mean Velocity:	0.2	m*s ⁻¹
Cross-sectional area :	1.7	m ²
Mean Probability (Fry):	42.7	%
Mean Probability (Parr):	26.1	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	3.8	m
%Transect Usable by Fry	42.7	%
Usable Area for Fry	62.6	m ²
Usable Width Parr:	2.3	m
%Transect Usable by Parr	26.1	%
Usable Area for Parr	38.2	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.40	0.40	0.00
0.90	0.00	0.00
1.50	0.19	0.14
2.40	0.23	0.08
3.00	0.23	0.03
3.80	0.22	0.00
4.80	0.09	0.00
6.00	0.14	0.60
6.70	0.17	0.24
7.70	0.20	0.01
8.60	0.32	0.84
9.00	0.46	0.15

APPENDIX E
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2011

FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 003 Cheakamus

Stream:	Cheakamus	
Site number:	003	
Site length:	18.3	m
Site width:	8.0	m
Site area:	146.4	m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1527	1544	700	G6	557
Pass 2	1602	1617	700	G7	667
Pass 3	1627	1642	700	G8	610

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate
<i>O. mykiss</i>	0+	2	1	1	4	1.3	45.8	4	3	0.43	6	
<i>O. mykiss</i>	1+	5	0	1	6	13.6	104.5	6	4			
<i>O. mykiss</i>	2+	0	0	0	0			0	0			
<i>O. mykiss</i>	3+	0	0	0	0			0	0			
<i>O. mykiss</i>	4+	0	0	0	0				0			
<i>Cottus</i>		1	0	0	1	27.3	121.0	1	1			

ELECTROFISHING SITE DESCRIPTION FORM

SITE 004 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	004
Date:	18/10/2011
Surveyed by:	RH/AL/AL
UTM:	10U 489101 5534961

Hydraulic type:	pool
Mainstem/sidechannel (m/s,s/c)	m/s
Field gradient:	1.5 %
Stream width:	33.0 m
Channel width:	50.0 m
Mean depth:	0.30 m
Maximum depth:	0.61 m
Mean velocity:	0.10 m*s ⁻¹
Maximum velocity:	0.47 m*s ⁻¹

Turbidity:	Low
Temperature (°C @ time):	9.0 @ 10:11

Stream Stage:	Low
Conductivity:	30 mS*cm ⁻¹

COVER:		
log:	0	%
boulder:	100	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	5	%
small gravel:	5	%
large gravel:	10	%
cobble:	50	%
boulder:	30	%
bedrock:	0	%

Compaction:	high
Sand (% of area):	0 %
d90:	1.73 m
dMax:	1.30 m

Site length:	16.5	m
Site width:	10.0	m
Site area*:	165.0	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



Kanaka Creek Juvenile Steelhead Survey, October 2001

**DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)**

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 004 Cheakamus

Stream:	Cheakamus	
Date:	18/10/2011	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	11.3	m

Site length:	16.5	m
Site width:	10.0	m
Site area**:	165.0	m ²
Discharge:	0.357	m ³ s ⁻¹

UTM:	10U 489101 5534961	
Watershed code:	900-097600-12900	
Site number:	004	
Transect #:	3	

Hydraulic type:	pool	
Width:Mean Depth Ratio:	33.42	

Transect type:	EF site	
Stream width:	33	m
Number of stations:	14	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.3	m
Mean Velocity:	0.1	m*s ⁻¹
Cross-sectional area :	3.8	m ²
Mean Probability (Fry):	36.7	%
Mean Probability (Parr):	35.1	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	4.1	m
%Transect Usable by Fry	36.7	%
Usable Area for Fry	60.6	m ²
Usable Width Parr:	4.0	m
%Transect Usable by Parr	35.1	%
Usable Area for Parr	57.9	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.70	0.12	0.00
1.30	0.38	0.04
2.40	0.49	0.06
3.40	0.61	0.01
4.50	0.37	0.00
5.30	0.22	0.00
6.50	0.23	0.14
7.40	0.35	0.30
8.30	0.22	0.11
8.80	0.33	0.15
9.60	0.00	0.00
10.30	0.55	0.10
11.30	0.57	0.49

APPENDIX E
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2011

Cheakamus River Rainbow Trout Survey, 2011
FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 004 Cheakamus

Stream:	Cheakamus
Site number:	004
Site length:	16.5 m
Site width:	10.0 m
Site area:	165.0 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1109	1135	700	G6	844
Pass 2	1154	1215	700	G7	872
Pass 3	1221	1235	700	G8	550

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate
<i>O. mykiss</i>	0+	2	0	0	2	0.6	36.0	2	1	0.37	3	
<i>O. mykiss</i>	1+	5	0	0	5	9.1	92.4	5	3			
<i>O. mykiss</i>	2+	0	1	0	1	27.1	135.0	1	1			
<i>O. mykiss</i>	3+	0	0	0	0			0	0			
<i>O. mykiss</i>	4+	0	0	0	0			0	0			
<i>Cottus</i>		0	0	0	0	0.0	0.0	0	0			
<i>S. fontinalis</i>		0	0	0	0	0.0	0.0	0	0			
<i>G. aculeatus</i>		0	0	0	0	0.0	0.0	0	0			

ELECTROFISHING SITE DESCRIPTION FORM

SITE 005 Cheakamus

Stream:	Cheakamus	
Watershed code:	900-097600-12900	
Site number:	005	
Date:	19/10/2011	
Surveyed by:	RH/AL/AL	
UTM:	10U 488178	5533024

Hydraulic type:	riffle and run	
Mainstem/sidechannel (m/s,s/c)	m/s	
Field gradient:	1.0	%
Stream width:	8.8	m
Channel width:	55.0	m
Mean depth:	0.16	m
Maximum depth:	0.41	m
Mean velocity:	0.12	m*s ⁻¹
Maximum velocity:	0.39	m*s ⁻¹

Turbidity:	clear	
Temperature (°C @ time):	7.94 @ 1541	

Stream Stage:	Low	
Conductivity:	27	mS*cm ⁻¹

COVER:		
log:	20	%
boulder:	25	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	5	%
small gravel:	5	%
large gravel:	15	%
cobble:	45	%
boulder:	30	%
bedrock:	0	%

Compaction:	Low	
Sand (% of area):	0	%
d90:	0.89	m
dMax:	0.96	m

Site length:	13.3	m
Site width:	8.8	m
Site area*:	117.0	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 005 Cheakamus

Stream:	Cheakamus	
Date:	19/10/2011	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	11.0	m

UTM:	10U 488178 5533024	
Watershed code:	900-097600-12900	
Site number:	005	
Transect #:	6	

Hydraulic type:	riffle and run	
Width:Mean Depth Ratio:	65.66	

Site length:	13.3	m
Site width:	8.8	m
Site area**:	117.0	m ²
Discharge:	0.311	m ³ s ⁻¹

Transect type:	EF site	
Stream width:	8.8	m
Number of stations:	13	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.2	m
Mean Velocity:	0.2	m*s ⁻¹
Cross-sectional area :	1.8	m ²
Mean Probability (Fry):	59.4	%
Mean Probability (Parr):	38.5	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	6.5	m
%Transect Usable by Fry	59.4	%
Usable Area for Fry	69.5	m ²
Usable Width Parr:	4.2	m
%Transect Usable by Parr	38.5	%
Usable Area for Parr	45.0	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.40	0.05	0.00
0.60	0.06	0.00
1.30	0.04	0.00
2.10	0.15	0.32
3.20	0.25	0.14
4.10	0.18	0.04
5.50	0.22	0.39
6.10	0.25	0.21
7.40	0.11	0.21
8.50	0.41	0.12
9.50	0.00	0.00
11.00	0.39	0.10

APPENDIX E
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2011

Cheakamus River Rainbow Trout Survey, 2011
FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 005 Cheakamus

Stream:	Cheakamus
Site number:	005
Site length:	13.3 m
Site width:	8.8 m
Site area:	117.0 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1550	1614	600	G6	673
Pass 2	1645	1703	600	G6	734
Pass 3	1717	1733	600	G6	645

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate
<i>O. mykiss</i>	0+	6	2	0	8	1.3	43.6	8	7	0.59	12	
<i>O. mykiss</i>	1+	4	0	0	4	14.4	96.8	4	3			
<i>O. mykiss</i>	2+	7	1	0	8	22.4	122.9	8	7			
<i>O. mykiss</i>	3+	0	0	0	0			0	0			
<i>Salvelinus fontinalis</i>		0	0	0	0			0	0			
<i>Cottus</i>		0	0	0	0			0	0			
<i>G. aculeatus</i>		0	0	0	0			0	0			

ELECTROFISHING SITE DESCRIPTION FORM

SITE 006 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	006
Date:	19/10/2011
Surveyed by:	RH/AL/AL
UTM:	10U 488040 5532897

Hydraulic type:	run
Mainstem/sidechannel (m/s,s/c)	m/s
Field gradient:	1.0 %
Stream width:	6.8 m
Channel width:	55.0 m
Mean depth:	0.47 m
Maximum depth:	1.02 m
Mean velocity:	0.16 m*s ⁻¹
Maximum velocity:	0.54 m*s ⁻¹

Turbidity:	clear
Temperature (°C @ time):	8.1 @ 1306

Stream Stage:	Low
Conductivity:	29 mS*cm ⁻¹

COVER:		
log:	0	%
boulder:	50	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	15	%
small gravel:	10	%
large gravel:	10	%
cobble:	50	%
boulder:	15	%
bedrock:	0	%

Compaction:	Med
Sand (% of area):	0 %
d90:	0.77 m
dMax:	0.88 m

Site length:	22.5	m
Site width:	6.8	m
Site area*:	153.0	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 006 Cheakamus

Stream:	Cheakamus	
Date:	19/10/2011	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	7.4	m

UTM:	10U 488040 5532897	
Watershed code:	900-097600-12900	
Site number:	006	
Transect #:	5	

Hydraulic type:	run	
Width:Mean Depth Ratio:	13.99	

Site length:	22.5	m
Site width:	6.8	m
Site area**:	153.0	m ²
Discharge:	1.015	m ³ *s ⁻¹

Transect type:	EF site	
Stream width:	55	m
Number of stations:	11	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

Swoffer spindle bent, so velocities may be underestimates.

SITE WEIGHTED MEANS

Mean Depth:	0.5	m
Mean Velocity:	0.3	m*s ⁻¹
Cross-sectional area :	3.9	m ²
Mean Probability (Fry):	22.8	%
Mean Probability (Parr):	46.8	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	1.7	m
%Transect Usable by Fry	22.8	%
Usable Area for Fry	35.0	m ²
Usable Width Parr:	3.5	m
%Transect Usable by Parr	46.8	%
Usable Area for Parr	71.5	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.20	0.00
0.90	0.27	0.00
1.80	0.29	0.00
2.70	0.34	0.01
3.50	0.41	0.08
4.00	0.05	0.21
4.50	0.75	0.19
5.30	0.90	0.35
6.70	0.92	0.40
7.40	1.02	0.54

APPENDIX E
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2011

Cheakamus River Rainbow Trout Survey, 2011
FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 006 Cheakamus

Stream:	Cheakamus
Site number:	006
Site length:	22.5 m
Site width:	6.8 m
Site area:	153.0 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1120	1141	700	G6	851
Pass 2	1208	1226	700	G6	840
Pass 3	1241	1258	600	G6	804

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate
<i>O. mykiss</i>	0+	7	4	1	12	1.5	48.0	12	8	0.29	27	
<i>O. mykiss</i>	1+	7	2	0	9	11.8	100.7	9	6			
<i>O. mykiss</i>	2+	2	0	0	2	34.7	143.0	2	1			
<i>O. mykiss</i>	3+	0	0	0	0	n/a	n/a	0	0			
<i>O. mykiss</i>	4+	0	0	0	0			0	0			

ELECTROFISHING SITE DESCRIPTION FORM

SITE 007 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	007
Date:	20/10/2011
Surveyed by:	RH/AL/AL
UTM:	10U 487937 5532784

Hydraulic type:	run
Mainstem/sidechannel (m/s,s/c)	m/s
Field gradient:	1.0 %
Stream width:	9.0 m
Channel width:	55.0 m
Mean depth:	0.22 m
Maximum depth:	0.37 m
Mean velocity:	0.17 m*s ⁻¹
Maximum velocity:	0.55 m*s ⁻¹

Turbidity:	clear
Temperature (°C @ time):	7.61 @ 1636

Stream Stage:	Low
Conductivity:	29 mS*cm ⁻¹

COVER:		
log:	5	%
boulder:	35	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	5	%
small gravel:	5	%
large gravel:	10	%
cobble:	60	%
boulder:	20	%
bedrock:	0	%

Compaction:	high
Sand (% of area):	0 %
d90:	0.81 m
dMax:	1.02 m

Site length:	12.3	m
Site width:	9.0	m
Site area*:	110.7	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 007 Cheakamus

Stream:	Cheakamus	
Date:	20/10/2011	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	10.0	m

UTM:	10U 487937 5532784	
Watershed code:	900-097600-12900	
Site number:	007	
Transect #:	8	

Hydraulic type:	run	
Width:Mean Depth Ratio:	43.85	

Site length:	12.3	m
Site width:	9.0	m
Site area**:	110.7	m ²
Discharge:	0.475	m ³ *s ⁻¹

Transect type:	EF site	
Stream width:	55	m
Number of stations:	20	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

Swoffer spindle bent, so velocities may be underestimates.

SITE WEIGHTED MEANS

Mean Depth:	0.2	m
Mean Velocity:	0.2	m*s ⁻¹
Cross-sectional area :	2.3	m ²
Mean Probability (Fry):	56.9	%
Mean Probability (Parr):	46.7	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	5.7	m
%Transect Usable by Fry	56.9	%
Usable Area for Fry	62.9	m ²
Usable Width Parr:	4.7	m
%Transect Usable by Parr	46.7	%
Usable Area for Parr	51.7	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.06	0.00
1.00	0.00	0.00
2.20	0.34	0.36
2.60	0.15	0.23
3.00	0.25	0.55
3.50	0.34	0.13
4.00	0.19	0.03
4.50	0.32	0.08
5.00	0.28	0.02
5.50	0.29	0.06
6.00	0.15	0.35
6.50	0.37	0.55
7.00	0.34	0.37
7.50	0.26	0.16
8.00	0.21	0.03
8.50	0.24	0.17
9.00	0.23	0.06
9.50	0.26	0.03
10.00	0.21	0.18

APPENDIX E
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2011

FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 007 Cheakamus

Stream:	Cheakamus
Site number:	007
Site length:	12.3 m
Site width:	9.0 m
Site area:	110.7 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1510	1533	600	G6	668
Pass 2	1555	1608	600	G6	631
Pass 3	1619	1634	600	G6	644

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate
<i>O. mykiss</i>	0+	3	1	0	4	1.3	45.5	4	4	0.57	6	0.067
<i>O. mykiss</i>	1+	4	1	0	5	8.5	94.0	5	5			0.000
<i>O. mykiss</i>	2+	2	0	1	3	41.2	144.3	3	3			0.000
<i>O. mykiss</i>	3+	1	0	0	1	28.8	135.0	1	1			0.000
<i>O. mykiss</i>	4+	0	0	0	0			0	0			0.074
<i>Salvelinus fontinalis</i>		0	1	0	1	11.1	105.0	1	1			0.023

ELECTROFISHING SITE DESCRIPTION FORM

SITE 008 Cheakamus

Stream:	Cheakamus		
Watershed code:	900-097600-12900		
Site number:	008		
Date:	20/10/2011		
Surveyed by:	RH/AL/AL		
UTM:	10U 487890	5532681	

Hydraulic type:	riffle		
Mainstem/sidechannel (m/s,s/c)	m/s		
Field gradient:	0.5	%	
Stream width:	9.0	m	
Channel width:	0.0	m	
Mean depth:	0.22	m	
Maximum depth:	0.64	m	
Mean velocity:	0.11	m*s ⁻¹	
Maximum velocity:	0.54	m*s ⁻¹	

Turbidity:	clear		
Temperature (°C @ time):	7.7 @ 1303		

Stream Stage:	Low		
Conductivity:	30	mS*cm ⁻¹	

COVER:		
log:	0	%
boulder:	60	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	20	%
small gravel:	15	%
large gravel:	15	%
cobble:	40	%
boulder:	10	%
bedrock:	0	%

Compaction:	Moderate	
Sand (% of area):	0	%
d90:	1.09	m
dMax:	1.24	m

Site length:	13.5	m
Site width:	9.0	m
Site area*:	60.8	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd

SITE 008 Cheakamus

Stream:	Cheakamus	
Date:	20/10/2011	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	12.1	m

UTM:	10U 487890 5532681	
Watershed code:	900-097600-12900	
Site number:	008	
Transect #:	7	

Hydraulic type:	riffle	
Width:Mean Depth Ratio:	53.33	

Site length:	13.5	m
Site width:	9.0	m
Site area**:	60.8	m ²
Discharge:	0.488	m ³ s ⁻¹

Transect type:	EF site	
Stream width:	0	m
Number of stations:	13	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

Swoffer spindle bent, so velocities may be underestimates.

SITE WEIGHTED MEANS

Mean Depth:	0.2	m
Mean Velocity:	0.2	m*s ⁻¹
Cross-sectional area :	2.7	m ²
Mean Probability (Fry):	20.5	%
Mean Probability (Parr):	26.6	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	2.5	m
%Transect Usable by Fry	20.5	%
Usable Area for Fry	12.5	m ²
Usable Width Parr:	3.2	m
%Transect Usable by Parr	26.6	%
Usable Area for Parr	16.2	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.70	0.05	0.00
1.30	0.06	0.00
1.90	0.23	0.00
3.60	0.02	0.00
4.00	0.00	0.00
5.20	0.17	0.45
6.70	0.21	0.02
7.80	0.00	0.00
8.70	0.51	0.01
10.50	0.50	0.17
11.30	0.45	0.54
12.00	0.64	0.30

APPENDIX E
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2011

Cheakamus River Rainbow Trout Survey, 2011
FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 008 Cheakamus

Stream:	Cheakamus
Site number:	008
Site length:	13.5 m
Site width:	9.0 m
Site area:	60.8 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1101	1118	600	G6	710
Pass 2	1151	1308	600	G6	694
Pass 3	1223	1239	600	G6	696

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate
<i>O. mykiss</i>	0+	2	2	0	4	1.8	50.5	4	7	0.21	31	0.067
<i>O. mykiss</i>	1+	5	3	0	8	9.2	101.5	8	13			0.000
<i>O. mykiss</i>	2+	3	1	0	4	36.4	143.0	4	7			0.000
<i>O. mykiss</i>	3+	0	0	0	0			0	0			0.000
<i>O. mykiss</i>	4+	0	0	0	0			0	0			0.074
<i>Salvelinus fontinalis</i>		4	1	1	6	31.2	138.0	6	10			0.023
<i>Gasterosteus aculeatus</i>		0	0	0	0	0.0	0.0	0	0			0.236

ELECTROFISHING SITE DESCRIPTION FORM

SITE 009 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	009
Date:	21/10/2011
Surveyed by:	RH/AL/AL
UTM:	10U 487938 5532643

Hydraulic type:	glide
Mainstem/sidechannel (m/s,s/c)	m/s
Field gradient:	1.0 %
Stream width:	4.5 m
Channel width:	50.0 m
Mean depth:	0.55 m
Maximum depth:	0.78 m
Mean velocity:	0.33 m*s ⁻¹
Maximum velocity:	0.67 m*s ⁻¹

Turbidity:	Low
Temperature (°C @ time):	11.0 @ 13:40

Stream Stage:	Low
Conductivity:	30 mS*cm ⁻¹

COVER:		
log:	0	%
boulder:	50	%
instream vegetation:	0	%
overstream vegetation:	5	%
cutbank:	5	%

SUBSTRATE:		
finer:	5	%
small gravel:	5	%
large gravel:	20	%
cobble:	55	%
boulder:	15	%
bedrock:	0	%

Compaction:	High
Sand (% of area):	5 %
d90:	0.48 m
dMax:	0.84 m

Site length:	22.2	m
Site width:	4.5	m
Site area*:	99.9	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 009 Cheakamus

Stream:	Cheakamus	
Date:	21/10/2011	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	5.5	m

UTM:	10U 487938 5532643	
Watershed code:	900-097600-12900	
Site number:	009	
Transect #:		

Hydraulic type:	glide	
Width:Mean Depth Ratio:	9.43	

Site length:	22.2	m
Site width:	4.5	m
Site area**:	99.9	m ²
Discharge:	1.096	m ³ s ⁻¹

Transect type:	EF site	
Stream width:	50	m
Number of stations:	12	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

Swoffer spindle bent, so velocities may be underestimates.

SITE WEIGHTED MEANS

Mean Depth:	0.6	m
Mean Velocity:	0.3	m*s ⁻¹
Cross-sectional area :	3.2	m ²
Mean Probability (Fry):	13.9	%
Mean Probability (Parr):	93.8	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	0.8	m
%Transect Usable by Fry	13.9	%
Usable Area for Fry	13.9	m ²
Usable Width Parr:	5.2	m
%Transect Usable by Parr	93.8	%
Usable Area for Parr	93.7	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.40	0.42	0.40
0.80	0.60	0.17
1.50	0.60	0.28
2.00	0.50	0.15
2.50	0.53	0.28
3.00	0.57	0.39
3.50	0.55	0.31
4.00	0.64	0.21
4.50	0.68	0.56
5.00	0.76	0.49
5.50	0.78	0.67

APPENDIX E
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2011

Cheakamus River Rainbow Trout Survey, 2011
FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 009 Cheakamus

Stream:	Cheakamus	
Site number:	009	
Site length:	22.2	m
Site width:	4.5	m
Site area:	99.9	m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1104	1120	600	G6	693
Pass 2	1140	1151	600	G6	619
Pass 3	1222	1233	600	G6	557

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate
<i>O. mykiss</i>	0+	0	0	0	0			0	0	0.14	0	
<i>O. mykiss</i>	1+	1	1	0	2	98.0	10.4	2	2			
<i>O. mykiss</i>	2+	0	0	0	0			0	0			
<i>O. mykiss</i>	3+	0	0	0	0			0	0			
<i>O. mykiss</i>	4+	0	0	0	0			0	0			
<i>S. fontinalis</i>		1	0	0	1	12.4	101.0	1	1			

ELECTROFISHING SITE DESCRIPTION FORM

SITE 010 Cheakamus

Stream:	Cheakamus
Watershed code:	900-097600-12900

Site number:	010
Date:	21/10/2011
Surveyed by:	RH/AL/AL
UTM:	10U 487939 5532076

Hydraulic type:	run
Mainstem/sidechannel (m/s,s/c)	m/s
Field gradient:	1.0 %
Stream width:	9.7 m
Channel width:	65.0 m
Mean depth:	0.25 m
Maximum depth:	0.59 m
Mean velocity:	0.24 m*s ⁻¹
Maximum velocity:	0.99 m*s ⁻¹

Turbidity:	clear
Temperature (°C @ time):	7.66 @ 1700

Stream Stage:	Low
Conductivity:	30 mS*cm ⁻¹

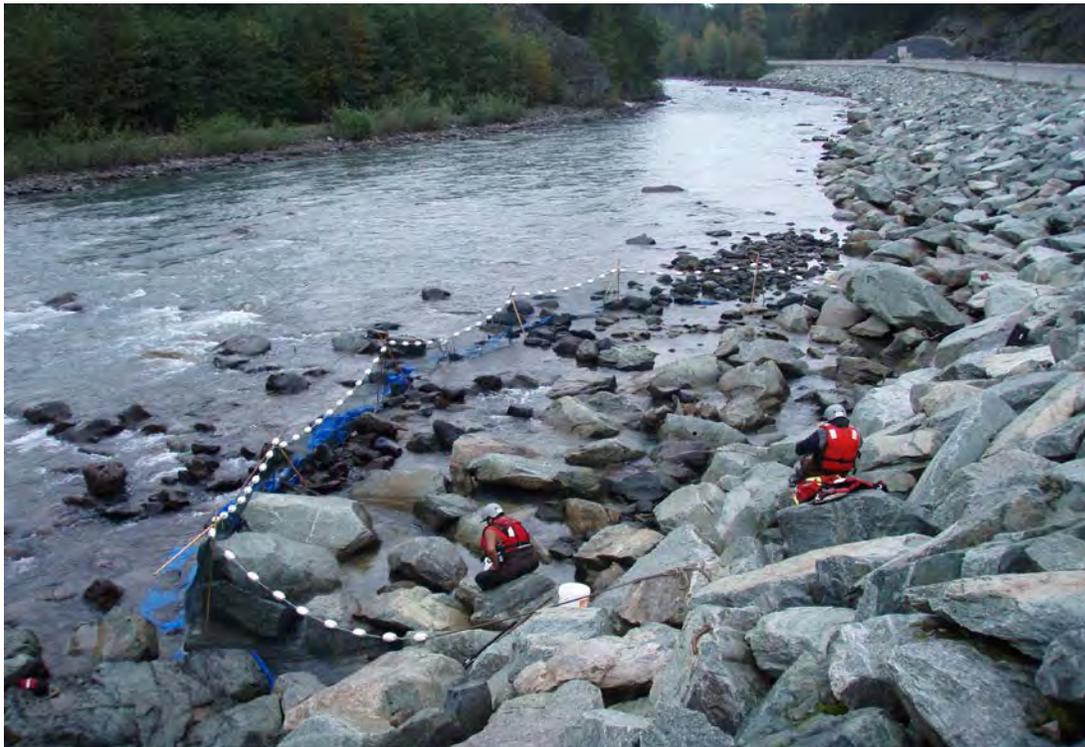
COVER:		
log:	0	%
boulder:	90	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	0	%
small gravel:	5	%
large gravel:	5	%
cobble:	15	%
boulder:	75	%
bedrock:	0	%

Compaction:	High
Sand (% of area):	0 %
d90:	0.90 m
dMax:	1.68 m

Site length:	19.7	m
Site width:	9.7	m
Site area*:	191.1	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 010 Cheakamus

Stream:	Cheakamus	
Date:	21/10/2011	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	10.5	m

UTM:	10U 487939 5532076	
Watershed code:	900-097600-12900	
Site number:	010	
Transect #:	1	

Hydraulic type:	run	
Width:Mean Depth Ratio:	39.27	

Site length:	19.7	m
Site width:	9.7	m
Site area**:	191.1	m ²
Discharge:	0.791	m ³ s ⁻¹

Transect type:	EF site	
Stream width:	65	m
Number of stations:	21	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.3	m
Mean Velocity:	0.3	m*s ⁻¹
Cross-sectional area :	2.8	m ²
Mean Probability (Fry):	32.5	%
Mean Probability (Parr):	49.8	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	3.4	m
%Transect Usable by Fry	32.5	%
Usable Area for Fry	62.0	m ²
Usable Width Parr:	5.2	m
%Transect Usable by Parr	49.8	%
Usable Area for Parr	95.2	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.59	0.00
1.00	0.57	0.00
1.50	0.22	0.16
2.00	0.23	0.47
2.50	0.05	0.02
3.00	0.06	0.58
3.50	0.00	0.00
4.00	0.23	0.32
4.50	0.38	0.56
5.00	0.54	0.23
5.50	0.26	0.14
6.00	0.00	0.00
6.50	0.00	0.00
7.00	0.35	0.45
7.50	0.26	0.42
8.50	0.42	0.34
9.00	0.24	0.05
9.50	0.27	0.07
10.00	0.31	0.99
10.50	0.28	0.14

APPENDIX E
CHEAKAMUS RIVER RAINBOW TROUT MONITOR, 2011

Cheakamus River Rainbow Trout Survey, 2011
FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 010 Cheakamus

Stream:	Cheakamus
Site number:	010
Site length:	19.7 m
Site width:	9.7 m
Site area:	191.1 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1523	1547	600	G6	733
Pass 2	1627	1644	600	G6	537
Pass 3	1709	1720	600	G6	517

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate
<i>O. mykiss</i>	0+	1	0	0	1	1.6	45.0	1	1	0.33	2	
<i>O. mykiss</i>	1+	1	1	0	2	13.2	108.5	2	1			
<i>O. mykiss</i>	2+	7	2	1	10	25.4	130.2	10	5			
<i>O. mykiss</i>	3+	3	2	0	5	69.8	182.8	5	3			
<i>O. mykiss</i>	4+	0	0	0	0			0	0			
<i>S. fontinalis</i>		1	0	0	1	30.7	136.0	1	1			



APPENDIX F

Length at Age Tables from Aged Scales 2007-2010



APPENDIX F
Length at Age Tables from Aged Scales

Table 1: Age, mean length, standard deviation in length, and number of fish aged by scale analysis in each age class of rainbow trout sampled on the Cheakamus River from 2007 to 2011

Fish Aged by scales only															
Age	2007 2008						2009 2010						2011		
	Mean Length	Stdev Length	Count												
0	-	-	0	60.67	5.28	6	75.91	17.91	23	61.00	-	1	-	-	0
1	100.14	15.27	21	106.45	19.35	31	118.87	17.00	23	101.67	11.97	18	101.24	30.26	42
2	167.00	24.44	10	195.89	61.62	9	163.25	19.34	8	128.47	29.53	77	133.44	30.09	41
3+	212.92	31.29	13	256.75	64.44	8	231.35	33.02	20	207.11	54.63	27	174.67	40.37	12

Table 2: Average fork lengths and predicted fork lengths (FL) for each age class of scale-aged rainbow trout using the Von Bertalanffy Growth Curve

Age	Number	Average FL	Predicted FL
0	785	49.1	39.9
1	342	101.2	104.5
2	198	134.6	152.9
3	85	203.2	189.3
4	15	257.5	216.6
5	1	360.0	237.0

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APPENDIX G

Cheakamus Trout Maximum Likelihood Estimates 2007-2010



APPENDIX G
CHEAKAMUS RIVER RAINBOW TROUT MAXIMUM LIKELIHOOD ESTIMATES

2007 Rainbow Trout Density Calculations

Site No.	Area(m ²)	Age	Population Estimate	Population SE	Population CV	Parameter Estimation	Population Lower CI	Population Upper CI	Density (RB/100m ²)
1	70	0	2	2.87	1.43	Bayes	2.0	7.6	2.86
		1	5	0.44	0.09	MLE exact	5.0	5.9	7.14
2	124.8	0	4	1.47	0.37	Bayes	4.0	6.9	3.20
		1	11	0.22	0.02	MLE exact	11.0	11.4	8.80
		2	2	0.00	0.00	MLE exact	2.0	2.0	1.60
3	140.3	0	1	0.00	0.00	MLE exact	1.0	1.0	0.71
		1	2	1.04	0.52	Bayes	2.0	4.0	1.43
		2	2	1.04	0.52	Bayes	2.0	4.0	1.43
4	178.5	0	4	1.47	0.37	Bayes	4.0	6.9	2.24
		1	4	0.00	0.00	MLE exact	4.0	4.0	2.24
5	152	0	12	2.88	0.24	Bayes	11.0	17.7	7.89
		1	30	0.51	0.02	MLE exact	30.0	31.0	19.74
6	120	0	6	0.67	0.11	MLE exact	6.0	7.3	5.00
		1	17	0.69	0.04	MLE exact	17.0	18.3	14.17
7	187	0	8	0.51	0.06	MLE exact	8.0	9.0	4.28
		1	10	0.24	0.02	MLE exact	10.0	10.5	5.35
		2	2	1.04	0.52	Bayes	2.0	4.0	1.07
		3	1	0.00	0.00	MLE exact	1.0	1.0	0.53
8	70	0	14	2.16	0.15	MLE exact	13.0	18.2	18.57
		1	13	5.44	0.42	Bayes	11.0	23.7	15.71
9	80.5	0	4	0.21	0.05	MLE exact	4.0	4.4	4.97
		1	2	0.00	0.00	MLE exact	2.0	2.0	2.48
10	98	0	0	0.00	0.00	MLE exact	0.0	0.0	0.00
		1	9	0.46	0.05	MLE exact	9.0	9.9	8.82
		2	8	1.06	0.13	MLE exact	8.0	10.1	7.84
		3	1	0.73	0.73	Bayes	1.0	2.4	0.98



APPENDIX G
CHEAKAMUS RIVER RAINBOW TROUT MAXIMUM LIKELIHOOD ESTIMATES

2008 Rainbow Trout Density Calculations

Site No.	Area(m ²) A	ge	Population Estimate	Population SE	Population CV	Parameter Estimation	Population Lower CI	Population Upper CI	Density (RB/100m ²)
1	80.0	0	1	0.00	0.00	MLE exact	1.0	1.0	1.3
		1	4	0.00	0.00	MLE exact	4.0	4.0	5.0
		2	1	0.00	0.00	MLE exact	1.0	1.0	1.3
2	184.0	0	16	1.13	0.07	MLE exact	16.0	18.2	8.7
		1	6	0.51	0.08	MLE exact	6.0	7.0	3.3
		2	5	0.06	0.01	MLE exact	5.0	5.1	2.7
		3	2	0.00	0.00	MLE exact	2.0	2.0	1.1
3	110.5	0	25	0.32	0.01	MLE exact	25.0	25.6	22.6
		1	1	0.00	0.00	MLE exact	1.0	1.0	0.9
4	157.5	0	30	3.53	0.12	MLE exact	27.0	36.9	19.0
5	150.0	0	38	2.53	0.07	MLE exact	36.0	43.0	25.3
		1	21	0.03	0.00	MLE exact	21.0	21.1	14.0
		2	2	0.00	0.00	MLE exact	2.0	2.0	1.3
6	147.0	0	32	0.89	0.03	MLE exact	32.0	33.8	21.8
		1	10	0.41	0.04	MLE exact	10.0	10.8	6.8
		2	2	0.19	0.09	MLE exact	2.0	2.4	1.4
7	196.0	0	17	0.59	0.03	MLE exact	17.0	18.2	8.7
		1	12	0.07	0.01	MLE exact	12.0	12.1	6.1
8	69.0	0	25	2.98	0.12	MLE exact	23.0	30.8	36.2
		1	16	0.52	0.03	MLE exact	16.0	17.0	23.2
9	92.5	0	6	0.67	0.11	MLE exact	6.0	7.3	6.5
		1	2	0.00	0.00	MLE exact	2.0	2.0	2.2
10	185.0	0	3	0.68	0.23	MLE exact	3.0	4.3	1.6
		1	11	0.50	0.05	MLE exact	11.0	12.0	5.9
		2	10	0.71	0.07	MLE exact	10.0	11.4	5.4



APPENDIX G
CHEAKAMUS RIVER RAINBOW TROUT MAXIMUM LIKELIHOOD ESTIMATES

2009 Rainbow Trout Density Calculations

Site No.	Area(m ²) A	ge	Population Estimate	Population SE	Population CV	Parameter Estimation	Population Lower CI	Population Upper CI	Density (RB/100m ²)
1	130.0	0	9	0.46	0.051	MLE exact	9.0	9.9	6.9
		1	4	0.00	0.00	MLE exact	4.0	4.0	3.1
		2	2	0.00	0.00	MLE exact	2.0	2.0	1.5
2	187.0	0	28	0.94	0.03	MLE exact	28.0	29.9	15.0
		1	13	0.02	0.00	MLE exact	13.0	13.0	7.0
		2	3	0.00	0.00	MLE exact	3.0	3.0	1.6
		3	6	0.32	0.05	MLE exact	6.0	6.6	3.2
3	107.3	0	52	0.62	0.01	MLE exact	52.0	53.2	48.5
		1	5	0.06	0.01	MLE exact	5.0	5.1	4.7
4	156.8	0	68	1.49	0.02	MLE exact	67.0	70.9	43.4
		1	10	1.05	0.11	MLE exact	10.0	12.1	6.4
5	155.0	0	57	5.61	0.10	MLE exact	50.0	68.0	36.8
		1	16	3.72	0.23	Bayes	15.0	23.3	10.3
6	187.0	0	98	5.11	0.05	MLE exact	90.0	108.0	52.4
		1	4	0.26	0.07	MLE exact	4.0	4.5	2.1
7	220.6	0	52	10.6	0.20	MLE exact	40.0	72.8	23.6
		1	8	0.00	0.00	MLE exact	8.0	8.0	3.6
8	160.0	0	73	2.12	0.03	MLE exact	71.0	77.2	45.6
		1	4	0.08	0.02	MLE exact	4.0	4.2	2.5
9	110.5	0	13	0.68	0.05	MLE exact	13.0	14.3	11.8
		1	3	0.71	0.24	MLE exact	3.0	4.4	2.7
10	94.5	0	15	2.07	0.14	MLE exact	14.0	19.1	15.9
		1	13	1.09	0.08	MLE exact	13.0	15.1	13.8
		2	1	0.39	0.39	MLE exact	1.0	1.8	1.1
			9	0.46	0.05	MLE exact	9.0	9.9	9.5



APPENDIX G
CHEAKAMUS RIVER RAINBOW TROUT MAXIMUM LIKELIHOOD ESTIMATES

2010 Rainbow Trout Density Calculations

Site No.	Area(m ²)	Age	Population Estimate	Population SE	Population CV	Parameter Estimation	Population Lower CI	Population Upper CI	Density (RB/100m ²)
1	140.0	0	3	0.00	0.00	MLE exact	3.0	3.0	2.1
		1	5	0.17	0.03	MLE exact	5.0	5.3	3.6
		2	9	0.69	0.08	MLE exact	9.0	10.4	6.4
		3	1	0.00	0.00	MLE exact	1.0	1.00	0.7
2	165.0	0	5	0.79	0.16	MLE exact	5.0	6.5	3.0
		1	7	0.12	0.02	MLE exact	7.0	7.2	4.2
		2	16	0.56	0.04	MLE exact	16.0	17.1	9.7
		3	1	0.00	0.00	MLE exact	1.0	1.0	1.2
		4	1	0.73	0.73	Bayes	1.0	2.4	n/a
3	171.0	0	12	1.17	0.10	MLE exact	12.0	14.3	7.0
		1	1	2.03	2.03	Bayes	1.0	5.0	0.6
		2	4	0.21	0.05	MLE exact	4.0	4.4	2.3
		3	1	0.73	0.73	Bayes	1.0	2.4	0.6
4	165.0	0	10	0.42	0.04	MLE exact	10.0	10.8	6.1
		1	4	0.97	0.24	MLE exact	4.0	5.9	2.4
		2	8	0.51	0.06	MLE exact	8.0	9.0	4.9
5	121.5	0	9	0.46	0.05	MLE exact	9.0	9.9	7.4
		1	4	0.21	0.05	MLE exact	4.0	4.4	3.3
		2	16	1.09	0.07	MLE exact	16.0	18.1	13.2
		3	1	0.00	0.00	MLE exact	1.0	1.0	0.8
6	164.0	0	17	1.03	0.06	MLE exact	17.0	19.0	10.4
		1	1	0.00	0.00	MLE exact	1.0	1.0	0.6
		2	10	0.24	0.02	MLE exact	10.0	10.5	6.1
		3	1	0.00	0.00	MLE exact	1.0	1.0	0.6



APPENDIX G
CHEAKAMUS RIVER RAINBOW TROUT MAXIMUM LIKELIHOOD ESTIMATES

2010 Rainbow Trout Density Calculations

Site No.	Area(m ²)	Age	Population Estimate	Population SE	Population CV	Parameter Estimation	Population Lower CI	Population Upper CI	Density (RB/100m ²)
7	200.0	0	4	0.54	0.14	MLE exact	4.0	5.1	2.0
		1	1	0.00	0.00	MLE exact	1.0	1.0	0.5
		2	7	1.20	0.17	MLE exact	7.0	9.3	3.5
		3	3	0.00	0.00	MLE exact	3.0	3.0	1.5
8	104.5	0	5	0.44	0.09	MLE exact	5.0	5.9	4.8
		1	1	0.00	0.00	MLE exact	1.0	1.0	1.0
		2	6	1.38	0.23	MLE exact	6.0	8.7	5.7
9	57.5	0	6	1.00	0.17	MLE exact	6.0	8.0	10.4
		2	2	0.38	0.19	MLE exact	2.0	2.8	3.5
10	200.0	0	1	0.00	0.00	MLE exact	1.0	1.0	0.5
		1	5	2.14	0.43	Bayes	5.0	9.2	2.5
		2	25	1.87	0.07	MLE exact	24.0	28.7	12.5
		3	7	0.33	0.05	MLE exact	7.0	7.6	4.0
		4	1	0.00	0.00	MLE exact	1.0	1.0	n/a



APPENDIX G
CHEAKAMUS RIVER RAINBOW TROUT MAXIMUM LIKELIHOOD ESTIMATES

2011 Rainbow Trout Density Calculations

Site No.	Area(m ²)	Age	Population Estimate	Population SE	Population CV	Parameter Estimation	Population Lower CI	Population Upper CI	Density (RB/100m ²)
1	150.4	0	1	0.73	0.73	Bayes	1.0	2.44	0.7
		1	2	0.00	0.00	Bayes	2.0	2.00	1.3
		2	11	1.46	0.13	Bayes	10.0	13.85	6.7
		3+	4	0.00	0.00	Bayes	4.0	4.00	2.7
2	200.2	0	4	2.65	0.66	Bayes	4.0	9.20	2.0
		1	7	0.12	0.02	MLE exact	7.0	7.24	3.5
		2	7	0.12	0.02	MLE exact	7.0	7.24	3.5
		3+	1	0.00	0.00	MLE exact	1.0	1.00	0.5
3	146.4	0	4	0.97	0.24	MLE exact	4.0	5.90	2.7
		1	6	0.38	0.06	MLE exact	6.0	6.74	4.1
4	165.0	0	2	0.00	0.00	MLE exact	2.0	2.00	1.2
		1	5	0.00	0.00	MLE exact	5.0	5.00	3.0
		2	1	0.73	0.73	Bayes	1.0	2.44	0.6
5	117.0	0	8	0.29	0.04	MLE exact	8.0	8.57	6.8
		1	4	0.00	0.00	MLE exact	4.0	4.00	3.4
		2	8	0.11	0.01	MLE exact	8.0	8.22	6.8
6	153.0	0	12	0.94	0.08	MLE exact	12.0	13.85	7.8
		1	9	0.26	0.03	MLE exact	9.0	9.51	5.9
		2	2	0.00	0.00	MLE exact	2.0	2.00	1.3
7	110.7	0	4	0.21	0.05	MLE exact	4.0	4.40	3.6
		1	5	0.17	0.03	MLE exact	5.0	5.33	4.5
		2	3	0.71	0.24	MLE exact	3.0	4.39	2.7
		3+	1	0.00	0.00	MLE exact	1.0	1.00	0.9



APPENDIX G CHEAKAMUS RIVER RAINBOW TROUT MAXIMUM LIKELIHOOD ESTIMATES

2011 Rainbow Trout Density Calculations

Site No.	Area(m ²)	Age	Population Estimate	Population SE	Population CV	Parameter Estimation	Population Lower CI	Population Upper CI	Density (RB/100m ²)
8	121.5	0	4	0.54	0.14	MLE exact	4.0	5.07	6.6
		1	8	0.51	0.06	MLE exact	8.0	9.00	13.2
		2	4	0.21	0.05	MLE exact	4.0	4.40	6.6
9	99.9	1	2	0.38	0.19	MLE exact	2.0	2.75	2.0
10	191.1	0	1	0.00	0.00	MLE exact	1.0	1.00	0.5
		1	2	0.38	0.19	MLE exact	2.0	2.75	1.1
		2	10	0.63	0.06	MLE exact	10.0	11.23	5.2
		3+	5	0.44	0.09	MLE exact	5.0	5.87	2.6

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