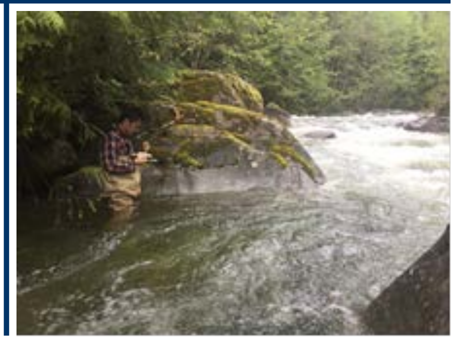
Narrows Inlet Hydroelectric Project

Chickwat Creek Baseline Monitoring Report



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EXECUTIVE SUMMARY

This baseline report documents environmental monitoring studies completed from 2014 to 2016 for the Chickwat Creek component of the Narrows Inlet Hydro Project (the Project). Baseline monitoring is required as part of the operational monitoring plan (OEMP; Faulkner *et al.* 2016) to support issuance of a conditional water license. Proposed long term operational environmental monitoring components for the Project were presented in Condition #12 of Schedule B of the EAC (EAO 2014 and EAO 2016; E13-04). Baseline parameters summarized in this report include water quality, water temperature, stream channel morphology, fish community, and invertebrate abundance. Baseline data for water flow is reported in the Narrows Inlet Hydro Project Instream Flow Study (Healey *et. al.* 2012. Monitoring for Coastal Tailed Frogs was previously a condition of the EAC (EAO 2014), however, based on results of Year 1 baseline studies and collaboration with FLNRO, this monitoring component was removed from Chickwat Creek monitoring (Faulkner *et al.* 2016).

Chickwat Creek is located approximately 75 km northwest of Vancouver, BC, at the head of Narrows Inlet, near the town of Sechelt. The Chickwat Creek component of the Project is a run-of-river hydroelectric generating station with a design capacity of 19 MW. The Chickwat Creek component consists of a main intake located approximately 3 km upstream of the confluence with the Tzoonie River, and a powerhouse and tailrace located approximately 1 km upstream of the confluence with the Tzoonie River. Two tributary intakes will be located on C1, preferentially referred to as Kid - s-xwixwtl'ay-ulh Creek (Kid), and C2, preferentially referred to as Mountain Goat - s-xwitl'ay Creek (Mountain Goat), which flow into the diversion reach on the mainstem of Chickwat Creek. The powerhouse will be situated on Chickwat Creek roughly one km from its confluence with the Tzoonie River. Approximately one km of new transmission line will be built and tie into the existing Tyson Creek transmission line.

Historical Data from multiple sources including provincial and federal agencies and environmental consultants have been collected in Chickwat Creek and were previously compiled and summarized by Ecofish (O'Toole *et al.* 2012). Gaps in the ability of the existing data to support OEMP requirements were identified and have been addressed in the most recent baseline data collection (2014 to 2016). The 2014 to 2016 environmental monitoring studies successfully collected data for all monitoring parameters. The location, timing, methods, and results of sampling are described in the following sub-sections.

Water Quality

The objective of baseline water quality monitoring is to establish baseline ranges of specific water quality parameters. The same parameters will be monitored during operations to identify any biologically significant changes stemming from Project development and operation. Water quality was monitored on a quarterly basis during baseline monitoring (two years). Water quality metrics include pH, specific conductivity, total dissolved solids, alkalinity, total suspended solids, turbidity,

dissolved gases (dissolved gases and total gas pressure (TGP)), and nutrients. Water quality samples were collected at an upstream control site, in the upper diversion, and in the lower diversion.

In general, Chickwat Creek exhibits clear flow conditions in every season, with low conductivity and low alkalinity indicating sensitivity to acidic inputs. The water quality sampling sites exhibited well oxygenated conditions, with pH values typical for BC streams. Based on low total phosphorus concentration, Chickwat Creek trophic status is ultra-oligotrophic. Nitrogen based nutrients were either not detected or detected at low concentrations, as is typical for BC streams.

All parameters except for total gas pressure met water quality guidelines for the protection of aquatic life. TGP exceeded the more conservative shallow water guideline for the protection of aquatic life in both the upper and lower diversion sites in Chickwat Creek during baseline sampling on several dates in all sampling quarters. Natural exceedances of the dissolved gas supersaturation guideline are not uncommon in steep, fast flowing BC streams.

During the first year of Project operations, quarterly water quality monitoring will be required for pH, specific conductivity, total dissolved solids, dissolved oxygen, TGP, and low level nutrients (orthophosphate, total phosphorous, ammonia, nitrate and nitrite) at upstream, diversion and downstream water quality sites. In addition, total suspended solids and turbidity will be monitored in the lower diversion reach and downstream, and alkalinity will be monitored once per year. After the first year of operations, the frequency of water quality monitoring will be re-evaluated.

Water Temperature

Baseline water temperature data was collected by Aquarius R&D from March 2008 to September 2011 at two sites: one in the Chickwat Creek upstream reach and one in the lower diversion reach (O'Toole *et al.* 2012). Data collection continued at these sites using hydrometric gauges from 2011 to 2016, however only the upstream site provided reliable data during this period. In 2014, Ecofish was commissioned to monitor baseline water temperature in the Project Area at five key locations (upstream, upper and lower diversion in Chickwat Creek and upstream of the proposed tributary intakes in Kid and Mountain Goat creeks) in support of the Project OEMP (Faulkner *et al.* 2016).

The baseline thermal regime of Chickwat Creek and the two tributaries (Kid and Mountain Goat) was characterized using temperature data logged from fall 2014 to early May 2016, supplemented with water temperature data collected at the hydrometric gauge operated by Aquarius R&D in the upstream location (2010 to 2016) and historical data set spanning 2008 to 2011. Air temperature data was also collected at the Chickwat Creek lower diversion reach site from September 2014 to early May 2016.

High inter-annual variation in temperature was observed with annual average temperatures ranging from 4.4°C (2011) to 7.7°C (2015). Considering all sites and dates in the baseline period, the watercourses exhibited an overall cold/cool water temperature regime with the minimum and maximum monthly average temperatures ranging from 0.9°C (recorded in the upstream reach in

December 2009) to 15.8°C (recorded in the lower diversion reach in August 2009) in the mainstem and from 1.6°C to 14.4°C in the tributaries.

Air temperature data recorded in the upper diversion reach of Chickwat Creek, exhibited an air temperature regime with typical annual cycling and diurnal fluctuations ranging from -5.7°C to 27.1°C from September 18, 2014 to May 3, 2016.

Evaluation of the occurrence of daily average temperatures that exceed extremely low (<1ºC) and/or high water temperatures (>18°C and >20°C) indicates that water temperatures less than 1 ºC were recorded at all the sampling sites in Chickwat Creek (annual occurrence of daily average temperature <1°C ranged from 0 to 12) and the tributary (annual occurrence of daily average temperature <1°C ranged from 0 to 30). No daily average temperatures above 18 °C were recorded at any site in the mainstem or the tributary. The start of the growing season was variable between years and sites and ranged from April 13 to June 14. The end of the season was less variable ranging from November 8 to November 24. The accumulated thermal degree days, calculated as a sum of daily average temperature during the growing season, ranged from 1,160 (upstream in 2011) to 2,674 (lower diversion site in 2015).

In the baseline record, there were a small percentage of exceedances of the ±1°C/hr temperature change threshold (MOE 2017), ranging from 0.00% to 0.3% across all sites. The greatest rate of water temperature change was a decrease of 1.4°C/hr, observed in the tributaries during the cooler months.

The Project OEMP (Faulkner *et al.* 2016) stipulates continued temperature monitoring for the first five years of operations to facilitate the identification of any biologically significant differences between baseline and operational temperature regimes.

Stream Channel Morphology

Baseline stream channel morphology data was collected during October 2015. The monitoring requirements were detailed in the Project OEMP (Faulkner *et al.* 2016), and were based on previous geomorphic assessments and potential Project effects noted in the Updated Aquatic Environmental Assessment (Lacroix *et al.* 2015). Baseline surveys were undertaken from the existing bridge crossing in the downstream reach to the anadromous barrier in the lower diversion reach.

The survey consisted of a combination of quantitative and qualitative observations. Quantitative observations included topographic transect surveys in the diversion reach (5) and downstream reach (2), a thalweg survey connecting the transects, and Wolman pebble counts at each of the seven transects. Qualitative assessment consisted of a photo based rapid geomorphic assessment to characterize channel form and active processes, oblique photos from multiple perspectives at each topographic transect, vertical photos of cobble and gravel deposits in the vicinity of the transects, oblique photographs in the headpond reach, and aerial photographs in the headpond, diversion, and downstream reach. Additionally, previous catchment scale observations (NHC 2011, MMA 2013) and reach scale geomorphic based habitat assessments (Zyla and Lewis 2012) were reviewed and summarized.

The upstream reach morphology was only assessed using the previous habitat assessment (Zyla and Lewis 2012). This reach was dominated by riffle morphology with a bankfull width of 24.0 m, bankfull depth of 1.5 m, and thalweg gradient of 2.6%. The dominant substrate class was boulder, and 26.5 m^2 of total spawning habitat was observed. Large wood distribution will be assessed by comparing aerial photographs, which were captured during baseline using a UAV on August 4, 2016.

The diversion reach morphology consisted of boulder and bedrock forced cascade morphology, with a section of boulder step-pool morphology. The channel morphology was generally stable with moderate localized bank erosion. Transects were surveyed through partial pools below step or cascade features. The average channel gradient was 8.7% over 158 m of surveyed thalweg. Pool depths relative to downstream feature crests ranged from 18.6 cm to 65.9 cm. The reach D50 was 132 mm and D84 was 662 mm. The previous habitat assessment (Zyla and Lewis 2012) found an average bankfull width between 25.0 and 26.0 m, and 230.7 m^2 of total spawning habitat. Large wood distribution will be assessed by comparing future aerial photographs.

The downstream reach morphology consisted of a downstream progression from boulder forced cascade to boulder/cobble plain bed. The general direction of change appears to vary based on large flow and sediment transport events. The current direction of change consists of a recovering sinuous bankfull channel within the existing entrenched channel. Downstream of the existing bridge, the channel opens into a debris fan with active aggradation, which provides evidence that upstream mass wasting events convey large quantities of sediment through the diversion and downstream reaches. Transects were surveyed through partial pools below cascades. The average channel gradient was 4.64% over 120 m of surveyed thalweg. Pools depths ranged from 11.6 cm to 39.5 cm. The reach D50 was 118 mm and D84 was 446 mm. The previous habitat assessment (Zyla and Lewis 2012) found a bankfull width of 21.0 m, bankfull depth of 1.4 m, and 121.2 m^2 of total spawning habitat. Large wood distribution will be assessed by comparing aerial photographs.

The Project OEMP (Faulkner *et al.* 2016) stipulates that the stream channel morphology survey should be repeated 5 years after facility commissioning or after a 1 in 10 year discharge event, whichever comes first. Additionally, spawning gravel surveys and operational history records will be collected annually throughout the first 5 years.

Fish Community

The objective of the fish community monitoring program is to monitor potential Project effects on the health of the fish community. The diversion reach in Chickwat Creek is differentiated into the lower and upper diversion based on the presence of a barrier to upstream migration for anadromous fish (Yeomans-Routledge *et al.* 2012a). The lower diversion reach is defined as the area between the tailrace and the anadromous fish barrier; juvenile and adult Rainbow Trout, Cutthroat Trout, Dolly Varden, and Coho Salmon have been observed within this reach. Within the upper diversion (resident) reach, Dolly Varden are the only species present. Other species of anadromous fish may also use the lower diversion reach, such as steelhead though none have been observed during anadromous snorkels within this reach to date. This report presents data on fish abundance, density, condition, biomass, size-at-age, and distribution for the two years of baseline monitoring of the resident Dolly Varden population within the upper diversion and upstream reaches, and the first of two years of required baseline monitoring within the lower diversion of Chickwat Creek and the Tzoonie River, in support of the adaptive management plan (AMP) prescribed in the Project OEMP (Faulkner *et al.* 2016). An additional year of baseline monitoring will be conducted within the lower diversion in 2017 and will be reported on separately.

After an additional year of baseline monitoring in the lower diversion of Chickwat Creek and Tzoonie River and five years of operational monitoring, baseline and operational results from the upper diversion (impact) and upstream reach (control) of Chickwat Creek, and the lower diversion (impact) and Tzoonie River (control) will each be compared through a before-after control-impact (BACI) experimental design. Data were primarily collected through mark-recapture snorkel surveys in all reaches and secondarily, through minnow trapping within the upper diversion and upstream reaches of Chickwat Creek, and through reconnaissance open-site electrofishing within the Chickwat Creek lower diversion and Tzoonie River.

Overall, capture efficiencies of fry (0+) and adult (≥3+) Dolly Varden were lower in the upstream reach than in the upper diversion of Chickwat Creek in 2014, but higher in the upstream reach than in the upper diversion in 2015. In contrast, capture efficiencies were higher in the upstream reach than in the upper diversion for juveniles (1+ and 2+) in both years of baseline monitoring. Estimated densities and biomass of Dolly Varden fry were considerably higher in the upstream reach than in the diversion reach in 2014, having the highest density amongst all age classes in both reaches. In contrast, no fry were observed during snorkel surveys in the upper diversion in 2015. The densities and biomass of juvenile and adult Dolly Varden were similar among the two reaches in both years, but slightly higher for juveniles in 2015, and highest for 1+ juveniles in both years. Fish captures and catch per unit effort in minnow traps were low in both years, but, on average, considerably higher in 2015 compared to 2014. Captured Dolly Varden were slightly larger on average in both reaches in 2015, however their condition was similar among both reaches and years.

The power to detect a 50% effect based on the 2014 and 2015 baseline density (FPU_{obs}) data varied widely among age classes. However, the power to detect a 50% effect on combined age class metrics (e.g. ≥1+ and All fish) was high (~1.0), with detectable effect sizes as low as 21%, based on five years of monitoring. Therefore, the estimated power and detectable effect size for combined age classes are consistent with the minimum 0.8 power recommended by monitoring guidelines, suggesting that the existing study design and baseline data collection will be adequate to detect a 50% reduction in Dolly Varden densities after 5 years of monitoring.

On average, capture efficiencies of Rainbow Trout and Cutthroat Trout were lower in the Chickwat Creek lower diversion than in the Tzoonie River control sites. Overall, densities and biomass densities of fry (0+), and to a lesser extent juvenile (1-2+) trout, were much higher in the Chickwat Creek lower diversion than those in the Tzoonie River reach. In contrast, densities and biomass densities of adult (≥3+) trout were very similar in the two systems. Densities and biomass densities of both ≥1+ and adult combined Rainbow Trout and steelhead (i.e., AMP metrics 1and 3, respectively) were higher in the diversion of Chickwat Creek, than those of ≥1+ and adult Cutthroat Trout in the Tzoonie River.

Due to low captures it was not possible to calculate capture efficiencies for Dolly varden within the lower diversion of Chickwat Creek and the Tzoonie River, instead capture efficiencies of all trout species combined were used to estimated abundance for this species. No fry or 2+ juveniles were captured in either the lower diversion or Tzoonie River in 2016. Overall, densities and biomass of 1+ Dolly Varden were higher in the Tzoonie River than in the lower diversion of Chickwat Creek, while adults of this species were only captured in the Chickwat Creek lower diversion.

As with Dolly Varden, Coho Salmon fry captures were too low to calculate capture efficiencies so that of trout fry were used to estimate abundance for this species. Densities and biomass densities were highest in the lowermost sites within the lower diversion, while no Coho fry were captured in the two uppermost mark-recapture sites and none were captured within the Tzoonie River.

Capture efficiencies of combined trout juveniles (1-2+; AMP metric 2) and adults (≥3+; Metric 4) were similar in the Chickwat Creek lower diversion and the Tzoonie River, being slightly higher for adults than for juveniles. Densities and biomass densities of combined trout varied among the two AMP metrics, sites and the two reaches. In general, densities of combined juvenile trout (metric 2) were higher than that of adults (metric 4), and higher in the Chickwat lower diversion reach than in the Tzoonie River. In contrast, densities of combined adult trout were very similar in the two systems. In contrast to trends in density, biomass of juveniles and adults were very similar, but as with density estimates, on average, juvenile biomass densities were higher in the Chickwat Creek lower diversion than those in the Tzoonie River, and those of adults were similar in the two reaches.

Cutthroat Trout were the most abundant species captured during reconnaissance electrofishing within both reaches, followed by Coho fry and Rainbow Trout in the lower diversion of Chickwat Creek, and Dolly Varden within Tzoonie River sites. Total Trout captures were higher in the Chickwat Creek lower diversion than in the Tzoonie River.

Individual fish metrics varied with species, and reach, but, in general, fish were slightly larger in the lower diversion of Chickwat Creek, than in the Tzoonie River, with Cutthroat Trout being the largest species on average. Condition of individuals varied, but was similar across species and between the two reaches, with values being slightly higher, on average, for smaller individuals.

During anadromous snorkel surveys, the most commonly observed species in both seasons were Rainbow Trout, followed by Cutthroat Trout within the lower diversion and downstream reaches of Chickwat Creek and Tzoonie River, with counts being higher in the fall than in the spring.

On average, counts of Cutthroat Trout were higher in the spring and lower in the fall compared to those in the Tzoonie River sites. Results for Rainbow Trout were more variable, but aside from higher average counts in the AMP control reach within the Tzoonie River in the fall, generally followed trends for Cutthroat. Counts of Dolly Varden were very low during anadromous snorkel surveys, particularly in the Tzoonie River sites, but with counts similar among surveys in the two seasons. Counts of steelhead were similarly low, with none observed during fall surveys or in the Chickwat Creek lower diversion. Coho Salmon were not observed during surveys in the spring and counts of this species were similarly low in Chickwat Creek in the fall, but they were abundant within the Tzoonie River sites in the fall with counts similar to that of Rainbow Trout. Counts of combined steelhead and Rainbow Trout adults (i.e., AMP metric 3) closely followed those of Rainbow Trout described above. Overall, adult snorkel counts showed high variability, which limit statistical power to detect a Project related effect. Therefore, we propose to focus on the mark-recapture based adult abundance estimates for monitoring of the AMP.

No changes to the resident fish community monitoring program or anadromous and resident AMP monitoring program are recommended at this time. Accordingly, monitoring will continue using the same methods used to date for the required five years of operational monitoring within the upper diversion and upstream reaches of Chickwat Creek and the second year of AMP baseline monitoring and five years of operational monitoring within the Chickwat Creek lower diversion and Tzoonie River, as specified in the OEMP.

Invertebrate Drift

The objective of monitoring invertebrate drift is to test whether change occurs in the density, biomass, or community composition of the invertebrate drift population to the extent that the productive capacity of fish habitat in the diversion and/or downstream sections may be reduced. Requirements for operational monitoring of invertebrate drift was not identified as a component of the OEMP (EAO 2014; therefore operational monitoring of macroinvertebrate drift is not proposed. The baseline data collected will form the foundation for an evaluation of the ecosystem response to the Project should this be a requirement at a future date (e.g., if the Project is shown to have altered the thermal regime or water quality to a degree that is deemed to be potentially significant).

Invertebrate drift sampling in Chickwat Creek occurred in late September and early November of 2014 and 2015 at three sites in Chickwat Creek; one upstream site, one diversion site, and one downstream site. Density, biomass, Simpson's diversity index, richness, and the Canadian Ecological Flow Index (CEFI) were calculated for each sample collected on each date of monitoring. The top five families contributing to biomass at each site on each date were also identified.

The mean invertebrate drift density at a site on a given sample date varied from 0.55 to 3.25 individuals/m^3, while mean biomass varied from 0.046 to 0.51 mg/m^3. For a given year, higher density and biomass at a site were typically observed in September compared to November. Mean Simpson's diversity index values (family level) at a site on a given sample date varied from 0.20 to

0.92, while mean richness (number of families) varied from 18.8 to 44.2. Simpson's diversity index and richness values were generally consistent across sites and sample dates, with the exception of samples collected in September 2014, where results were relatively lower. Mean Canadian Ecological Flow Index (CEFI) values varied from 0.33 to 0.42, and were consistent across sample dates, with the highest values generally observed at the upstream site, and the lowest values observed at the downstream site.

The invertebrate drift community was dominated in terms of biomass primarily by mayflies (Baetidae, Heptageniidae, Ameletidae, and Ephemerellidae) and true flies (Chironomidae, Muscidae, Mycetophilidae, Tachinidae and Tipulidae), and to a lesser extent by caddisflies (Limnephilidae, Rhyacophilidae, and Lepidostomatidae) and butterflies/moths (Notodontidae, Geometridae, and Lepidoptera).

The drift invertebrate community composition differed most strongly by sample collection date with the communities for individual reaches clustering together. The invertebrate community sampled in September 2014 diverged from the communities sampled in November 2014 and September and November 2015. Across reaches on a given sample date, the downstream site diverged the most from the other two sites and this was significant on two occasions (both days in 2014). Overall, the invertebrate drift communities at Chickwat Creek appear to be primarily driven by the date of sampling with relatively similar communities observed across reaches.

The diversion reach power analysis predicts that a 50% reduction in invertebrate drift density would be detected with 1.00 power at a significance level of (α) of 0.05 after five years of operational monitoring. The minimum detectable effect sizes after five years of operational monitoring with 0.80 power are estimated at 32% for α=0.05 significance level. In contrast, the downstream reach power analyses predicts less power, 0.74, to detect a 50% reduction in density at a significance level of α=0.05. An effect sizes of 54% for α=0.05 would be detectable after five years of operational monitoring at the downstream sites.

The diversion and downstream reach power analysis predicts that a 50% reduction in invertebrate drift biomass would be detected after five years of operational monitoring with a 0.41 and 0.12 power, respectively at a significance level of (α) of 0.05. The minimum detectable effect sizes after five years of operational monitoring with 0.80 power are estimated at 86% and >100% for the diversion and downstream sites, respectively. More than 20 years of operational monitoring in the diversion and downstream would be necessary to detect a 50% decrease in biomass with a power of 0.80.

Closure

The baseline data have been collected according to the required methods stated in the Chickwat Creek OEMP (Faulkner *et al.* 2016). The data are adequate to effectively monitor the study components over the planned duration of the monitoring program. No issues of concern have been noted for four out of five monitoring components (Water Quality, Water Temperature, Stream

Morphology, and Invertebrate Drift) during baseline data collection. Results from adult fish abundance from adult snorkel surveys in the Chickwat lower diversion and downstream reaches showed high variability, which limit statistical power to detect a project related effect. Therefore we propose to focus monitoring of the fish AMP on the mark-recapture based adult abundance estimates.

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1. INTRODUCTION

Ecofish Research Ltd. (Ecofish) was retained by tems sayamkwu Limited Partnership (tems sayamkwu) to prepare a draft operational environmental monitoring plan (OEMP) that is required to support issuance of a conditional water licence for the Chickwat Creek component of the Narrows Inlet Hydro Project (the Project). The OEMP includes plans for baseline and operational monitoring. Proposed long term operational environmental monitoring components for the Project were initially listed in brief in Volume 1 Part P of the Application for an Environmental Assessment Certificate (the Application) and were presented in Condition #12 of Schedule B of the EAC (EAO 2014; E13-04). A draft OEMP addressing the operational monitoring components listed in the EAC was submitted to tems sayamkwu on March 29, 2016 (Faulkner *et al.* 2016). This report provides a summary of baseline aquatic data collected from 2014 to 2016 in Chickwat Creek.

Chickwat Creek is located approximately 75 km northwest of Vancouver, B.C., at the head of Narrows Inlet, near the town of Sechelt (Map 1) and is the largest tributary basin to the Tzoonie River. The Chickwat Creek component of the Project is a run-of-river hydroelectric generating station with a design capacity of 19 MW. The Chickwat Creek component consists of a main intake located approximately 3 km upstream of the confluence with the Tzoonie River, and a powerhouse and tailrace located approximately 1 km upstream of the confluence with the Tzoonie River. The elevations of the intake and powerhouse are 438 m and 114 m above sea level, respectively. Two intakes will be located on tributaries of Chickwat Creek, C1, preferentially referred to as Kid - s-xwixwtl'ay-ulh Creek (Kid), and C2, preferentially referred to as Mountain Goat - s-xwitl'ay Creek (Mountain Goat), which flow into the diversion reach on the mainstem of Chickwat Creek. The tributary intakes will divert water from the tributaries to the main intake by way of penstock pipes. The powerhouse will be situated on Chickwat Creek roughly one km from its confluence with the Tzoonie River. Approximately one km of new transmission line will be built and tie into the existing Tyson Creek transmission line.

The footprint and operational effects of the Chickwat Creek components of the Project on the aquatic environment will be monitored as outlined in the OEMP (Faulkner *et al.* 2016). The approach is consistent with the most recent provincial and federal guidance documents for long term monitoring of hydroelectric projects (Hatfield *et al.* 2007, Lewis *et al.* 2013). Baseline parameters summarized in this report include water quality, water temperature, stream channel morphology, fish community, and invertebrate abundance. Baseline data for water flow, mitigation and compensation measurement, and aquatic and riparian habitat are reported elsewhere. Monitoring for Coastal Tailed Frogs was previously a condition of the EAC (EAO 2014), however, based on results of Year 1 baseline studies and collaboration with FLNRO, this monitoring component was removed from Chickwat Creek monitoring (Faulkner *et al.* 2016).

2. BACKGROUND AND OBJECTIVES

Historical Data from multiple sources including provincial and federal agencies and environmental consultants have been collected in Chickwat Creek and were previously compiled and summarized by Ecofish (O'Toole *et al.* 2012). Gaps in the ability of the existing data to support OEMP requirements were identified and have been addressed in the most recent baseline data collection (2014 to 2016).

2.1. Water Quality

Water use can affect water quality indirectly by altering the volume of water remaining in a channel, or directly by returning water of altered quality to the river channel (Hatfield *et al.* 2007). Reduction of flow can modify levels of pH, specific conductivity, total dissolved solids (TDS), alkalinity, total suspended solids (TSS), turbidity, dissolved oxygen (DO), total gas pressure (TGP), and low-level macro-nutrient parameters (nitrogen (N) and phosphorus (P) based). Water quality variables must be maintained within strict parameter ranges to ensure the protection of fish and fish habitat (Lewis *et al.* 2013). Certain water quality variables must therefore be monitored to ensure that biologically significant changes to water quality are not induced by Project development and operation.

Historical baseline water quality data for Chickwat Creek was summarized in O'Toole *et al.* (2012) Water quality samples were previously collected at one site in the downstream reach, in a location considered to be representative of conditions in the diversion site. Five samples collected in each of the four seasons were collected, except for dissolved gases which were measured on only a single occasion. Chickwat Creek exhibited water quality characteristics typical of the region. Concentrations of dissolved minerals and ions were low and trophic status was deemed ultra-oligotrophic based on very low concentrations of nutrients. pH was slightly acidic, and alkalinity was low indicating low buffering capacity. Historical baseline monitoring prior to 2012 did not meet long-term monitoring requirements (Lewis *et al.* 2013). A control site was not established and sampling frequency was insufficient. Additional baseline monitoring was therefore planned.

The objective of this report is to summarize the methods and results of two years (2014 to 2016) of quarterly baseline water quality sampling in the upstream and diversion reaches of Chickwat Creek. This baseline report will provide the water quality data required to support the long term monitoring plan as prescribed in the Project OEMP (Faulkner *et al.* 2016).

Quarterly operational water quality monitoring will be required for pH, specific conductivity, TDS, DO, TGP, and low level nutrients (orthophosphate, total phosphorous, ammonia, nitrate and nitrite), at the upstream, diversion and downstream water quality sites during the first year of operation. In addition, TSS and turbidity will be monitored in the lower diversion reach of Chickwat Creek and downstream of the Chickwat Creek tailrace. Alkalinity will be monitored once per year during operations during the critical period streamflow (CPSF) for use in calculations of stream productivity. After the first year of operations, the frequency of water quality monitoring will be re-evaluated.

2.2. Water Temperature

The diversion of water has the potential to change water temperature in the diversion reaches relative to baseline due to the decrease in volume of water in the channel (Meier *et al.* 2003). During the warmer months, the reduction of flow in the diversion reach could potentially increase temperature to harmful levels for aquatic life. Conversely, in the cooler months lower flows could result in depressed temperatures and increased risk of ice formation. The rate of water temperature heating and cooling may be altered and water temperature in the downstream reach may also be affected by diversion of water from the upstream sources (Chickwat Creek and the two tributaries), unnatural heat exchange rates in the penstock, seasonal fluctuations in temperature and flow rate, as well as temperature induced changes in the diversion reach all contribute to the final temperature observed in the reach downstream of the Project.

Fish are vulnerable to small changes in water temperature, shifts in water temperature regimes and alteration of the rate of change of water temperature. Tolerances to temperature changes vary between species, life-history stages, and the baseline temperature regime to which species are adapted.

Baseline water temperature data was collected by Aquarius R&D from March 2008 to September 2011 at two sites: one in the Chickwat Creek upstream reach and one in the lower diversion reach (Bates *et al.* 2010, O'Toole *et al.* 2012).

In 2014, Ecofish was commissioned to monitor baseline water temperature in the Project Area at five key locations in accordance with the provincial guidelines (Hatfield *et al.* 2007) and the DFO Long term Monitoring Protocols (Lewis *et al.* 2013) for hydroelectric projects. Response monitoring of water temperature employs a rigorous and quantitative before-after control-impact (BACI) experimental design. In a BACI design, "control" sites (i.e., streams or reaches without water extraction) are monitored simultaneously with "impact" sites for a predetermined period both before and after project implementation. Control sites will generally be chosen upstream of the intake, and impact sites will be within the diversion reach. Baseline data will be collected for two years and compared to long term monitoring data collected during operations (Lewis *et al.* 2013).

Commencing in 2014, water temperature was collected in the Chickwat mainstem (upstream, diversion and lower diversion sites) and upstream of the proposed tributary intakes in Kid and Mountain Goat creeks. The upstream sites in Chickwat Creek provide the control data used to assess temperature fluctuations resultant of climate variability between monitoring years. The lower diversion site in Chickwat Creek will provide the baseline data to evaluate potential downstream effects during operations.

The objective of this baseline report is to provide the water temperature baseline data summary and analysis required to support the long term monitoring plan as prescribed in the Project OEMP (Faulkner *et al.* 2016). Long term monitoring of water temperature for a period of five years is prescribed in the OEMP to determine Project effects on stream temperature and assess whether project-related effects are biologically significant, affecting growth, survival, or reproductive success of the fish populations.

BACI criteria for comparing baseline and operational water temperature results include comparison of the following metrics: monthly water temperature summary statistics (average, minimum, maximum and standard deviation), comparison of temperature regimes relative to the upstream control site, degree days in the growing season, and number of days when the temperature is >18°C, >20°C or <1°C.

2.3. Stream Channel Morphology

The purpose of this report is to provide results of the baseline geomorphic monitoring surveys of Chickwat Creek conducted in October 2015. These results establish the baseline geomorphic requirements for monitoring projects as per Hatfield *et al.* (2007), Lewis *et al.* (2004), and the Clean Energy Development Plan Guidelines (Province of British Columbia 2011). Guidelines for the level of geomorphology assessment are provided in Lewis *et al.* (2004) and Lewis *et al.* (2013). Necessity for this baseline survey effort and details of post-commissioning geomorphic monitoring are detailed in the Operational Environmental Monitoring Plan (OEMP) for the Project (Faulkner *et al.* 2016). Baseline surveys were undertaken from the existing bridge crossing in the downstream reach to the anadromous barrier in the lower diversion reach. This area was selected due to the presence of multiple fish species and dynamic morphology susceptible to upstream changes in sediment transport regime. The observations consisted of topographic transect and thalweg profile surveys, pebble counts, and oblique and vertical photographs. Oblique photographs were also collected in the headpond reach and aerial photographs were collected in the headpond, upstream, diversion, and downstream reach during August 2016.

The purpose of this baseline assessment is to characterize existing conditions and the current directions of change resultant of natural or anthropogenic processes, in order to differentiate the cause of future changes between Project and non-Project drivers. The focus of the assessment was therefore guided by the processes most likely to be affected by the Project outlined in the Updated Aquatic Environmental Assessment (Lacroix *et al.* 2015). This survey will be repeated in year 5 post-commissioning, or after a 1 in 10 year daily peak flow event, with spawning gravel surveys and operational history records collected each year (Faulkner *et al.* 2016).

Existing geomorphic assessments (NHC 2011, MMA 2013, Zyla and Lewis 2012) and the Aquatic Environmental Assessment (Lacroix *et al.* 2015) were reviewed to identify watershed scale geomorphic characteristics, disturbance history and potential Project effects given current conditions.

2.3.1. Watershed Description

Chickwat Creek is a 5th order stream with a total length of 14 km and drainage area of 52 km^2 (NHC 2011). Most sediment is derived from historical glacial deposits. The Chickwat headwaters are located in a glacially formed U-shaped valley with small cirque lakes at the heads of the five main tributaries. The valley gradient is less steep upstream of the proposed intake compared to the diversion reach. The catchment forest ranges from Coastal Western Hemlock in lower areas up to Alpine Tundra at high elevation (NHC 2011).

Logging in the Chickwat watershed has been ongoing since at least 1972 when it was observed to extend 11.7 km upstream of the Tzoonie River confluence (NHC 2011). Logging in the largest tributary watersheds (Kid and Mountain Goat) has caused slope failures that have affected these tributaries as well as Chickwat Creek (MMA 2013). A debris fan between the bridge crossing and Tzoonie River confluence has grown in size and created multi-thread channels as a result of logging practices (NHC 2011). As of 2005, parts of the Chickwat catchment had stabilized, but some areas were still subject to slope failures (NHC 2011). Heightened sediment loading is expected to occur until mature trees have established on slopes. The frequency of large sediment input events could be years or decades (NHC 2011). A 1997 landslide event in the Kid Tributary catchment caused by logging related slope instability was estimated to have deposited 50,000 m^3 of material on the downstream fan (Lacroix *et al.* 2015).

Upstream of the proposed intake, the channel consists of a low gradient riffle dominated alluvial section and a steep bedrock and boulder controlled section from the intake at km 3.5 to approximately 169 m upstream of the proposed tailrace (NHC 2011). The diversion reach has an average gradient of 13% and is dominated by highly confined bedrock and boulder controlled morphology. The lower diversion reach has a gradient of 8% and is dominated by boulder controlled cascades with cobble and gravel patches. The lower diversion and downstream reach between the canyon and active bridge crossing features bank protection consisting of steep boulder and cobble slopes that was installed to protect the bridge (MMA 2013). The downstream fan has a gradient of 2% and consists of multiple unstable distributary channels with cobble and gravel dominated plane-bed morphology (MMA 2013). Tributaries Kid and Mountain Goat have gradients of 29% and 21%, respectively, and are also dominated by bedrock and boulders (NHC 2011).

2.3.2. Potential Project Effects

Potential Project effects on stream channel morphology were assessed to be limited to the downstream reach (Lacroix *et al.* 2015) from the tailrace to Tzoonie River. The morphology of the diversion reach canyon section is not expected to change due to the dominant cascade morphology and valley wall confinement. A small section of the lower diversion reach may be affected between the canyon reach and the tailrace (169 m) where gravel patches were identified. The upstream reach will be backwatered by the headpond which will cause changes in morphology within the headpond and in the channel adjustment storage zone (NHC 2013). Previously identified potential effects to the downstream and lower diversion reach include: down-cutting (reduction in bed elevation), net loss of spawning gravel until bedload transport through the headpond resumes, bed material coarsening, transient fines deposition, and loss of functional large wood. A description of how the baseline and year 5 surveys will be used to assess these potential effects is provided as follows.

Comparison of oblique and aerial headpond photos will provide an indication of the amount of sediment and large wood prevented from transport downstream. Large wood pieces trapped in the headpond will be enumerated during the year 5 survey using aerial photos.

Changes in the quantity and functionality of spawning gravel patches and large wood will be identifiable using information from the FHAP survey (Zyla and Lewis 2012) and aerial photos. Changes in the bulk amount of spawning gravel in the channels will be observable in the transect sediment size distributions, spawning gravel surveys, and to a lesser extent in transect and aerial photos.

Accumulation of fines will be assessed via oblique photo inspection of pool bottom substrate class, gravel embeddedness, substrate fouling level, bed and bar material sorting, and bar extents. Fines accumulation will also be identifiable using topographic transect surveys and pebble counts.

Down-cutting will be observable in the thalweg and transect topographic surveys. General reach and transect photos will be used to confirm that any observed changes are not merely a result of survey uncertainties. Down-cutting would also likely result in a coarsening of substrate size, which may be detectable with the pebble counts.

2.4. Fish Community

The construction and operation of a hydroelectric project has the potential to directly or indirectly impact the health of fish communities in the diversion reach and/or downstream of the Project. Potential impacts include changes to abundance, density, condition, biomass, size-at-age relationships, distribution, timing of migration, and survival (Lewis *et al.* 2013). The diversion reach in Chickwat Creek is differentiated into the lower and upper diversion based on the presence of a barrier to upstream migration for anadromous fish (Yeomans-Routledge *et al.* 2012a). The lower diversion reach is defined as the area between the tailrace and the anadromous fish barrier; Rainbow Trout, Cutthroat Trout, Dolly Varden and Coho Salmon (parr and adults) have been observed within this reach and other species of anadromous fish such as steelhead may also use this reach (Yeomans-Routledge *et al.* 2012b). Within the upper diversion (resident) reach, Dolly Varden is the only species present.

Monitoring will be conducted in both upper diversion reach and in the lower diversion reach. In the upper diversion reach the resident Dolly Varden population will be monitored along with an upstream control location with the objective of identifying any changes in abundance, density, condition, distribution, or timing of migration. The anadromous and resident fish population in the lower diversion reach of Chickwat Creek along with a control reach in the Tzoonie River will be monitored as part of the adaptive management plan (AMP) (Lewis *et al.* 2015). The AMP was prepared for the management of instream flows in an adaptive management framework to manage potential risks to fish habitat to an acceptable level to MFLNRO. The AMP specifically defines the threshold in terms of adverse effects to fish abundance, at which, after further investigations and confirmation, the application of additional mitigation measures (including additional IFR) would be required (Table 1; Lewis *et al.* 2015). Any one of the four metrics may trigger a decision to pump flow; however, any decision would be preceded with a detailed analysis and biological interpretation by a qualified professional (QP) of the baseline and operational data collected at the impact and control sites to rule out, to the extent the data permit, other causes of a decrease in fish abundance.

This report includes the results from the two years of baseline monitoring required for the upper diversion reach and five years of baseline anadromous snorkel surveys (2011-2016) and the first of two years (2016) of required baseline data of fish abundance in the lower diversion of Chickwat Creek and Tzoonie River, in support of the AMP long term monitoring plan prescribed in the Project OEMP (Faulkner *et al.* 2016).

Table 1. Monitoring Metric, action abundance threshold (AAT) and Pumped Flow Release required for Adaptive Management Plan (Lewis *et al.* 2015).

Metric	AAT[1]	Pumped Flow Release [3]
1. Rainbow Trout/steelhead juvenile (>0+) abundance	Average before[2] compared to average after: Y2 -40%; Y3 -35%, Y4 -30%; Y5 -30%.	May 8 – Oct 23: 0.2 m^3/s
2. Salmonid juvenile (>0+) abundance	"	as for Metric 1
3. Rainbow Trout/steelhead adult abundance	"	Mar 1 – May 7: 1.9 m^3/s
4. Salmonid adult abundance	"	Jan 1 – Jan 7: 0.6 m^3/s Oct 24 – Dec 31: 0.6 m^3/s

[1] The AAT is -40% after Year 2, -35% after Year 3, and -30% after Year 4 and 5 and there is no corresponding decrease evident in the relevant control reach.

[2] Before refers to the average of all baseline years, with a minimum of 2 years required.

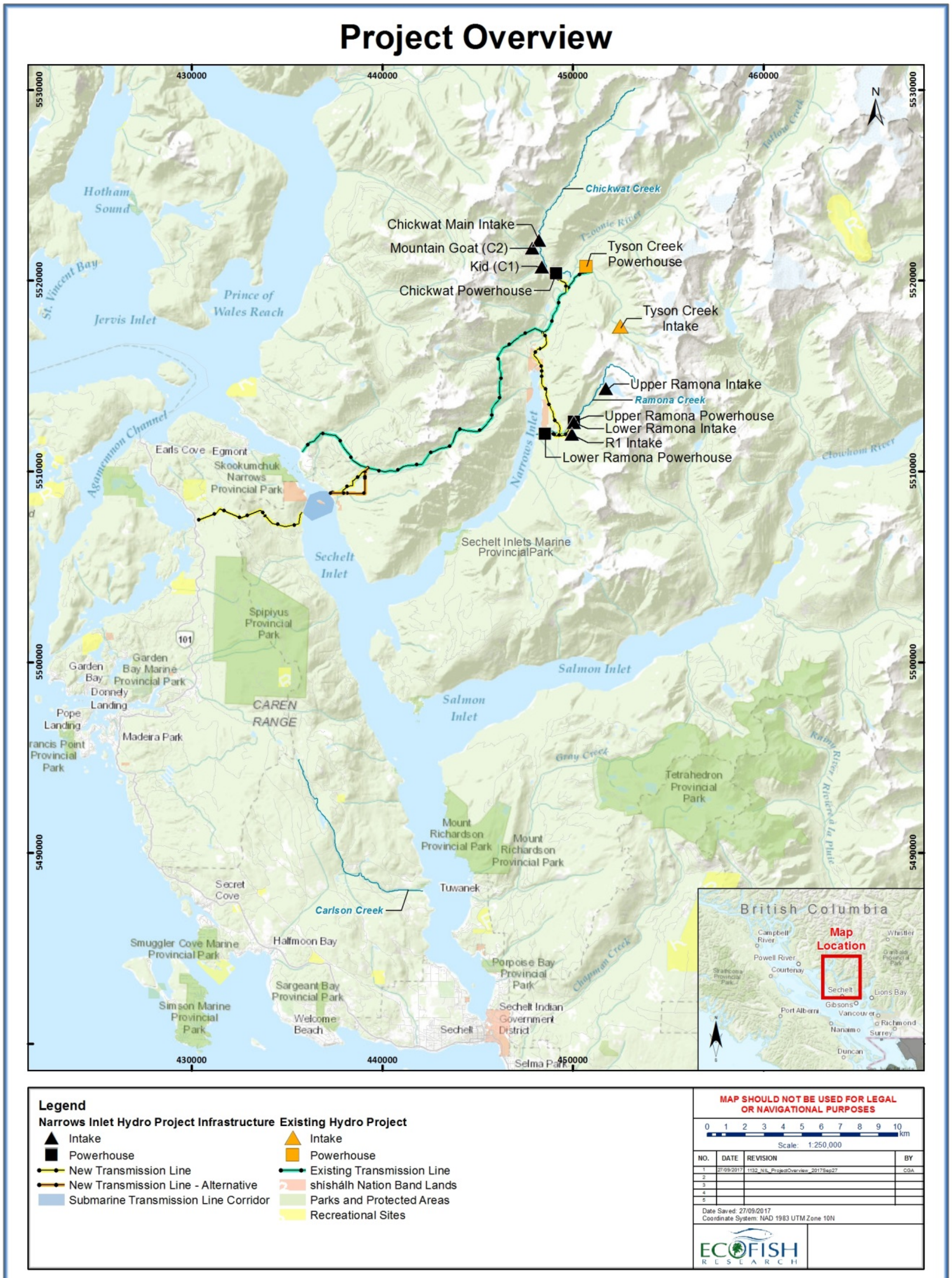
[3] No pumped flow release is required between Jan 8 and end of February. Specified dates reflect periodicity of fish species in Chickwat Creek as described in the AEA (Lacroix *et al*. 2015).

2.5. Invertebrate Drift

Macroinvertebrates and their habitats are included in instream flow assessments because salmonid growth and abundance have been shown to correlate with abundance of drifting invertebrate prey (e.g., Huryn 1996). Maintenance of food sources for fish is therefore the primary motivation for studies of macroinvertebrates. However, the density, biomass, and community composition of invertebrate drift are important measures of stream productive capacity, and therefore also serve as an indicator of general system health. Numerous studies have shown changes in invertebrate density, distribution and taxonomic composition in response to flow regulation, although the magnitude of biological response varies among locations and with characteristics of the regulated flow regime (Harvey *et al.* 2006, Wills *et al.* 2006, and Dewson *et al.* 2007).

The objective of this component of the monitoring program is to test whether the productive capacity of fish habitat in the diversion and/or downstream reaches has declined due to Project operation using the density, biomass and composition of the invertebrate drift community as key indicators. Invertebrate drift parameters are calculated using methods described in Lewis *et al.* (2013). Density (# of individuals) and biomass (mg dry weight) data are expressed in units per m^3 of water, with volume calculated as the amount of water filtered through the net during the set. Community composition is examined by calculating family richness (# of families present), family dominance (top five ranked families in terms of % contribution to total biomass), and family diversity (Simpson's diversity index scores calculated from density data). The Canadian Ecological Flow Index (CEFI, Armanini *et al.* 2011) is also calculated. This index enables a multispecies assessment of the effects of flow alteration that is minimally influenced by confounding factors (e.g., stream type, organic enrichment; Armanini *et al.* 2011). Community structure is assessed using the Bray-Curtis similarity index, a commonly used measure of multi-taxa invertebrate communities that is used to quantify the relative resemblance of samples (e.g., diversion reach vs. control, pre- and post-development). Together, these metrics allow a comparison to be made between seasons and sites prior to and following construction, and provide sufficient information to monitor change using the BACI design or a suitable alternative approach.

Map 1. Overview map showing the location of the Chickwat Creek component of the Narrows Inlet Hydro Project.



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3. METHODS

3.1. Water Quality

3.1.1. Monitoring Sites, Schedule and Parameters

Three baseline water quality monitoring sites were established in 2014 (Table 2). The sites were located upstream of Project operations in Chickwat Creek (CHK-USWQ), in the Chickwat upper diversion (CHK-UDVWQ), and in the Chickwat lower diversion (CHK-LDVWQ) (Map 2; Table 2). The location of the proposed intake was changed in 2015, placing the upstream site CHK-USWQ in the proposed headpond area, therefore a new site was established upstream of the proposed Project effects (CHK-USWQ02).

Baseline water quality samples were collected quarterly from September 2014 to May 2016 using two distinct methods at each site: in situ sampling and collection of water samples for laboratory analysis. The parameters measured in-situ (Table 3) and in the laboratory (Table 4) were consistent with those prescribed in the Project OEMP (Faulkner *et al.* 2016). Representative site photos are presented in Appendix A.

Table 2. Summary of baseline water quality sampling locations and sampling schedule.

Site	Location	UTM Coordinates (Zone 10 U)		Elevation (masl)[1]	Sampling Dates
		Easting (m)	Northing (m)		
CHK-USWQ02	Chickwat Creek Upstream	448,239	5,522,523	464	18-Nov-2015, 17-Mar-2016, 3-May-2016
CHK-USWQ	Chickwat Creek Upstream: site replaced with CHK-USWQ02[2]	448,250	5,522,297	456	18-Sep-2014, 22-Sep-2014, 1-Dec-2014, 8-Mar-2015, 28-May-2015, 23-Sep-2015
CHK-UDVWQ	Chickwat Creek Upper Diversion Reach	448,249	5,521,906	439	18-Sep-2014, 22-Sep-2014, 1-Dec-2014, 8-Mar-2015, 28-May-2015, 23-Sep-2015, 18-Nov-2015, 17-Mar-2016,
CHK-LDVWQ	Chickwat Creek Lower Diversion Reach	448,982	5,520,267	137	18-Sep-2014, 22-Sep-2014, 1-Dec-2014, 8-Mar-2015, 28-May-2015, 23-Sep-2015, 18-Nov-2015, 17-Mar-2016, 3-May-2016

[1] Estimated using Google Earth.

[2] Due to project design changes, CHK-USWQ was replaced with CHK-USWQ02.

Table 3. Baseline in situ water quality parameters and meters; 2014 to 2016.

Parameter	Unit	Meter
General Water Quality		
pH	pH units	YSI Pro Plus/YSI 556
Specific Conductivity	µS/cm	YSI Pro Plus/YSI 556
Water Temperature	°C	YSI Pro Plus/ YSI 556
Air Temperature	°C	Alcohol Thermometer
Dissolved Gases		
Dissolved Oxygen	mg/L	YSI Pro Plus/YSI 556
Dissolved Oxygen	% saturation	YSI Pro Plus/YSI 556
Total Gas Pressure	mm Hg	P4Tracker
Barometric Pressure	mm Hg	P4Tracker
Total Gas Pressure	%	P4Tracker
Δ Pressure	mm Hg	P4Tracker

Table 4. Baseline water quality parameters measured in the laboratory (ALS Environmental Labs); 2014 to 2016.

Parameter	Units	Minimum Detection Limits (MDL)
Physical		
pH	pH units	0.1
Specific Conductivity	µS/cm	10
Total Dissolved Solids[2]	mg/L	1.0
Total Alkalinity	mg/L ($CaCO_3$)	2.0
Total Suspended Solids	mg/L	1
Turbidity	NTU	0.1
Low Level Nutrients		
Ammonia (as N)	µg/L	5.0
Nitrate (as N)	µg/L	20.0
Nitrite (as N)	µg/L	1.0
Total Nitrogen	µg/L	30.0 to 50.0
Orthophosphate (as P)	µg/L	1.0
Total Phosphorus	µg/L	2.0

3.1.2. Quality Assurance/Quality Control

In situ water quality meters were maintained and operated following manufacturer recommendations. Maintenance included calibration, cleaning, periodic replacement of components, and proper storage. Triplicate in situ readings were recorded during in situ sampling and triplicate lab samples were collected for analysis. Triplicate sampling improves the precision of the results and improves our ability to detect outliers and erroneous data resulting from travel, field or laboratory sample contamination.

Sampling procedures for in situ and water sample collection for lab analysis as well as assignment of detection limits followed the guidelines of the Ambient Fresh Water and Effluent Sampling Manual within the British Columbia Field Sampling Manual (Clark 2003). Baseline water quality samples for laboratory analysis were collected in bottles provided by ALS laboratory. Samples were packaged in clean coolers that were filled with ice packs and couriered to the laboratory within 24 to 48 hours of collection. Samples were collected in 1 L plastic or amber glass bottles as required, and sample containers and preservatives were provided by ALS. Standard Chain of Custody procedure was strictly adhered to. ALS maintains a Quality Management System that adheres to the requirements of the ISO:IEC 17025:2005 standards. Laboratory QC procedures included replicate analysis of a subset of samples, analysis of standard reference materials, and method blanks. Laboratory results and Quality Control (QC) reports are provided in Appendix B.

The RISC manual "Guidelines for Interpreting Water Quality Data" (RISC 1998) was referred to for data analysis as it provides detailed direction for screening, editing, compiling, presenting, analyzing, and interpreting water quality data.

It is a common occurrence in clear fast flowing mountain streams to have concentrations of a number of parameters (nutrients in particular) that are less than, or near, the MDL. When this occurs, there are a number of different possible methods which can be used to analyze these values. In this report, any values that were "less than" the MDL were assigned the actual MDL values and averaged with the results of the other replicates. In this case the average is also considered to be less than the value reported.

Exceedance of pH hold times (0.25 hours) is unavoidable; and is observed for all samples; nonetheless, laboratory results for pH can be relied upon due to the accuracy of laboratory equipment in comparison to hand held pH meters (Langlais, pers. comm. 2012). In general hold times are conservative in nature in order to provide guidance for a number of different water quality sample types ranging in complexity (e.g., wastewater may require a more stringent hold time in comparison to clear flowing surface water samples) (Langlais, pers. comm. 2012). If hold times are exceeded, the results are reviewed and any outliers are identified. The hold time exceedance summary is provided in Appendix C.

In-situ and laboratory results were reviewed for outliers in the event that qualifiers were identified during the QA/QC procedure. The relative percent difference (RPD) as described in RISC 1998 was calculated for all triplicates to determine if variability is greater than 18%. Triplicate results are evaluated and data are flagged if high variability between replicates results in suspect data.

3.1.3. Guidelines for the Protection of Aquatic Life

Water quality guidelines for the protection of aquatic life and typical ranges of water quality parameters in British Columbia waters that were considered for this report are provided in Appendix C. Water quality parameter results were compared to provincial water quality guidelines where they exist. For total phosphate, there are no provincial guidelines, and results were therefore compared to federal guidelines. For parameters without provincial or federal guidelines (e.g., orthophosphate, alkalinity, and specific conductivity) results were compared to typical ranges found in British Columbia streams (Appendix C). Any results for water quality parameters that approached or exceeded guidelines for the protection of aquatic life or ranges typical for British Columbia are discussed.

3.2. Water Temperature

3.2.1. Monitoring Sites, Schedule and Metrics

Methods referring to the water temperature data collection from 2008 to 2011 are provided in detail in O'Toole *et al.* (2012). Historical site names have changed from 2008 to 2014, therefore to facilitate comparison of historical data to current site locations a site name change key is provided in Appendix D along with the historical baseline summary plots and tables.

In 2014, Ecofish established water temperature sites corresponding to water quality site locations as provided in Table 2. Temperature logging sites were established in the Chickwat Creek upper and lower diversion reach (CHK-UDVWQ and CHK-LDVW) and in each of Kid Tributary (CHK-C1WQ) and Mountain Goat Tributary (CHK-C2WQ) (Table 5, Map 2). In 2015 the Project design was changed placing the upstream site in the proposed headpond location, therefore a new upstream site (CHK-USWQ02) was established in November 2015 (Table 5). Air temperature was also monitored at the Chickwat Creek upper diversion site (CHK-UDVWQ).

The air and water temperature data were downloaded at all sites in May 2016. Due to equipment malfunction or loss attributable to extreme weather events, a number of data gaps occurred in the temperature records at CHK-USWQ, CHK-DVWQ and CHK-C2WQ. Supplementary data for CHK-USWQ was provided from a water level/temperature gauge operated by Aquarius R&D, located in the immediate vicinity of CHK-USWQ. Once a full overlapping year of data is available for the two upstream sites and the correlation is confirmed for all seasons, the baseline data set at USWQ02 will be combined with USWQ and relied upon to support the long term monitoring.

Duplicate water temperature sensors/loggers (Onset TidbiT v2, -20°C to +70°C range, ±0.2°C accuracy or Onset Hobo Water Temp Pro v2, -40°C to 70°C range, ±0.21°C accuracy) were installed at all sites. Water temperature was recorded at 15 min. intervals using Onset Tidbit/Hobo loggers. Air temperature was recorded at the CHK-UDWQ site at intervals of 30 minutes, using selfcontained HOBO U23-002 Temp/RH sensors made by Onset (range of -40°C to 70°C, accuracy of ±0.21°C from 0°C to 50°C) (Table 5).

Table 5. Summary of water and air temperature site names, logging details and duration of data record in Chickwat Creek and Kid and Mountain Goat Tributaries.

Water/ Air	Creek/Reach	Site	Elevation (masl)[1]	Start Date of Record	End Date of Record	No. of Loggers	Logging Interval (min.)	No. of Days with Valid Data	Data Gaps (%)[2,3]
Water	Chickwat Creek Upstream	CHK-USWQ02	464	18-Nov-2015	3-May-2016	2	15	167	0
		CHK-USWQ	456	19-Jul-2010	3-May-2016	2	15	2,114	0
	Chickwat Creek Upper Diversion	CHK-UDVWQ	439	18-Sep-2014	3-May-2016	2	15	537	9
	Chickwat Creek	CHK-LDVWQ	137	16-Sep-2014	4-May-2016	2	15	596	0
	Tributary C1	CHK-C1WQ	457	3-Dec-2014	3-May-2016	2	15	517	0
	Tributary C2	CHK-C2WQ	544	1-Dec-2014	3-May-2016	2	15	301	42
Air	Chickwat Creek Upper Diversion	CHK-UDVAT	439	18-Sep-2014	3-May-2016	1	30	593	0

[1]Estimated using Google Earth.

[2]The data prior to 18 Sept 2014 and gaps in data at CHK-USWQ from 23 Sept 2015 to 17 Mar 2016 are supplemented by data collected at a nearby hydrometric gauge operated by Aquarius R&D.

[3]Data collection gaps at sites CHK-UDVWQ and CHK-C2WQ are due to Tidbit malfunctioning.

3.2.2. Quality Assurance/Quality Control

Temperature data were carefully inspected and QA'd to ensure that any suspect or unreliable data were excluded from data analysis and presentation. Excluded data included instances where the water temperature sensor was suspected of being out-of-water/dry, affected by snow/ice or buried in sediment.

The accuracy of the tidbit temperature readings were evaluated by periodically performing in-situ spot temperature measurements and comparing these results to the corresponding data logged with the tidbit sensor. The spot temperature measurements and corresponding temperature data are presented graphically in Appendix E.

Two hydrometric gauges located in the Chickwat Creek upstream and lower diversion reach continued to collect flow and water temperature data from 2010 to 2016. The temperature data was provided to Ecofish by Aquarius R&D and was evaluated for reliability by comparison to overlapping temperature records from nearby sites. The data from the upstream site exhibited good correlation to CHK-USWQ data and was therefore included in the data summary. However, the data collected in the lower diversion reach did not correlate with existing data and as data reliability could not be confirmed, the data are not included in the baseline analysis and summary.

3.2.3. Data Analysis and Presentation

Water and air temperature data were processed as follows. First, outliers were identified and removed. This was done for the record from each logger by comparing temperature data from the duplicate station logger (where available) and the loggers at the other sites. Sources of outliers in the data include occasional drops in water level, which can expose the sensors to the atmosphere and high flows which can move sediment and bury the sensors. When the sensors were exposed to air or buried under sediment, data were identified as erroneous and removed from the temperature records. After identifying and removing outliers, the records from duplicate loggers (where available) were averaged and records from different download dates were combined into a single time-series for each monitoring site. The time series for all sites were then interpolated to a regular interval of 15 minutes (where data were not already logged on a 15 minute interval), starting at the full hour.

Plots were generated from temperature data collected at, or interpolated to, 15 minute intervals. Plots were also generated to display the baseline hourly rates of change in water temperature as per the provincial guidelines for the protection of aquatic life which indicate that water temperature should not change by more than ±1°C per hour (Oliver and Fidler 2001).

The differences in water temperature between sites were computed relative to the upstream control site and presented graphically as the cumulative distribution of the frequency of occurrence for the period of record. This served to illustrate the baseline relationship of the water temperature relative to the control site.

To further characterize the baseline temperature regime, statistical analysis of the baseline data involved computing the following summary statistics: average, minimum and maximum water temperatures for each month of record and year of record if available Table 6. The hourly rate of change of temperature was summarized and the overall high and low temperature regimes were evaluated by summarizing the number of days with mean daily temperature >18°C, >20°C, and <1°C.

The length of the growing season and the accumulated growing degree days over the growing season were calculated for each site (Table 6). The growing degree-day is the equivalent of 1˚C over a 24 hour period. For example, a day in which the average temperature was 12˚C would have 12 degree-days. These statistics were based on the data collected at or interpolated to intervals of 15 minutes.

Table 6. Description of water temperature summary metrics and method of calculation.

Metric	Description	Method of Calculation
Monthly water temperature statistics	Average, minimum, and maximum temperatures on a monthly basis	Calculated from temperatures recorded at or interpolated to 15-min intervals.
Number of days with extreme daily-average temperature	>20°C , >18°C , and <1°C	Total number of days with daily-average water temperature >20°C , >18°C , and <1°C
Degree days in growing season	The beginning of the growing season is defined as the beginning of the first week that average stream temperatures exceed and remain above 5°C; the end of the growing season is defined as the last day of the first week that average stream temperature dropped below 4°C (as per Coleman and Fausch 2007).	The degree days is the sum of the average water temperatures over this period (i.e., from the first day of the first week when weekly average temperatures reached and remained above 5°C until the last day of the first week when weekly average temperature dropped below 4°C).
Rate of water temperature change	Hourly rate of change in water temperature in exceedance of 1°C per hour can adversely impact fish and aquatic life.	Calculated from temperatures recorded at, or interpolated to, 15-min intervals. The hourly rate of change was set to the difference between temperature data points that are separated by one hour and was assigned to the average time for these data points.

3.3. Stream Channel Morphology

A combination of qualitative and quantitative observations were collected in the lower diversion and downstream reaches of Chickwat Creek. The existing magnitude and direction of change were qualitatively assessed by interpreting field indicators. During October 2015, five transects were established in the lower diversion reach and two in the downstream reach to measure cross-sectional geometry, sediment size distribution, and collect fixed point photographs of channel features. Thalweg profiles were surveyed in the lower diversion and downstream reach segments that included the transects. The stream morphology aspects of a previously completed FHAP survey (Zyla and Lewis 2012) were reviewed, including gravel surveys, bed material approximations, morphology characterization, and large wood distribution. During August 2016, fixed point photographs were taken in the headpond and unmanned aerial vehicle (UAV) based aerial photographs were taken of the headpond, lower diversion below the canyon, and downstream reaches (Appendix F). The location of surveyed transects and thalweg profiles are provided in Map 3 and Appendix F.

3.3.1. Aerial photographs

Aerial photographs were completed on August 4, 2016 using a UAV to characterize channel form and processes in the upstream, lower diversion, and downstream reaches. Orthomosaic images for each reach were generated using overlapping images and photogrammetry software. Images from the UAV were captured at flight elevations ranging from 555 to 559 mASL at the upstream reach and from 203 to 214 mASL at the downstream reach. These flight elevations have limited vertical accuracy since they were recorded from an interval GPS unit onboard the UAV. Flight elevations varied within each reach due to navigation around vegetation and other obstacles as well as efforts to maintain a consistent height above the sloped stream bed. Imagery for both the upstream and downstream reaches was collected on August 5th 2016 (Upstream: 10:30am – 11:30 am; Downstream: 1:00pm – 4:20pm). Weather conditions were clear with no overcast.

3.3.2. Rapid Assessment

A mainly qualitative rapid assessment of baseline conditions was guided by the diagnostic approach described in Montgomery and MacDonald (2002) and WSDNR (2011). Field observations were collected during the baseline survey on October 15 & 16, 2015, including observations of confinement, entrenchment, riparian vegetation, overbank deposits, channel pattern, bank conditions, bar formations, pool characteristics, and bed material distribution. The rapid assessment was restricted to the channel section between the downstream extent of the canyon reach in the lower diversion to the approximate debris fan apex in the downstream reach. Most of the 2015 observations were made with field notes and by reviewing oblique photographs.

3.3.3. Photographic Monitoring

Photographic monitoring, using polarized lenses, consisted of: oblique and vertical photographs in the vicinity of transects and at locations of meaningful features in the section where the rapid assessment was completed. Vertical photographs were taken of geomorphic features with a scale and each feature was complimented with an oblique perspective photo. Geomorphic features photographed included gravel patches, bars, pools, and functional large wood. Oblique photos viewing upstream, downstream, and across at either bank were taken at each of the seven transect locations and at five photo points within the headpond or upstream reach. The channel character was briefly summarized for each transect.

3.3.4. Topographic Survey

Topographic transect surveys were taken at five locations in the lower diversion reach and two locations in the downstream reach (Map 3 and Appendix F). Each transect was referenced with permanent pins and benchmarks for future sampling. A transect tape was placed across the stream connecting the pins, with the survey initiating at the river left bank. Verticals (i.e. measurement points) along the transect tape were positioned based on breaks in streambed topography and water edges, with a minimum of 20 verticals established for each transect. The height of each pin was referenced to a benchmark and water surface elevations surveyed during the field visit.

Thalweg surveys were collected in the channels where transect surveys were completed. The survey was conducted by two field staff with a reflector and total station. Each survey exceeded the upper and lower transect within each sub-section by at least 20 m to ensure the crests of bounding geomorphic features were included for channel slope calculation. Survey points were measured every

1 - 3 m by walking upstream or downstream within the stream thalweg. The survey was completed using local datum and linked to the transect pins and BM's. The goals of these surveys are to provide a basis for comparison for future stream channel geomorphology work. Pool depths were measured relative to the crest of the next downstream geomorphic unit. All survey data is archived in Appendix G.

3.3.5.Sediment Sampling

Along each survey transect, a Wolman pebble count (Wolman 1954) was conducted to quantify surface substrate composition and provide sediment size distribution. This method involved selecting and hand-picking a minimum of 100 surface particles along each transect. The pebble count method included all particle sizes, with particles <2 mm counted but not measured. At each station, a field crew member placed a measuring stick vertically downward from the transect tape and measured the substrate that they first touched after placing a finger at the end of the meter stick. For each stone that was picked up, the intermediate axis was measured (mm). For embedded particles, the shorter of the two exposed axis was measured. Substrate measurements were later grouped according to the Wentworth Scale. The distribution of surface sediment size is reported as: (a) the number of grains in increasing size categories (mm), and (b) as a cumulative percentage of grains finer than a particular size (mm). This data will be used to compare against subsequent survey data to monitor the potential influence of the Project on channel morphology and sediment transport.

3.3.6.FHAP review

A fish habitat assessment (FHAP) Level 1 (Johnston and Slaney 1996) was previously performed in Lower Ramona Creek during September 2011 (Zyla and Lewis 2012). Information collected as part of the FHAP includes channel and riparian characteristics relevant to a geomorphic assessment. The FHAP geomorphic information helps to characterize the existing geomorphic condition and identify current directions of change that could be affected by Project operations. Relevant observations include geomorphic unit classification and gradient, substrate classification, channel geometry measurements, spawning gravel quality and extents, riparian vegetation characteristics, and large wood distribution and functionality. The geomorphically relevant information was summarized and integrated with observations from the geomorphic assessment to characterize channel form, active processes, and vulnerabilities to Project operations.

3.4. Fish Community

3.4.1.Upper Diversion

Two years of baseline data have been collected using mark-recapture methods within the upper diversion and upstream reaches within the resident fish bearing section of Chickwat Creek. In total, five snorkel mark-recapture monitoring sample sites have been established within the upper diversion reach and five have been established within the upstream reach (Map 4, Appendix H). Due to project infrastructure alterations, one of the upstream sites established in 2014 is now within the proposed headpond area. Therefore, a new site (CHK-USSN06) was established in the fall of 2015, increasing the total number of sites sampled in 2015 to six.

3.4.1.1. B Night Snorkelling Mark-Recapture

Mark-Recapture Sampling

The night snorkel mark re-capture study followed methods similar to those outlined in Korman *et al.* (2010). Two snorkelers swam each site in an upstream direction with the aid of underwater flashlights. The snorkellers worked through the site slowly and methodically to avoid chasing fish from their holding locations while recording fish species and estimated fork length (to the nearest 5 mm) and attempting to capture each fish observed using one or two dip nets. Following capture, fish were immediately moved to a holding container on shore for marking and collection of biological data. Fish were not anaesthetized on mark nights to avoid the uncertainty of behavioural effects from an anaesthetic, including the possibility of an increased emigration risk (Korman *et al.* 2010). Each fish was marked, measured for fork length, weighed, and allowed to recover before being released back into the area where they were captured at the end of the mark survey. Marks consisted of the injection of a fluorescent elastomer into the interstitial space between the fin rays of the caudal fin. The location of the injections varied by reach; lower caudal for the upper diversion sites and upper caudal for the upstream reach sites. Passive integrated transponder (PIT) tags were implanted into the body cavity of each fish ≥80 mm. On the subsequent recapture night of sampling, snorkellers again moved through the site slowly and methodically in an upstream direction. As during mark sampling, the snorkellers attempted to capture all observed fish and recorded the species, fork length, and the presence of marks for any fish that were observed but not captured. Captured fish were then processed as per methods described in Section 3.4.1.3. In 2014, the mark event occurred on October 7-8 and the recapture occurred one week later on October, 15-16. In 2015, the mark event occurred on October 6-7 and the recapture occurred on October, 14-15. After the recapture snorkel, crews performed a separate snorkel swim, up to 30 m outside of each site, to record any fish that had emigrated outside of the defined site area to test the assumption of a closed site between sampling nights.

Habitat data and sampling conditions were collected at each mark-recapture site. Dominant and sub-dominant cover types were recorded, along with estimates of substrate composition. Cover and substrate composition were estimated following the guidelines outlined in RISC (2001) and Lewis *et al.* (2004). Crews also recorded water temperature, conductivity, alkalinity, estimated turbidity level, effective visibility, and depth, as well as vertical site gradient.

Habitat suitability of each mark-recapture sampling site was determined using depth-velocity transect data and habitat suitability indices (HSI) for Bull Trout fry (0+) and juveniles (1+ and 2+) as a surrogate for Dolly Varden. Given the relatively small size of the adult fish present in these streams, the juvenile suitability curves were also applied to adult fish (≥3+). The HSIs were derived for Bull Trout using curves obtained from EMA (1991). Transect data could not be collected during the first year of baseline sampling in 2014 due to consecutive high flow events that followed mark-recapture sampling. Habitat suitability data was collected at each site in the second year of baseline sampling on October 15, 2015, after all mark-recapture sampling had been completed. Depth and velocity data were recorded at a minimum of 20 stations at equal intervals along a transect at one or more locations within each site (Appendix I), and permanent pins were installed to provide benchmarks for annual monitoring. Habitat suitability is expressed as a usability percentage, which is calculated by computing the weighted usable width (WUW) of a transect within the sampled reach and dividing by the wetted width of the transect.

3.4.1.2. Minnow Trapping

Minnow trapping was conducted in association with the snorkel mark-recapture sampling sites. A total of five traps were set in close proximity to each snorkel site. Traps were baited with roe placed inside a perforated film canister and set overnight for approximately 24 hours. A combination of traps with mesh sizes of 3.2 mm and 6.4 mm were used at each site. Where possible, traps were set below the snorkel site to reduce the influence of the baited traps on fish within the site. Captured fish were processed following those methods described in Section 3.4.1.3. Data on minnow trap site-specific habitat and conditions were also collected, and included water temperature, set depth (m), mesohabitat type, and cover type. In 2014, traps were deployed in the upstream and upper diversion reaches on October 14 and 15, respectively. In 2015, traps were deployed in the upper diversion and upstream reaches on October 6 and 7, respectively.

3.4.1.3. Individual Fish Data

All fish captured during snorkelling or in minnow traps were processed as soon as possible following capture. Fish captured during the recapture event and in minnow traps were anaesthetized using ENO® antacid and identified to species. Fish were measured for fork lengths using a measuring board (±1.0 mm), weighed (±0.1 g or ±1 g, depending on fish size), and photographed. Age samples were collected from Dolly Varden through a fin clip of the leading fin ray of one of the pelvic fins. After sampling, all fish were placed in a container of fresh water to recover. Upon recovery fish were released back into the sample site. Any fish mortalities or abnormalities associated with sampling or marking were recorded.

3.4.1.4. Data Analysis

Age Analysis

Fin ray age samples collected in the field were encased in epoxy, sectioned and mounted to a microscope slide and aged by viewing the cross sections under a dissecting microscope. Mounting and initial aging was completed by North-South Consultants. A second independent aging was completed by an Ecofish Biologist.

The fish density and biomass analysis outlined in the OEMP (Faulkner *et al.* 2016) requires that the fish species of interest be separated into age classes. In order to define discrete age class length ranges, length-frequencies of captured fish were reviewed along with all of the length at age data from the fin ray analysis. Based on a review of these data, discrete fork length ranges were defined for each of the following age classes: fry (0+), juveniles (1+), juveniles (2+), and adult fish ($\geq$3+). All fish were then assigned to an age class based on these fork length ranges for subsequent population analysis.

Fish Metrics and Condition

To further describe the fish community, length-frequency, length-weight, and age-at-length relationships were examined for each age class in each sampling reach using individual fish data. Fulton's condition factor (*K*) was calculated for all captured fish using the following equation:

$$K = \left(\frac{W}{L^3}\right)100{,}000$$

where W is the weight in grams, L is the fork length in millimeters, and $100{,}000$ is a scaling constant (Blackwell *et al.* 2000). Weight, fork length, *K*, and percent fat content were then summarized by age and reach for each species.

Mark-Recapture Population Analysis

Population estimates for each age class of Dolly Varden were calculated based on the snorkel mark-recapture data in each sampling site by correcting the number of fish captured during recapture sampling by snorkeler capture efficiency. Average capture efficiency for each age class was calculated separately for the upper diversion reach and upstream reach using the following equation (Korman *et al.* 2011):

$$ce = \frac{\sum_1^n \frac{R}{(M-O)}}{n}$$

where, *ce* is the average capture/observer efficiency, *n* is the number of sites, *R* is the number of recaptured fish, *M* is the number of marked fish, and *O* is the number of marked fish recaptured outside of the site. As indicated by the equation, any marked fish captured/observed outside of the site were removed from the capture efficiency calculation by subtracting them from the number of initially marked fish.

Average capture efficiency was then used to calculate population estimates for each age class within each site using the following equation:

$$Abundance = \frac{C}{ce}$$

where *C* is the number of fish captured within the recapture survey.

The density of each age class within each site was then calculated by dividing the population estimate by the sampled linear length of the site and biomass density per linear length was calculated by multiplying the density estimate by the mean weight (g) of fish captured from each age class in each site. Finally, the average and standard error (SE) of the abundance, density, and biomass of each age class was calculated for sites within the upper diversion reach and upstream reach of Chickwat Creek.

Power Analysis

Guidelines recommend that fish community monitoring is designed so that a 50% effect can be detected after two years of baseline data collection and five years of post-construction monitoring at a 0.05 significance level and a power of 0.8 (Lewis *et al.* 2013). The power to detect Project-related effects (of 50%) was estimated using a BACI power analysis routine in the statistical software R (Schwarz 2012). The BACI power analysis routine requires five sets of parameters:

1. Number of subsamples per site
2. Number of monitoring sites
3. Number of periods monitoring
4. Marginal means
5. Variance components

The parameter values used for the study are provided in Table 7. These parameters are based on the following information and estimates:

1. Each site is sampled once each year (i.e., no subsampling).
2. There are five monitoring sites in the diversion reach, and six monitoring sites in the control reach (in 2014 however, there were only five control sites).
3. Two years of baseline monitoring have been completed, and monitoring will continue once per year (matching the timing of baseline data collection) for five years during Project operation.
4. Marginal means for the 50% effect were estimated for baseline conditions using two years of baseline data. Marginal means for operational data in the control reach were set to the pre-project mean (i.e., assuming no effect), and operational marginal means for the impact reach were set based on an effect size of 50%.
5. Variance components were estimated from a linear mixed-effects model (lme routine in the R package "nlme"; Pinheiro *et al.* 2016). The site classification (control or diversion) was set as a fixed effect and site and year were included as random effects. The site-year interaction cannot be separated from the residual variance based on data to date, and was set to zero.

For each analysis, we performed a one-tailed test to evaluate the ability to detect adverse effects in the impacted diversion reach. Results are reported at the $\alpha=0.05$ significance level as this is the level recommended by the long-term monitoring protocols (Lewis *et al.* 2013). We also present power and detectable effect size at the $\alpha=0.10$ significance level for comparison. The power to detect an effect is higher at the 0.10 significance level; however, there is an increased risk of falsely concluding that there has been an effect, when in fact there has not. For each metric, the following questions are addressed for the diversion impact sites:

1. Will a 50% negative effect be detectable with 0.8 power after five years of monitoring? The BACI power analysis routine was run to determine the power to detect a 50% effect size.
2. What is the minimum effect size that can be detected after five years of monitoring with 0.8 power? Power was estimated for effect sizes ranging from 1% to 99%. The minimum effect size that could be detected at 0.8 power was noted. Graphs of power versus effect size are presented.
3. If a 50% effect will not be detectable at 0.8 power after five years, what monitoring duration would be required to detect such an effect? In cases where the estimated power to detect a 50% effect is less than 0.8, power was estimated for 1 to 20 years of post-project monitoring to estimate length of monitoring required to detect such an effect. Graphs of power versus the number of years of operational monitoring are presented.

This analysis is based on the following assumptions and caveats:

1. Density estimates did not satisfy the necessary parametric assumption of normality. As such, the natural logarithm of fish density (FPU_{obs}; N/10 m) was used in the analysis. This is a standard transformation that is often applied to biological data (Zar 1999). The transformed data satisfy all other parametric assumptions, including the requirement of homogeneity of variance. Data may be re-evaluated during operational or post-operational monitoring analysis to ensure continued agreement with these assumptions.

Variance components estimates are subject to change once additional data have been collected and incorporated into the analysis. If the residual values decrease as additional data are collected, then power to detect effects is expected to increase.

Table 7. Parameter values included in power analysis for Dolly Varden densities (FPU_{obs}) within Chickwat Creek.

River		Chickwat Creek				
Species		Dolly Varden				
Metric		ln(FPUobs)				
Stage		Fry (0+)	Juv. (1-2+)	Adult (≥3+)	Fish (≥1+)	All Fish
Parameter Category	**Parameter**					
Setting	alpha	0.1	0.1	0.1	0.1	0.1
Sub-Sample Sizes	n_TA	1	1	1	1	1
	n_TB	1	1	1	1	1
	n_CA	1	1	1	1	1
	n_CB	1	1	1	1	1
Number of Sites	ns_T	5	5	5	5	5
	ns_C	6	6	6	6	6
Number of Years Monitoring	ny_B	2	2	2	2	2
	ny_A[1]	5	5	5	5	5
Marginal Means	mu_TA[2]	0.3	0.6	0.2	0.7	0.9
	mu_TB	0.6	1.0	0.3	1.2	1.3
	mu_CA[3]	0.7	1.2	0.4	1.3	1.5
	mu_CB	0.7	1.2	0.4	1.3	1.5
Variance Components[4]	std_site	0.1	0.4	0.1	0.3	0.3
	std_year	0.9	0.1	0.1	0.2	0.4
	std_site_year	0.0	0.0	0.0	0.0	0.0
	std_resid	0.5	0.1	0.2	0.1	0.2
Power (alpha=0.05, one-tailed)		0.24	1.00	0.39	1.00	1.00
Power (alpha=0.10, one-tailed)		0.37	1.00	0.54	1.00	1.00

[1] This parameter varied to produce monitoring years Figures

[2] Assuming 50% Effect

[3] Assuming No Effect

[4] Estimated via R linear mixed effects model (lme)

3.4.2. Lower Diversion (AMP)

One year of baseline data was collected in 2016 using mark-recapture methods within the lower diversion reach of Chickwat Creek and in control sites within the Tzoonie River. In total, five snorkel mark-recapture monitoring sample sites were established within the lower diversion reach of Chickwat Creek and five control sites were established within the Tzoonie River (Map 4, Appendix H). In addition, open site reconnaissance electrofishing was conducted along the margins of snorkel sites as a secondary sampling method, and day-time snorkeling surveys to enumerate spawning adults were conducted in spring and/or fall in all years between 2011 and 2016, except 2012.

In addition, two years of spring and fall spawner surveys of anadromous fishes have been completed within the lower diversion and downstream reaches of Chickwat Creek (Appendix J).

3.4.2.1. Night Snorkelling Mark-Recapture

The night snorkel mark-recapture study within the Chickwat lower diversion reach and Tzoonie River control sites followed methods similar to those outlined in Korman *et al.* (2010) described in section 3.4.1.1, including the collection of habitat, sampling condition, and habitat suitability data within each site. The mark events occurred between September 27 and September 29, and the recapture events occurred one week later on between October, 3 and October 5, 2016. Captured fish were then processed as per methods described in Section 3.4.1.3, above. Snorkelling surveys were augmented by dip-netting conducted along the margins, and within habitat too shallow to be effectively snorkelled.

Habitat suitability of each mark-recapture sampling site was determined using depth-velocity transect data and habitat suitability indices (HSI) for Cutthroat Trout fry (0+) and juveniles (1+ and 2+), and Coho fry (0+). Given the relatively small size of the adult fish present in these streams, the juvenile suitability curves were also applied to adult fish (≥3+). The HSIs were derived for Cutthroat Trout fry and juveniles, and Coho fry using curves obtained from Ptolemy (2001). Rainbow Trout HIS criteria were used as a surrogate for Cutthroat Trout. Habitat suitability data was collected at each site after all mark-recapture sampling had been completed following the same methods as described above in section 3.4.1.1.

3.4.2.2. Reconnaissance Electrofishing

Open-site reconnaissance electrofishing was also conducted along stream margins at each of the Chickwat Creek lower diversion reach and Tzoonie River snorkelling sites (Map 4). A crew of two worked through the site slowly, in an upstream direction, conducting a single pass through a defined site area. Habitat and site conditions of reconnaissance electrofishing sites were the same as those collected from the snorkelling sites (Appendix H).

The number of fish captured was recorded and all fish were measured for length and weight. More details on the data collected from individual fish are provided above in Section 3.4.1.3, above. Standardized photographs were also taken at each site, including the benchmark location and views looking upstream and downstream at the site.

3.4.2.3. Individual Fish Data

All fish captured during snorkelling, electrofishing, or in minnow traps were processed as soon as possible following capture. Fish captured during the recapture event and during reconnaissance electrofishing were anaesthetized using ENO® antacid and identified to species. Processing of, and data collected from individual captured fish followed methods described above in section 3.4.1.3. Fin clips of the leading fin ray of one of the pelvic fins was collected for captured Dolly Varden while scale samples were collected from other species for age analysis.

3.4.2.4. Data Analysis

Age Analysis

Fin ray age samples collected from Dolly Varden were aged as described in Section 3.4.1.3. Scale samples collected from Cutthroat Trout, Rainbow Trout, and Coho Salmon were aged by examining the scales under a dissecting microscope: representative scales were photographed and annuli were counted on a digital image. Scales were aged using a QA process with two observers. Discrepancies in age estimates were identified, discussed and a final age determination was based on professional judgement of the senior biologist.

The fish density and biomass analysis outlined in the AMP (Lewis *et al.* 2015) requires that the fish species of interest be separated into age classes. In order to define discrete age class length ranges, length-frequencies of captured fish were reviewed along with all of the length at age data from the fin ray analysis. Based on a review of these data, discrete fork length ranges were defined for each of the following age classes: fry (0+), juveniles (1+), juveniles (2+), and adult fish (≥3+). All fish were then assigned to an age class based on these fork length ranges for subsequent population analysis. Because few Dolly Varden were captured and aged in the lower diversion of Chickwat Creek, fork length ranges that were defined for this species in the upper diversion and upstream reaches in 2015 along with length-frequency analysis were used to assign individual fish from the lower diversion to age classes.

Fish Metrics and Condition

To further describe the fish community, length-frequency, length-weight, and age-at-length relationships were examined for each age class and species in each sampling reach using individual fish data following methods described in section 3.4.1.3

Mark-Recapture Population Analysis

Population estimates for each age class of each trout species (e.g., Cutthroat Trout, Rainbow Trout, and Dolly Varden), and Coho Salmon fry, as well as the combined juveniles of all salmonid species were calculated based on the snorkel mark recapture data in each sampling site by correcting the number of fish captured during recapture sampling by snorkeler capture efficiency. Average capture efficiency for each age class-species combination was calculated separately for Chickwat lower diversion and Tzoonie River using the following (Korman *et al.* 2011) and described in section

3.4.1.4. Abundance and biomass densities are presented for individual sites and as averages for the Chickwat Creek lower diversion and Tzoonie River reaches. Abundance and biomass density metrics were summarized to support the specific AMP metrics: juvenile (>0+) Rainbow Trout/steelhead, juvenile (>0+) salmonids, adult Rainbow Trout/steelhead, and adult salmonids.

3.4.2.5. Anadromous Spawner Surveys

A total of 52 snorkel spawner surveys have been completed on Chickwat Creek to date. These surveys were completed in the fall of 2011 (September 7 to December 8), spring of 2013 (March 25 to June 12), fall of 2014 (September 15 to December 17), spring of 2015 (April 2 to June 25), spring of 2016 (March 22 to June 15), and fall of 2016 (September 2 to December 20), with the primary goal of documenting the presence of migratory adult salmonids (e.g. Pacific salmon, Cutthroat Trout and steelhead). Spawner surveys were conducted within the lower diversion and downstream reaches of Chickwat Creek, and within the Tzoonie River near the Chickwat Creek confluence. These areas were broken into five sections: 1) anadromous barrier (chute pool) to the new FSR bridge, 2) new FSR bridge to the old FSR Bridge, 3) old FSR Bridge to small island, 4) small island to the Chickwat confluence with the Tzoonie River and 5) area of the Tzoonie River immediately upstream and downstream of the Chickwat confluence, including a large woody debris jam pool located ~30 m upstream of the confluence. In addition, a control reach on the Tzoonie River upstream of the Chickwat Creek confluence was added starting in the spring of 2016, with 15 surveys completed to date. These surveys were completed in the spring of 2016 (March 22 to June 15) and fall of 2016 (September 2 to December 20). The reaches surveyed are illustrated in Map 4.

Anadromous surveys were completed by two snorkellers swimming in a downstream direction. During each swim, the number and species of fish observed was recorded for each section. Condition for each adult salmonid was recorded and categorized as: 1 = bright, 2 = moderately coloured, 3 = mid spawn, 4 = post spawn, and 5 = undetermined. Fish were divided into the following size categories: fry (0-80 mm), juveniles (80-150 mm), 150-250 mm, 250-350 mm, 350-450 mm, and >450 mm. Any redds observed during snorkel surveys were recorded and habitat parameters such as water temperature, visibility, and weather, were noted.

3.5. <u>Invertebrate Drift</u>

3.5.1. Field Sampling

Invertebrate drift sampling on Chickwat Creek occurred at three sites: one upstream (control) site (CHK-USIV), one upper diversion (impact) site (CHK-DVIV), and one downstream (impact) site (CHK-DSIV) (Map 2). Two years of biannual baseline sampling were conducted, with collection occurring during late summer (September) and fall (November). During each round of sampling, collection occurred simultaneously at each site. To facilitate comparison between years, sampling occurred during the same seasons, at similar flows and time of day. The sampling history at each site is provided in Table 8 along with site coordinates and sampling duration; representative site photographs are shown in Appendix K; locations of sample sites are shown on Map 2.

Table 8. Invertebrate drift sample site locations, sample timing, and sample duration.

Reach	Site	UTM Coordinates (Zone 9U)		Elevation (masl)†	Sample Date	Start Time‡	Finish Time‡	Sampling Duration (hr)
		Easting (m)	Northing (m)					
Upstream	CHK-USIV	448253	5522398	458	16-Sep-2014	08:35:00	12:35:00	4:00
					2-Nov-2014	08:25:00	12:33:00	4:04
					28-Sep-2015	08:10:00	12:11:00	4:01
					11-Nov-2015	08:18:00	12:19:00	4:01
Diversion	CHK-DVIV	448249	5521805	433	16-Sep-2014	08:35:00	12:44:00	4:09
					2-Nov-2014	08:34:00	12:37:00	4:03
					28-Sep-2015	08:12:00	12:14:00	4:02
					11-Nov-2015	08:35:00	12:35:00	4:00
Downstream	CHK-DSIV	449399	5520305	112	16-Sep-2014	08:34:00	12:36:00	4:02
					2-Nov-2014	08:20:00	12:22:00	4:02
					28-Sep-2015	08:10:00	12:10:00	4:00
					11-Nov-2015	08:20:00	12:27:00	4:07

† As determined in Google Earth

‡ Times given are for when the first net went in and the last net was removed (volume calcuations considered the start and finish time of each net individually).

Invertebrate drift sampling methods followed the guidance provided in Hatfield *et al.* (2007) and Lewis *et al* (2013). Sites for individual net sets were generally located in the downstream half of riffles; however, small steep streams are often dominated by cascades and pools and it was not always possible to sample ideal riffle habitats. All sites were marked with a unique permanent benchmark, and a pin to measure the distance of the left and right wetted edges as well as the placements of the nets within the river. Nets were installed in the same area (perpendicular with the pin) over all sampling dates and generally were set within the recommended water velocities of 0.2 m/s to 0.4 m/s (as per Hatfield *et al.* 2007). All sites were georeferenced with a handheld GPS and coordinates were recorded on field data sheets. Representative photographs of invertebrate sample sites on each sample date are provided in Appendix E.

At each site, five drift nets were deployed as a net set across the channel. Each drift net (250 μm mesh) extended 1 m downstream and had mouth dimensions of 0.3 m x 0.3 m. Most nets were deployed so that the top edge of the net was above the water surface, thereby facilitating sampling of drift organisms in the water column and on the water surface. On November 11, 2015 two nets at CHK-DSIV on were set below the water surface. Laboratory results for these sample dates were reviewed, and no considerable difference in invertebrate drift communities was observed between the submerged and non-submerged nets. Therefore all data was used.

Water depth and velocity was measured using a Swoffer meter at the center of each individual net immediately after the nets were set and on a roughly hourly basis while the nets were deployed. The stream depth and water temperature at each net was also recorded after the nets were set and prior to removal. Depth and velocity data allowed the quantification of volume of water filtered throughout the sampling interval, and allowed field personnel to determine if the nets were becoming clogged. Each net set was removed after approximately four hours of sampling, once a final depth measurement and final velocity measurement had been collected. Following removal, a depth/velocity profile at each net location was also taken with the Swoffer meter at 20%, 40%, and 80% of the water column depth.

Filtered water from the stream was used to rinse the material caught in each net into 500 mL plastic sample containers. Samples were preserved in the field with a 10% solution of formalin (formalin = 37-40% formaldehyde) and were topped up with filtered stream water to minimize the potential for damage to sample contents during transport. Samples were labeled, sealed, and placed in plastic bags for transport.

3.5.2. Laboratory Processing

All baseline samples were sent to Danusia Dolecki of Invertebrates Unlimited for processing. Ms. Dolecki is a taxonomist with Level II (genus) certification for Group 2 (Ephemeroptera, Plecoptera, and Trichoptera (EPT) and for Chironomidae from the Society for Freshwater Science.

3.5.2.1. Sorting, Identification, and Subsampling

The drift samples were first processed by removing the formalin (pouring it though at 250 μm sieve) followed by immediate picking of the very large and rare taxa. After a preliminary examination to estimate the number of invertebrates, the sample was split into subsamples if the number of invertebrates was over 1,000. The invertebrates were picked and sorted into their individual taxonomic groups and enumerated on a gridded Petri dish. The enumeration was done using a Leica stereo-microscope under suitable magnification (6-80x). However, in order to identify the invertebrates to the genus or species level (which was done wherever possible), additional examination of crucial body parts was done on slides at higher magnifications (up to 400x) with an Olympus inverted microscope.

3.5.2.2. Biomass Determination

A digitizing program and digitizing system, called Zoobbiom Version 1.3, developed by Russell Hopcroft (Hopcroft 1991) from the University of Guelph, was used to measure the lengths and calculate the biomass of the individuals. Zoobbiom has a multiple point measuring system which can measure curved or bent organisms with high accuracy. Biomass of individuals was then determined using established taxon-specific biomass-length relationships, based on logarithmically transformed variables. Average biomass was calculated for specific taxa based on measurements for a sample of individuals of each taxon. For abundant taxa, up to 25 randomly chosen individuals per taxon were digitized to reflect the variability in size structure of the group. For the rare taxa, all individuals in the taxon were measured. Damaged or partial specimens were excluded from the measurements. For pupae and emerging Chironomidae, which in many cases were the dominant group, up to 50 individuals were measured. In addition, direct weighing techniques were used for invertebrates for which established biomass-length relationships were unavailable (mainly terrestrial insects). The invertebrates were dried at 60ºC for 24 hours and weighed on a micro-balance with a sensitivity of 0.1 mg.

3.5.2.3. Quality Assurance, Quality Control (QA/QC)

The samples were picked under the microscope and re-picked a second time to ensure >90% accuracy was attained. Instead of choosing 10% of the samples for QA/QC, all the samples were re-picked and the number of invertebrates found in the second sort was used to calculate the accuracy of picking. Accuracy was over 95%.

3.5.3. Data Analysis

Parameters were chosen and calculated as per Lewis *et al.* (2013). Density (# of individuals) and biomass (mg dry weight) data for each sample (i.e., net) were expressed as units per m^3 of water, with volume estimated by calculating the amount of water that was filtered through a single net during a set. Volume was calculated as follows:

- Time period durations (seconds) were calculated for each depth (m) and velocity (m/s) measurement;
    - The duration attributed to the first measurement was from the time the nets were set until halfway between the first and second measurements;
    - In cases with greater than two measurements, the second duration was from halfway between the first and second measurements until halfway between the second and third measurements. This was repeated up to the last measurements;
    - The duration used for the last measurement was from halfway between the second to last and the last measurements associated with net retrieval.
- Average flow (m^3/s) was calculated for each net and time period by multiplying the depth (m) by the width of the net (0.3 m) and by the velocity (m/s). This was then multiplied by the time attributed to that measurement to obtain volume. The volumes associated with individual time periods were added together to obtain the total volume filtered by a net over the entire sampling duration.

Diversity of samples (family level taxonomic resolution for aquatic, semi-aquatic, and terrestrial taxa) was calculated using Simpson's diversity index (1-λ, Simpson 1949). Family richness (i.e., the number of families present) was calculated for each sample considering the aquatic, semi-aquatic, and terrestrial taxa present. The Canadian Ecological Flow Index (CEFI) was calculated using family level data for aquatic taxa following Armanini *et al.* (2011). Relative abundances of taxa in each net were calculated considering all aquatic taxa, and a standard subset of these taxa was used in the

CEFI calculation. As per the direction of David Armanini (Armanini, pers. comm. 2013), there is no need to exclude aquatic taxa from the CEFI calculation that are present in <5% of the samples. The mean, standard deviation, and coefficient of variation were calculated for each of these parameters at each site on each sample date. The top five families contributing to biomass at each site on each date were also identified (based on mg/m^3 data).

PRIMER (Plymouth Routines In Multivariate Ecological Research) version 6 software was used to generate a Bray-Curtis similarity matrix for all baseline data. The Bray-Curtis similarity matrix was generated from square root transformed density data for aquatic, semi-aquatic, and terrestrial taxa at the highest taxonomic resolution available for each taxon. The square root transformation down-weights the influence of the most abundant taxa, allowing a more accurate representation of the invertebrate community as a whole. The similarity matrix was generated by considering mean density data from each site on each date; these averaged data were considered as samples for the calculation of the similarity matrix.

The resulting Bray-Curtis similarity matrix was then examined using a cluster analysis dendrogram in PRIMER to detect trends in similarity among sites/dates. The clustering method used was hierarchical clustering with group-average linking. The method takes a Bray-Curtis similarity matrix as a starting point and successively fuses the samples into groups and the groups into larger clusters. The method starts with the highest mutual similarities then gradually lowers the similarity level at which groups are formed. The significance level for clustering was set at 5% using the SIMPROF test in PRIMER (1,000 permutations were used to calculate the mean similarity profile and 999 to generate the null distribution of the departure statistic). Further discussion of the cluster analysis can be found in Clarke and Warwick (2001) and Clarke and Gorley (2006).

The Bray-Curtis similarity matrix was also examined using non-metric, multi-dimensional scaling (MDS) ordination plots in PRIMER to detect trends in similarity among samples and among sample sites. MDS uses an algorithm that successively refines the positions of the points (samples) until they satisfy, as closely as possible, the dissimilarity between samples (Clarke and Warwick 2001). This algorithm was repeated 1,000 times for each similarity matrix (i.e., with average density from each site on each date as samples). The result is a two dimensional ordination plot in which points that are close together represent samples that are very similar in community composition with respect to the taxa present and their abundances. Similarly, points that are far apart represent samples with a very different community composition. Further discussion of the MDS analysis can be found in Clarke and Warwick (2001) and Clarke and Gorley (2006).

3.5.4. Power Analysis

DFO protocols (Lewis *et al.* 2013) recommend monitoring of project-related effects using a BACI study design. This study design requires establishment of sampling sites in a representative control reach and reaches being impacted by the Project, and sampling is required before construction and during operation. For invertebrate monitoring, the control reach in Chickwat Creek is located upstream of the intake, and the diversion and downstream reaches are sampled as impact reaches. As of June 2016, sampling has taken place four times in each reach.

It is recommended that monitoring be designed so that a 50% effect can be detected after two years of baseline data collection and five years of post-construction monitoring at a 0.05 significance level and a power of 0.80 (Lewis *et al.* 2013). The power to detect Project-related effects was estimated using a BACI power analysis routine for 'R' Statistical software (Schwarz 2012), which requires five parameters for analysis:

1. Number of subsamples per site;
2. Number of monitoring sites;
3. Number of monitoring periods;
4. Marginal means; and
5. Variance components.

The parameter values used for the invertebrate power analysis are provided in Table 9. These parameters are based on the following information and estimates:

1. Each site is sampled with five nets (subsamples).
2. There is one control site and one impact site (diversion and downstream impact sites are considered in separate analyses).
3. Two years of baseline monitoring have been completed, with two periods sampled per year. Monitoring will continue for five years during project operation with two sample periods per year (matching the timing of baseline data collection).
4. Marginal means were estimated for baseline conditions using baseline data. Marginal means for operational data in the control reach were set to the pre-project mean (i.e., assuming no effect), and operational marginal means for the impact reach were set based on the effect size being considered.
5. Variance components were estimated from a linear random effects model (lme routine in 'R' Statistical software). Factors considered were site, period, and site-period interaction.

For each metric and significance level (α=0.05 and α=0.10, one tailed), the following questions are addressed for both the diversion and downstream impact sites:

1. Will a 50% negative effect be detectable with 0.80 power after five years of monitoring? The BACI power analysis routine was run to determine the power to detect a 50% effect size. It was noted that smaller effect sizes are likely relevant for the Simpson's diversity, richness and CEFI metrics, and additional analyses were run to estimate the power to detect effect sizes of 25% and 10%.

2. What is the minimum effect size that can be detected after five years of monitoring with 0.80 power? Power was estimated for effect sizes ranging from 1% to 99%. The minimum effect size that could be detected at 80% power was noted. Graphs of power versus effect size are presented.

3. If a 50% effect will not be detectable at 0.80 power after five years, what monitoring duration would be required to detect such an effect? In cases where the estimated power to detect a 50% effect is less than 0.80, power was estimated for 1 to 20 years of post-project monitoring to estimate the length of monitoring required to detect such an effect. Graphs of power versus the number of years of operational monitoring are presented.

The analysis is based on the following assumptions and caveats:

1. Data transformations should be evaluated during operational monitoring analyses to determine if normalization of data are necessary. An appropriate data transformation may improve the power to detect effects. A ln(x+1) data transformation was applied to Chickwat Creek baseline invertebrate data.

2. Variance components estimates are subject to change once additional data have been collected and incorporated into the analysis. If these values decrease as additional data are collected, then the power to detect effects is expected to increase.

Table 9. Parameter values input into Chickwat Creek invertebrate power analysis.

Metric		Density (#/m³)		Biomass (mg/m³)		Family Richness		Simpson's Diversity (1-λ)		CEFI Index	
Impact Reach		Diversion	Downstream	Diversion	Downstream	Diversion	Downstream	Diversion	Downstream	Diversion	Downstream
Parameter Category	Parameter										
Sub-Sample Sizes	n_TA	5	5	5	5	5	5	5	5	5	5
	n_TB	5	5	5	5	5	5	5	5	5	5
	n_CA	5	5	5	5	5	5	5	5	5	5
	n_CB	5	5	5	5	5	5	5	5	5	5
Number of Sites	ns_T	1	1	1	1	1	1	1	1	1	1
	ns_C	1	1	1	1	1	1	1	1	1	1
Number of Periods Monitoring[1]	np_B	4	4	4	4	4	4	4	4	4	4
	np_A[2]	10	10	10	10	10	10	10	10	10	10
Marginal Means	mu_TA[3]	0.60	0.49	0.08	0.03	2.94	2.86	0.34	0.30	0.18	0.16
	mu_TB	0.97	0.82	0.15	0.06	3.60	3.52	0.60	0.53	0.33	0.30
	mu_CA[4]	0.88	0.88	0.18	0.18	3.52	3.52	0.57	0.57	0.33	0.33
	mu_CB	0.88	0.88	0.18	0.18	3.52	3.52	0.57	0.57	0.33	0.33
Variance Components[5]	std_site	0.04	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.02
	std_period	0.26	0.32	0.11	0.02	0.08	0.34	0.07	0.15	0.02	0.00
	std_period_site	0.04	0.13	0.05	0.10	0.15	0.00	0.03	0.09	0.00	0.02
	std_resid	0.19	0.18	0.08	0.07	0.27	0.25	0.05	0.05	0.01	0.00

[1] Assuming 2 samples periods per year with 2 years before and 5 years after
[2] This parameter varied to produce Years of Monitoring Figures
[3] Assuming 50% Effect
[4] Assuming No Effect
[5] Estimated via R linear mixed effects model (lme)

4. RESULTS AND DISCUSSION

4.1. Water Quality

General water quality parameters (in situ and laboratory data), dissolved gases (in situ and laboratory data), and low-level nutrients (laboratory data) results and hold time exceedances (are presented in data tables in Appendix C, representative site photos are presented in Appendix A and laboratory analysis reports from ALS Laboratory are presented in Appendix B.

In the following text, the data range observed in individual replicates at all sites on all sample dates are provided for each parameter. This range is compared to typical values for British Columbia waterbodies and to provincial or federal guidelines for the protection of aquatic life (Appendix C). If there is no discussion of parameter values with respect to the provincial and federal guidelines for the protection of aquatic life, then it is implied that sample results do not exceed guidelines.

4.1.1. Quality Assurance/Quality Control and Data Analysis

Hold time exceedances occurred for turbidity on May 28, 2015 (Appendix C). In addition, the RPD for turbidity triplicates on this date was greater than the threshold of 18% identified in the provincial guideline for interpreting water quality data (RISC 1998). However, average turbidity on these dates was less than five times the MDL, a range where greater variation between sample measurements is expected (RISC 1998). Turbidity values on May 28 were consistent with those measured on all other sampling dates. Therefore we assume that the hold time exceedance did not result in degradation of the samples and the results are included in the data analysis. No other hold time exceedances occurred with the exception of pH which is unavoidable (see Section 3.1.2).

The relative percent difference (RPD) of most sample replicates was less than the RISC (1998) threshold of 18%. In all cases when RPD was greater than 18%, the average value of the parameter was less than five times the applicable MDL. Small values close to the MDL are difficult to measure accurately and more variation between samples is expected in this range. Therefore, RPD exceedances are only discussed if results are a minimum of five times the MDL.

4.1.2. pH

Baseline pH measurements ranged from 5.68 to 6.41 pH units as measured in the laboratory, and from 5.24 to 8.53 pH units as measured in situ. Natural fresh waters have a pH range from 4 to 10 (Appendix C; RISC 1998).

4.1.3. Specific Conductivity and Total Dissolved Solids

Baseline specific conductivity measured in situ and in the lab ranged from 4.0 µS/cm to 22.8 µS/cm (Appendix C). In general conductivity was lowest upstream and highest in the lower diversion, however, conductivity appeared to be correlated more with season than with site and was higher in the fall and lower in winter and spring. Coastal British Columbia streams generally have a specific conductivity of ~100 µS/cm; Chickwat Creek exhibits conductivity values lower than those typically observed.

TDS is also a measure of dissolved ions. TDS ranged from <10 mg/L to 19 mg/L (Appendix C). Similar to conductivity, TDS appears to be correlated more with season than with site, although TDS was slightly lower at the upstream site. Generally, streams on the coast of BC have concentrations of TDS <75 mg/L; TDS in Chickwat Creek is within the range typically observed. Guidelines for the protection of aquatic life have not been established for conductivity or TDS due to natural high variability.

4.1.4. Alkalinity

Baseline alkalinity (measured as $CaCO_3$) ranged from <2.0 mg/L to 3.8 mg/L (Appendix C). Alkalinity was similar at the upstream, upper diversion, and lower diversion Chickwat Creek sites, and is typical of levels in coastal British Columbia streams. The buffering function of a stream can be inferred from the alkalinity and is an important feature of streams as abrupt changes in pH can negatively impact aquatic life. The data indicates that Chickwat Creek is highly sensitive to acidic inputs (alkalinity <10 mg/L) (Appendix C; RISC 1998). There are no provincial or federal water quality guidelines for alkalinity.

4.1.5. Total Suspended Solids and Turbidity

Baseline TSS was below the detection limit at most sites on most dates, and ranged from <1.0 mg/L to 2.3 mg/L. Baseline turbidity was also low, ranging from <0.10 NTU to 0.56 NTU. For both turbidity and TSS, natural values in BC can vary extensively from one waterbody to another and can have large variation within a day and among seasons (Appendix A, Singleton 1985 in Caux *et al.* 1997). Provincial water quality guidelines for turbidity and TSS are site specific, based on the establishment of background levels (Appendix C, Singleton 2001).

The data indicates that Chickwat Creek exhibits clear flow conditions, (TSS <25 mg/L or turbidity <8 NTU; Appendix C) in every season.

4.1.6. Dissolved Oxygen

Baseline DO concentrations ranged from 9.2 mg/L to 14.9 mg/L, and the percent saturation ranged from 83.1% to 108.7%. Dissolved oxygen levels met provincial guidelines for the protection of aquatic life at all sites on all sampling days (MOE 1997a and MOE 1997b). In BC, surface waters generally have dissolved oxygen concentrations greater than 10 mg/L, with saturations that are close to equilibrium with the atmosphere (i.e., close to 100%) (Appendix C).

4.1.7. Total Gas Pressure

TGP can be reported in mm Hg, as % saturation, or as ΔP (TGP in mm Hg minus barometric pressure in mm Hg). The ΔP measure is the most conducive for making comparisons among sites and to provincial guidelines, as it does not require adjustments for site elevation (Fidler and Miller 1994). Baseline TGP ranged from 101% to 114% and ΔP ranged from 5 mm Hg to 106 mm Hg (Appendix C).

The maximum allowable ΔP for the protection of aquatic life in British Columbia for waters >1 m is 76 mm Hg, and for shallow waters <1 m, ΔP should not exceed 24 mm Hg in the most stringent form of the guideline (Appendix C, Fidler and Miller 1994). In BC, dissolved gas supersaturation is a natural feature of many waters with ΔP commonly being between 50 mm Hg to 80 mm Hg; therefore natural exceedances of the dissolved gas supersaturation guidelines are not uncommon in steep, fast flowing BC streams (Appendix C, Fidler and Miller 1994).

Exceedance of the more conservative shallow water guidelines (24 mm Hg) was observed at the upstream site and in both the upper and lower diversion sites in Chickwat Creek during baseline sampling on several dates in all sampling quarters (Appendix A). ΔP ranged from 5 mm Hg (upstream) to 53 mm Hg (in the lower diversion).

On most sampling dates, TGP was highest at the lower diversion site (CHK-LDVWQ) and on one occasion, September 18, 2014, TGP was 113% and a ΔP of 103 mm Hg was calculated at this site. This ΔP exceeds the provincial guideline for deeper waters of 76 mm Hg. Data indicates that Chickwat Creek naturally exhibits high TGP and on occasion exceeds the deeper water guidelines for the protection of aquatic life in the lower diversion reach.

4.1.8. Nutrients – Nitrogen

Baseline low level nitrogen nutrient sampling included total ammonia, nitrate, nitrite, and total nitrogen. Total nitrogen ranged from <30.0 µg/L to 200.0 µg/L. There are no water quality guidelines for total nitrogen. Total ammonia was not detected (<5.0 µg/L) at all sampling sites on all dates. Ammonia is expected to be present at concentrations of <100 µg/L in waters not affected by waste discharges (Appendix C, Nordin and Pommen 1986). Nitrite was not detected (<1.0 µg/L) at all sampling sites on all dates. Nitrite is an unstable intermediate which serves as an indicator of recent contamination from sewage and/or agricultural runoff, and is typically present in surface waters in very small quantities (i.e., <1.0 µg/L) (Appendix C, RISC 1998).

Nitrate concentrations ranged from 12.4 µg/L to 154.0 µg/L, which is typical for BC streams. Nitrate is the most stable, oxidized form of nitrogen and most surface waters in Canada have levels that are less than 900 µg/L, unless they are impacted by industry such as sewage effluent, mining effluent or agricultural practices (CCME 2012). In oligotrophic lakes and streams, nitrate concentrations are expected to be <100 µg/L (Appendix C, Nordin and Pommen 1986).

4.1.9. Nutrients – Phosphorus

Very low orthophosphate concentrations are expected as it is a biologically readily available form of phosphorus and quickly utilized by biota. BC streams typically have orthophosphate concentrations <1.0 µg/L (Appendix C), Slaney and Ward 1993 and Ashley and Slaney 1997). Orthophosphate was not detected (<1.0 µg/L) at any site on any sampling day (Appendix C). Total phosphorus ranged from below the detection limit (<1.0 µg/L) to just above the detection limit (3.2 µg/L), indicating an ultra-oligotrophic (<4 µg/L) trophic classification for Chickwat Creek.

4.2. Water Temperature

Baseline temperature was collected in the upstream control reach and the upper and lower diversion reach of Chickwat Creek and in the Kid and Mountain Goat Tributaries from September 2014 to

May 2016 (Table 5, Map 2). In addition baseline data collected in the upstream reach from 2010 onwards was provide by Aquarius R&D and was included in the water temperature baseline data set for the Project. Baseline temperature data collected in the upstream and lower diversion reach from 2008 to 2011 is summarized in O'Toole *et al.* (2012) and data tables are included in Appendix D.

Baseline water temperature data collected from 2010 to 2016 (upstream only) and 2014 to 2016, were examined and metrics calculated as per the quality assurance methods and data analysis described in Section 3.2.2 and Section 3.2.3. Results of the QA spot temperature analysis are provided in Appendix E. Detailed water temperature plots, summary statistics and temperature metrics for each site are also provided in Appendix D. The following sections summarize the key features of the thermal regime in the Project area over the period of record (September 2010 to May 2016); including summary statistics (Section 4.2.2), occurrence of average daily temperature extremes (Section 4.2.3), and screening of the data to the provincial guidelines regarding the allowable hourly rate of temperature change (Section 4.2.4).calculation of growing season and accumulated growing degree days at each site (Section 4.2.5) Air temperature was also recorded in the upper diversion reach of Chickwat Creek from October 2014 to May 2016 and results are summarized in Section 4.2.6 and data tables are provided in Appendix D.

4.2.1.Water Temperature Regime

The baseline water temperature regime exhibited typical seasonal and inter-annual variability as depicted in the summary of water temperature for all sites over the period of record spanning September 2010 to May 2016 (Figure 1) and for the period spanning September 2014 to May 2016 (Figure 2).

In general, during the warmer months, greater fluctuation and variation in water temperature is observed in comparison to the cooler months (Figure 1). However, during the cooler winter months, differences in the water temperature between sites are more evident (Figure 2). Water temperature generally increases throughout the project area from upstream to downstream direction. The tributary sites and especially the higher elevation Mountain Goat Tributary site, generally exhibited cooler temperatures in comparison to the mainstem sites.

The differences in temperature at each site relative to the upstream control site (CHK-USWQ) can be evaluated in more detail by calculating and summarizing the relative difference in temperatures over the period of record (data summary in Appendix D) and plotting the cumulative distribution of the frequency of occurrence (% records) of the temperature difference (Figure 3).

The upper diversion has a similar temperature regime in comparison to the upstream site as expected given the close proximity of these sites (Map 2), while the higher elevation tributaries are predominantly cooler than the CHK-USWQ site. It should be noted that Kid Tributary can exhibit higher temperatures in the winter months, however the cumulative distribution indicates that for close to 90% of the record the temperature are equal to or less than those in the upstream control site (Figure 3, Appendix D). The lower diversion site is predominantly (~95% of the record) warmer than the upstream site with ~80 % of the record exhibiting 1°C higher temperatures.

Figure 1. Baseline water temperature data recorded in Chickwat Creek and the Kid and Mountain Goat Tributaries for the period of record spanning September 2010 to May 2016.

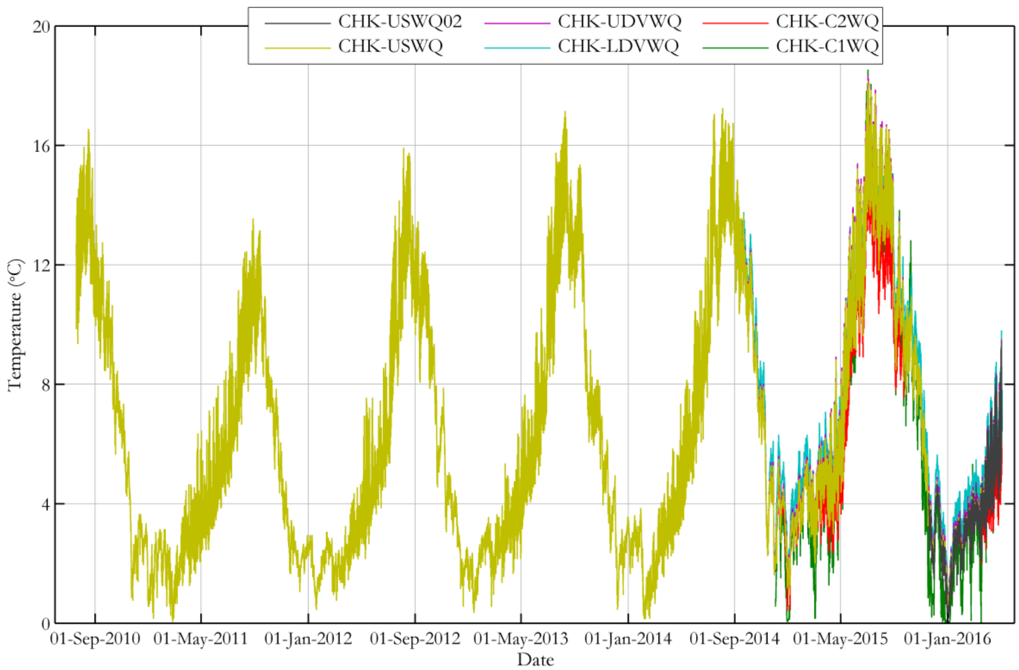


Figure 2. Baseline water temperature data recorded in Chickwat Creek and the Kid and Mountain Goat Tributaries for the period of record spanning September 2014 to May 2016.

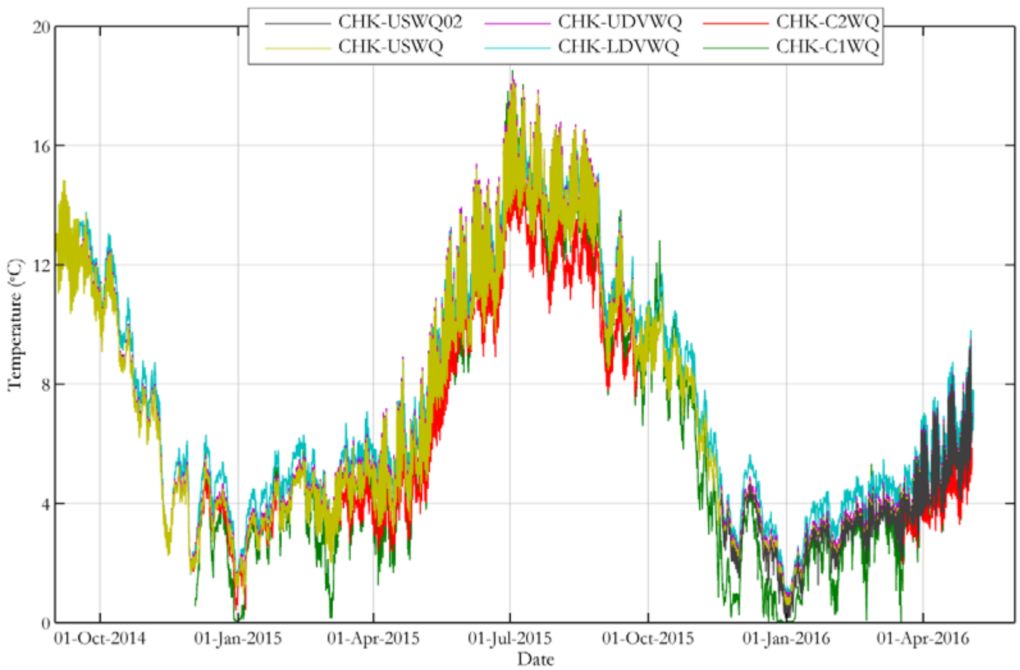
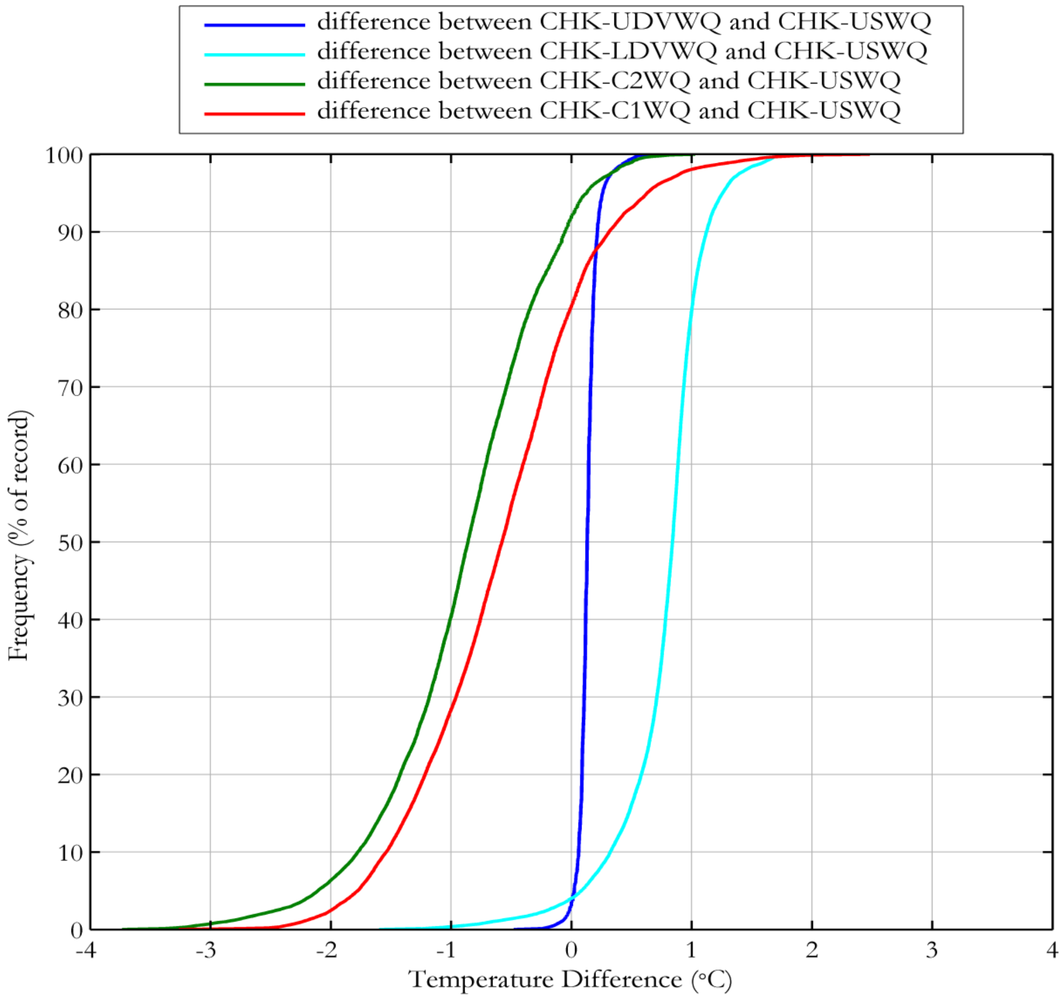


Figure 3. Comparison of temperature difference at each site relative to the CHK-USWQ site. Presented as the cumulative distribution of the frequency of occurrence for the period of record.



4.2.2. Summary Statistics

The monthly water temperature summary statistics (average, instantaneous minimum and maximum, and standard deviation) provide the monthly average and extreme temperature occurrences at each site over the period of record (data tables are provided in Appendix D).

Over the period of record (2008 to 2016) the monthly average temperatures ranged from 0.9°C (recorded in the upstream reach in December 2009) to 15.8°C (recorded in the lower diversion reach in August 2009) in the mainstem and from 1.6°C to 14.4°C in the tributaries (Appendix D). Evaluation of the data indicates that December and January are the coolest months with an instantaneous minimum temperature of 0.0°C recorded in Chickwat Creek and in the tributaries. The warmest months correspond to July and August with instantaneous maximum monthly temperatures reaching 21.2°C (2009) in Chickwat Creek and 15.6°C (CHK-C2WQ in 2015) to 18.5°C (CHK-C1WQ in 2015) in the tributaries.

Annual statistics were computed for complete annual data sets in the upstream reach (spanning 2011 to 2015), in the lower diversion reach (2011 and 2015) and in Kid Tributary (2015) (Table 10). Annual average temperatures increased from 2011 to 2015 ranging from 4.7°C to 7.7°C in the upstream site, indicating high inter annual variability (Table 10). In 2015, annual average temperatures increased progressively from the Kid Tributary (7.1°C) to upstream Chickwat Creek (7.7°C) and downstream to the Chickwat Creek lower diversion site (8.5°C).

Table 10. Annual water temperature summary statistics.

Year	Water Temperature[1] (°C)											
	CHK-USWQ[2]				CHK-LDVWQ				CHK-C1WQ			
	Avg	Min	Max	SD	Avg	Min	Max	SD	Avg	Min	Max	SD
2010[3]	4.7	0.1	13.6	3.1	-	-	-	-	-	-	-	-
2011	4.7	0.1	13.6	3.1	-	-	-	-	-	-	-	-
2012	5.5	0.5	15.9	4.1	-	-	-	-	-	-	-	-
2013	6.1	0.4	17.2	4.2	-	-	-	-	-	-	-	-
2014	6.7	0.2	17.3	4.3	-	-	-	-	-	-	-	-
2015	7.7	0.5	18.2	4.2	8.5	0.7	17.2	4.3	7.1	0.0	18.5	4.6

[1]Summary statistics were not generated for years with less than 52 weeks of data.

[2]The data prior to 18 Sept 2014 and gaps in data at CHK-USWQ from 23 Sept 2015 to 17 Mar 2016 are supplemented by data collected at a nearby hydrometric gauge (CKT-USWQ/ChickwatIntake) installed by Aquarius R&D.

4.2.3. Daily Average Temperature Extremes

In addition to monthly and annual summary statistics, average daily temperatures provide information regarding the exiting daily variation and daily temperature extremes in the Project Area. Evaluation of the occurrence of daily average temperatures that exceed cold (<1°C) and/or warm temperature (>18°C and >20°C) extremes aids in characterizing the existing thermal conditions for fish and aquatic life (Table 11).

Considering all sites during baseline monitoring (2010 to 2016), the water temperature exhibits a cold to cool regime. No exceedances of the upper daily average limits were recorded; however a number of days with temperatures less than 1°C were observed at all the sites (Table 11). Overall the Kid Tributary site exhibits the highest annual percentage of exceedance of the <1°C extreme (8.2%

(30/363) in 2015). Inter-annual variation in the number of exceedances during the cooler months is evident from the CHK-USWQ data set spanning 2010 to 2016.

Table 11. Summary of the number of exceedances of mean daily water temperature extremes (T_{water}>18°C, T_{water}>20°C, and T_{water}<1°C) in the Project area from 2010 to 2016.

Reach	Site	Year	Record Length (days)	Days T_{water}> 20°C	Days T_{water}> 18°C	Days T_{water} < 1°C
Upstream	CHK-USWQ02	2015	43	0	0	2
		2016	123	0	0	5
	CHK-USWO[1]	2010	165	0	0	2
		2011	364	0	0	12
		2012	363	0	0	4
		2013	363	0	0	7
		2014	365	0	0	9
		2015	362	0	0	2
		2016	123	0	0	3
Diversion	CHK-UDVWQ	2014	104	0	0	0
		2015	308	0	0	2
		2016	122	0	0	3
	CHK-LDVWQ	2014	105	0	0	0
		2015	364	0	0	1
		2016	123	0	0	3
Tributary	CHK-C2WQ	2014	30	0	0	2
		2015	220	0	0	0
		2016	46	0	0	0
	CHK-C1WQ	2014	28	0	0	3
		2015	363	0	0	30
		2016	121	0	0	14

[2]The data prior to 18 Sept 2014 and gaps in data at CHK-USWQ from 23 Sept 2015 to 17 Mar 2016 are supplemented by data collected at a nearby hydrometric gauge operated by Aquarius R&D.

4.2.4. Hourly Rates of Temperature Change

From March 2008 to September 2011, the hourly rate of change of the water temperature in Chickwat Creek was less than ±1°C/hr with very few (<0.3% of total data points) exceptions; maximum rates of: +1.18°C/hr and -1.02°C/hr were observed (Appendix D, O'Toole *et al.* 2012).

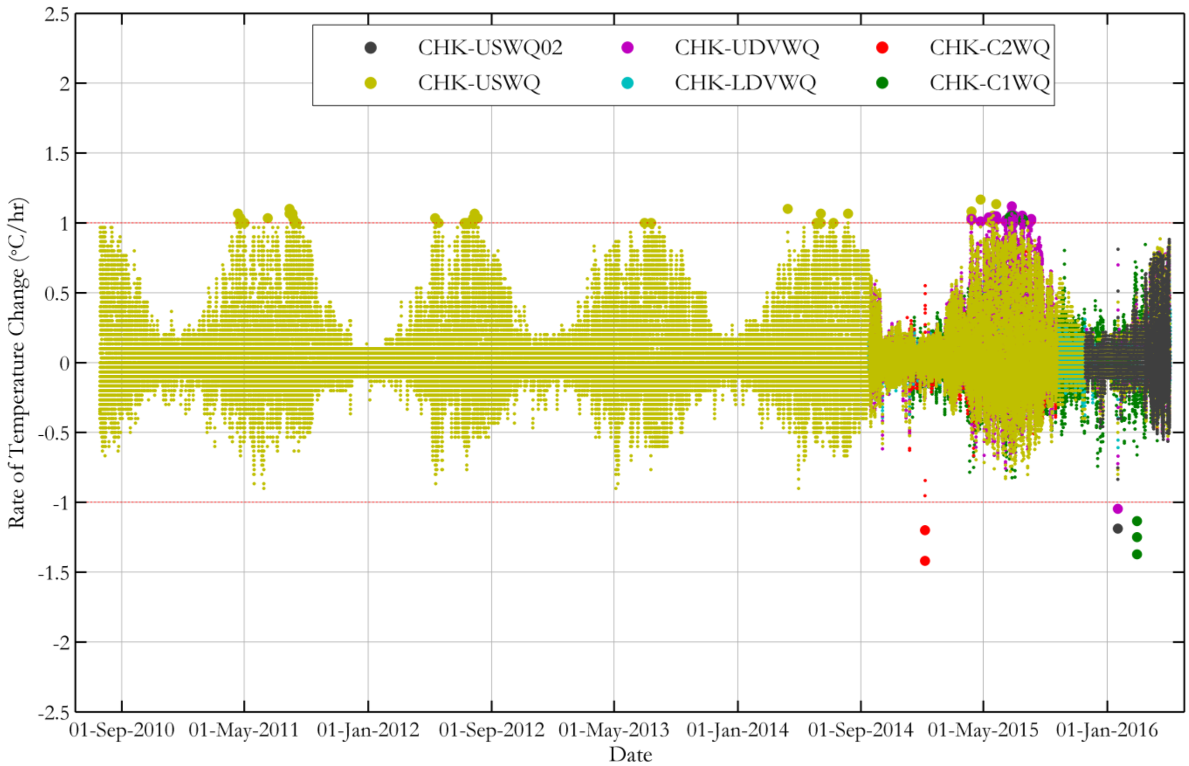
From September 2011 to May 2016, hourly rates of change in water temperature were calculated and screened against the provincial guidelines for the protection of aquatic life, which specify that the hourly rate of water temperature change should not exceed ±1°C/hr (Oliver and Fidler 2001). The baseline conditions regarding this metric identify a small (<0.1%) naturally occurring exceedance of the guideline in both directions (greater than 1°C/hr decrease in temperature and greater than 1°C/hr increase in temperature) at all sites (Figure 4, Appendix D). The magnitude of the exceedance is slightly higher for the rate of temperature decrease (~-1.4°C/hr) per hour as is evident on Figure 4 where the dots signify an exceedance of the rate of change per hour. These exceedances were observed in the tributaries during the cooler months. Based on Ecofish's experience collecting baseline data on several other streams in British Columbia, it is normal for a small percentage of data points to have hourly rates of water temperature change that exceed ±1°C/hr.

Table 12. Baseline statistics and exceedance of ±1°C/hr hourly rate of change in water temperature.

Site	Start Date	End Date	Number of Datapoints	Occurrence of rates >1°C/hr		Max -ve	Percentile				Max +ve
				#	% of record		1st	5th	95th	99th	
CHK-USWQ02	18-Nov-2015	3-May-2016	16,051	1	0.006	-1.2	-0.4	-0.2	0.2	0.6	0.9
CHK-USWQ[1]	19-Jul-2010	3-May-2016	202,914	51	0.025	-0.9	-0.4	-0.3	0.4	0.8	1.2
CHK-UDVWQ	18-Sep-2014	3-May-2016	51,561	45	0.087	-1.0	-0.4	-0.2	0.4	0.8	1.1
CHK-LDVWQ	16-Sep-2014	4-May-2016	57,200	0	0.000	-0.6	-0.3	-0.2	0.2	0.4	0.7
CHK-C2WQ	1-Dec-2014	3-May-2016	28,909	2	0.007	-1.4	-0.3	-0.2	0.3	0.6	0.9
CHK-C1WQ	3-Dec-2014	3-May-2016	49,595	9	0.018	-1.4	-0.3	-0.2	0.3	0.4	1.1

[1]The data prior to 18 Sept 2014 and gaps in data at CHK-USWQ from 23 Sept 2015 to 17 Mar 2016 are supplemented by data collected at a nearby hydrometric gauge operated by Aquarius R&D.

Figure 4. Baseline hourly rate of change in water temperature from 2010 to 2016. Dots indicate rates with magnitudes exceeding ±1°C/hr.



4.2.5. Growing Season and Degree Days

The length of the growing season and the number of degree days in the growing season are important predictors of fish growth and development (Coleman and Fausch 2007). Natural temperature changes are necessary to induce the reproductive cycles of aquatic organisms and the accumulated thermal units fish experience during their growing season is key in determining their length/size.

Growing season metrics for the period spanning 2011 to 2016, were only calculated for those years with sufficient temperature records over the entire growing season (Table 13). Growing season metrics for the period spanning 2008 to 2010 are provided in Appendix D.

The beginning of the growing season was defined as the beginning of the first week where average stream temperatures exceeded and remained above 5°C for the season; the end of the growing season was defined as the last day of the first week that average stream temperature dropped below 4°C as per Coleman and Fausch (2007). The growing degree days represent the accumulated average water temperature a fish experiences within the growing season; an equivalent of 1˚C over a 24 hour period was used (i.e., a day in which the average temperature was 12˚C would have 12 degree-days), and these values were summed over the entire growing season.

From 2008 to 2010, the growing season lasted from 195 to 210 days with the growing degree days spanning 1,688 to 2,101. During baseline monitoring commencing in 2011, complete records over the course of the growing season were recorded at the upstream control site (CHK-USWQ) from 2011 to 2015, and at Kid Tributary (CHK-C1WQ) and the upper and lower diversion reach in Chickwat Creek (CHK-UDVWQ and CHK-LDVWQ) in 2015. In the upstream reach, 2015 was the warmest (above average) year recorded with the earliest growing season start date (April 14, 2015) and the highest accumulated growing degree days (2,285) (Table 13). Therefore, we can assume that the 2015 baseline data for Kid Tributary and the upper and lower Chickwat diversion reach will also be representative of a warm year and may not be reflective of average conditions for this area. As expected the Kid Tributary is slightly cooler than the upstream site (2,106 growing degree days) while the lower diversion is warmer (2,674 growing degree days), however the length and number of growing degree days is reasonably similar for all sites in 2015 and reflective of the unusually warm year.

Table 13. Baseline summary of the growing season and growing degree days in Chickwat Creek and Kid and Mountain Goat Tributaries (2011 to 2016).

Reach	Site	Year	Number of days with valid data	Growing Season Data Summary[1]				
				Start Date	End Date	Length (days)	Gap (days)	Accumulated Degree Days (°C)
Tributary	CHK-C1WQ	2015	365	27-Apr	15-Nov	203	0	2,106
Upstream	CHK-USWQ[2]	2011	365	14-Jun	08-Nov	148	0	1,160
		2012	366	05-Jun	15-Nov	164	0	1,455
		2013	365	13-May	21-Nov	193	0	1,759
		2014	365	07-May	15-Nov	193	0	1,939
		2015	365	14-Apr	21-Nov	222	0	2,285
	Average					*184*		*1720*
Diversion	CHK-UDVWQ	2015	310	13-Apr	21-Nov	223	55	2,249
	CHK-LDVWQ	2015	365	07-Mar	24-Nov	263	0	2,674

[1] Growing season metrics were only calculated for those years with sufficient temperature data over the entire growing season.

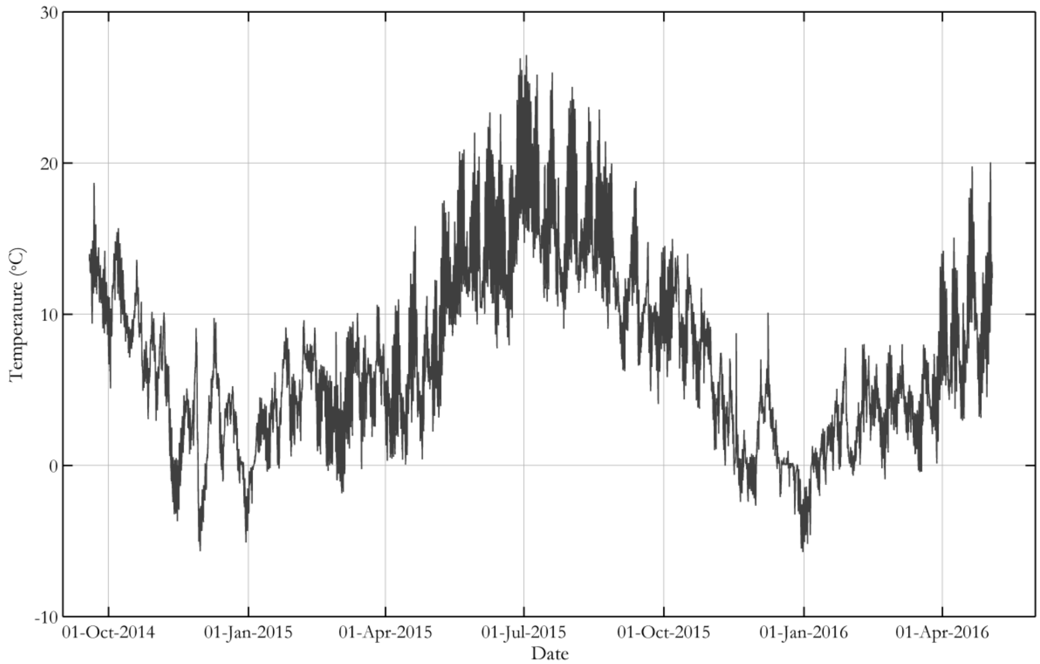
[2] The data prior to 18 Sept 2014 and gaps in data at CHK-USWQ from 23 Sept 2015 to 17 Mar 2016 are supplemented by data collected at a nearby hydrometric gauge operated by Aquarius R&D.

4.2.6. Air Temperature

Air temperature data recorded at CHK-UDVWQ in the upper diversion reach of Chickwat Creek, exhibits an air temperature regime with typical annual cycling and diurnal fluctuations (Figure 5). Similar to water temperature, diurnal fluctuations in air temperature were greatest during the summer months and of a lessor magnitude during the winter months.

The monthly average air temperature ranged from 0.9°C to 16.6°C from October 2014 to April 2016 (Appendix D). The lowest recorded temperature was -5.7°C which occurred in both November and December, while the highest recorded air temperature was 27.1°C which was recorded in July.

Figure 5. Baseline air temperature at CHK-UDVWQ from September 2014 to May 2016.



4.3. Stream Channel Morphology

4.3.1. Upstream Reach

4.3.1.1. Photographic Monitoring

Upstream reach oblique and aerial photographs were collected at five georeferenced photo points (Appendix L). The oblique photographs were taken either with a UAV or with a ground based DSLR camera. Oblique photos at additional photos points were archived for future reference. Aerial photographs were stitched into an orthomosaic image and shown in segments in Appendix F.

4.3.1.2. FHAP Assessment

An FHAP survey was performed on a total of 238 m of the upstream reach (Zyla and Lewis 2012). The upstream reach was dominated by riffle morphology (70%), and featured glide (20%) and pool (10%) habitat. The average bankfull width was 24.0 m (n = 3, SD = 7.0). The average gradient in this reach was 3.6%. Average bankfull depth was 1.5 m (n = 3, SD = 0.8). The dominant substrate class was boulder, with subdominant gravel and bedrock. A 22 m long pool was present in the upstream reach with unknown formation process. Identified spawning habitat consisted of 23.0 m^2 of functional spawning habitat suitable for both anadromous salmon and resident fish, and 3.5 m^2 of non-functional spawning habitat suitable solely for resident trout and charr. A total of 18 large wood pieces were identified ranging from 10 to 50 cm diameter with 7 pieces classified as functional. The riparian vegetation in this reach is completely comprised of young mixed coniferous-deciduous forest.

4.3.2. Lower Diversion Reach

4.3.2.1. Rapid Assessment

The channel condition and current direction of change in the lower diversion reach downstream of the canyon section were assessed with a rapid assessment. Oblique photos with relevant geomorphic observations are provided in Appendix M. A summary of the observations are provided below.

The channel pattern consists of boulder and bedrock forced cascade morphology extending from the downstream extent of the canyon section to the proposed tailrace. A short section just downstream of the canyon also features boulder step-pools. The gradient and bed material size progressively decreases in the downstream direction. Small pockets of gravel and small cobble were present at the downstream extent of small pools. Pools were generally formed by backwatering from partial steps or plunge pools. The channel was not confined by valley walls, but sinuosity was low and entrenchment high likely due to the non-erodible large boulder bank material. Just upstream of the reach, a large bedrock fracture resulted in a slab of material recently falling into the channel bringing small trees and approximately 20 m^2 of sand/gravel soil. It is expected this type of bank failure is likely uncommon and less influenced by fluvial processes. Barforms were non-existent aside from faint boulder accumulations that resemble lateral bars. Most boulder tops were free of moss indicating that large highly erosive flows are common. The floodplain material consists of a thin layer of soil overlying large boulders that were likely deposited by glaciofluvial processes. The floodplain vegetation consists of young to mature second growth trees with limited dead-fall in the channel. Large wood is common in the channel although pieces rarely contribute to channel morphology.

It is expected that gravel material is likely flushed from the system during high flow events requiring replenishment from upstream sources. The channel morphology appears stable due to the bank and bed large boulder composition. It is expected that the channel will remain stable unless an extremely large flood mobilizes the large boulders or a large pulse of sediment and large wood from upstream deposits; however, deposits would likely be transient.

4.3.2.2. Photographic Monitoring

Photographic survey points were established at five lower diversion reach transects (Appendix M). A description of channel character at the transects is provided below. Each of the transects were located in boulder dominated cascade/step-pool morphology. Vertical photos of substrate and geomorphic features near the transects are catalogued for future comparison in Appendix M. Transect oblique photos are provided in Appendix N. A summary of transect location and number of photos is provided in Table 14. Transects were generally selected near the downstream of pools through alluvial gravel accumulations. Aerial photographs were stitched into an orthomosaic image and shown in segments in Appendix F.

CHK-DVGM05 is located approximately 360 m upstream of the existing bridge crossing near the downstream extent of the canyon reach. The transect is downstream of a partial step-pool where a large deposit of gravel has accumulated behind large boulders on river left. The banks were vegetated with mature second growth trees with some partially leaning out into the channel. One larger tree was beginning to be outflanked, although the current condition looks to be persistent.

CHK-DVGM04 is located approximately 340 m upstream of the existing bridge crossing. The transect is also downstream of a partial step. The river left side consists of large boulders with minimal flow, with a large pool mostly lined with boulders. The right side is through the centre of a larger pool containing scattered large boulders and a mid-channel patch of gravel. The banks are composed of loose boulders with scattered large wood caught against trees.

CHK-DVGM03 is located approximately 330 m upstream of the existing bridge crossing. The channel morphology is a mix of cascade and step-pool morphology. A relatively deep pool is present downstream of the stump from CHK-DVGM04 with gravel patches along the margins near the right bank and centre of channel. Downstream of the section large wood can be seen at the channel margins impacted against live trees or fallen in from bank erosion.

CHK-DVGM02 is located approximately 290 m upstream of the existing bridge crossing. The transect is in pool downstream of a cascade with a gravel deposits near the river left downstream margin of the pool and near the river left bank. The river right floodplain is much lower at this section and cobble and gravel deposits extend into the forest. It is expected these floodplain deposits occur during large infrequent storms considering they are above bankfull.

CHK-DVGM01 is located approximately 260 m upstream of the existing bridge crossing. The transect is through a scour pool downstream of a cascade. A gravel deposit is present at the downstream river right margin of the pool. Smaller gravel deposits are present near both channel banks downstream of large boulders. The river right bank is gradual and the floodplain is low. Bank vegetation includes some herbaceous plants in front of mature trees. The river left bank features a large mound of sand, gravel, and cobble material just downstream that is eroding into the channel, possibly due to foot traffic.

Table 14. Photo points and channel description at surveyed transects.

Transect (UTM Coordinates)	Distance upstream of existing bridge crossing (m)	Number of Oblique Photos	Number of Substrate Photos	Morphology	Dominant Substrate
CHK-DSGM01 (449268 E 5520303 N)	60	10	15	cascade	boulder, cobble
CHK-DSGM02 (449229 E 5520301 N)	100	13	23	cascade	boulder
CHK-DVGM01 (449074 E 5520272 N)	260	11	23	cascade	boulder
CHK-DVGM02 (449047 E 5520263 N)	290	11	31	cascade / step-pool	boulder
CHK-DVGM03 (448999 E 5520268 N)	330	12	23	cascade / step-pool	boulder
CHK-DVGM04 (449007 E 5520234 N)	340	13	11	cascade / step-pool	boulder
CHK-DVGM05 (448972 E 5520253 N)	360	10	12	cascade / step-pool	boulder

4.3.2.3. Topographic Survey

Five transects were surveyed in the lower diversion reach of Chickwat Creek (Map 3). The bed profiles of the surveyed transects are provided in Appendix G. The thalweg profile was also surveyed from approximately 20 m upstream of the transects to approximately 35 m downstream (Appendix G).

The average channel gradient, measured from crest to crest of geomorphic units was 8.7%, and the length surveyed was 158 m. The average gradient faded from 9.47% in the upper section to 7.03% in the lower. Pool depths (measured relative to the crest of the next downstream geomorphic unit) were calculated for nine prominent pools. The pool depth ranged from 18.6 cm to 65.9 cm with an average 36.5 cm. Most pools were formed at the foot of cascades or below boulder steps.

4.3.2.4. Sediment Sampling

Sediment sampling was conducted along the five diversion reach surveyed transects to establish grain size distribution (Appendix G). The D50s (median diameter) ranged from 71 to 195 mm with an average of 132 mm. The D84s for the same transects ranged from 512 to 794 mm with an average of 662 mm. Representative photos of measured substrate are provided in Appendix O. Fines composition ranged from 2 to 8%, typically found in the lee of large boulders or boulder clusters.

4.3.2.5. FHAP Assessment

An FHAP survey was performed on a total of 169 m of the diversion reach below the canyon section (Zyla and Lewis 2012). The average gradient in the lower diversion reach was 22.4% in primary habitat and 0.7% in tertiary habitat. The lower diversion reach (including canyon section) was dominated by cascade morphology (71%), with riffles, chutes, pools, and falls being subdominant. The average bankfull width was measured at 25.6 m for primary habitat (n = 8, SD = 2.9) and 25.0 m for tertiary habitat (n = 1). The average water depth was relatively consistent with other reaches at 0.7 m in primary habitat (n = 8, SD = 0.2) and 0.5 m in tertiary habitat (n = 1). Note that it was not possible to collect bankfull measurements for all units. Boulders were identified as the dominant substrate type (88%), with a cobble component. Pools in this reach were formed by scouring. Almost equal in portion, a total of 115.0 m^2 of functional spawning habitat and 115.7 m^2 of non-functional spawning habitat were identified in the downstream reach. The vast majority of this amount was suitable for both anadromous salmon and resident fish. A total of 24 pieces of LWD were counted in this reach ranging from 20 to >50 cm in diameter with 58.3% of the total LWD tally classified as functional. The riparian vegetation in the lower diversion reach is comprised of young mixed coniferous-deciduous forest (71.4 %) and young coniferous forest (28.6%).

4.3.3. Downstream Reach

4.3.3.1. Rapid Assessment

The channel condition and current direction of change in the downstream reach from the intake to the approximate confluence fan apex were assessed with a rapid assessment. Oblique photos with relevant geomorphic observations are provided in Appendix M. A summary of the observations are provided below.

The channel pattern consists of a progression from boulder controlled cascade to plain-bed morphology in the downstream direction. The channel sinuosity is low until the fan apex where a multi-thread pattern with vegetated islands forms. The islands are partially covered in alluvial cobbles/boulders that have smothered vegetation. Small gravel deposits are fairly common upstream of the bridge in the lee of boulders and at the downstream extent of small pools. The channel bank within approximately 100 m of the bridge crossing has been engineered with cobble and boulder lining that now has young to mature trees growing on the bank slope. The raised bank height has resulted in the formation of a recovering partially confined bankfull channel within the existing larger channel. Erosion is also occurring along the river left engineered bank upstream of the bridge causing a partial scour pool and adjacent point bar. Downstream of the bridge, the river right channel bank is eroding with large undercuts forming. The bank vegetation generally consists of young trees and the floodplain consists of mature second growth trees. The floodplain consists of a thin layer of soil with minimal fresh fines deposits, similar to the diversion reach. Large wood is uncommon upstream of the bridge, while downstream of the bridge, numerous large wood pieces have deposited or eroded into the channel from the bank.

The general direction of change appears to be the recovery of a smaller channel within the larger engineered channel. The pattern of gravel deposits suggests they are transient, aside from the point bar forming near the bridge. The bridge itself is under-sized and appears to contribute to the sinuous pattern forming just upstream where high erosive flows are likely dampened by backwatering. Downstream of the bridge, the channel is migrating into the right bank and large pulses of gravel through boulder sized material appear to still occur commonly. As sediment supply recovers to pre-logging conditions, a general reduction in gravel in the downstream reach and formalization of a stable fan pattern could occur. However, the trends of morphological change appear to be highly dependent on individual extreme events since entrenchment and slope are high upstream of the bridge, resulting in limited energy dissipation on the floodplain.

4.3.3.2. Photographic Monitoring

Photographic survey points were established at two downstream reach transects (CHK-DSGM01, CHK-DSGM02). Transect oblique photos are provided in Appendix N. A description of channel character at the transects is provided below. Vertical photos of substrate and geomorphic features near the transects are catalogued for future comparison in Appendix O. Aerial photographs were stitched into an orthomosaic image and shown in segments in Appendix F.

CHK-DSGM02 is located approximately 100 m upstream of the existing bridge crossing. The channel morphology is cascade with a concentrated flow near river right over boulder substrate and lesser flow on river left over boulder, cobble, and gravel substrate. The banks are composed of cobble and boulders that may have been built up to protect the downstream bridge. Young trees extend down both banks to the level of a recovering bankfull channel. This new bankfull channel is entrenched by >3x the bankfull depth. The floodplain is composed of mature second growth trees.

CHK-DSGM01 is located approximately 60 m upstream of the existing bridge crossing. The morphology is cascade and the channel is migrating towards river left with a poorly sorted boulder, cobble, and gravel point bar forming on river right. Gravel deposits are present in the lee of boulders, especially near the channel margins. The recovering bankfull level at this location appears higher than at CHK-DSGM02; however the channel is still entrenched by >2x on river left. The river left bank is clearly engineered and may forms a berm/dyke that is elevated above the floodplain.

4.3.3.3. Topographic Survey

Two transects were surveyed in the downstream reach of Chickwat Creek (Map 3). The surveyed transects are shown in (Appendix G). The thalweg profile was also surveyed from approximately 57 m upstream of the transects to approximately 23 m downstream (Appendix G).

The average channel gradient, measured from crest to crest of geomorphic units, was 4.64%, and the length surveyed was 120 m. Pool depths (measured relative to the crest of the next downstream geomorphic unit) were calculated for eight prominent pools. The pool depth ranged from 11.6 cm to 39.5 cm with an average 21.5 cm. Most pools were formed at the foot of cascades.

4.3.3.4. Sediment Sampling

Sediment sampling was conducted along two downstream reach transects to establish grain size distribution (Figure 15 and Figure 16 of Appendix G). The D50s (median diameter) for the transects were 116 and 120 mm. The D84s for the transects were 429 mm and 462 mm. Representative photos of measured substrate are provided in Appendix O. Fines composition was 6% for both sections, with deposits both behind boulders and at the toe of banks.

4.3.3.5. FHAP Assessment

An FHAP survey was performed on a total of 205 m of the downstream reach below the tailrace (Zyla and Lewis 2012). The downstream reach was dominated by cascade morphology (70%), with the remainder comprised of riffles. Note that the percent cascade in the downstream reach applies only to the section extending from the tailrace to the bridge crossing. Below the bridge, habitat becomes high percentage riffle, run, and small percentages of cascade. The average gradient in this reach was 3.6% (n = 6, SD = 1.9). The bankfull width was measured at 21.5 m (n = 6, SD = 1.5), while bankfull depth was measured to be 1.4 m (n = 6, SD = 0.2). Boulders were identified as the dominant substrate type, with a cobble component. No deep pools were identified in the downstream reach. A total of 71.6 m^2 of functional spawning habitat and 49.6 m^2 of non-functional spawning habitat were identified in the downstream reach. The vast majority of this amount was suitable for both anadromous salmon and resident fish (i.e. 10-150 mm size particles, at least 1.5 m^2 patch size). A total of 17 pieces of LWD were counted in this reach. The diameters of LWD in the downstream reach were not measured. The survey identified young mixed coniferous-deciduous forest as the dominant riparian vegetation. The absence of mature forest in the area can likely be attributed to recent logging activities in the area.

4.3.4.Summary

This report documents the October 2015 and August 2016 survey efforts to establish baseline geomorphic conditions associated with the Chickwat Creek Hydroelectric Project. These surveys fulfil the baseline survey requirements identified in the OEMP (Faulkner *et al.* 2016). The reaches surveyed included the headpond and upstream reach, the lower diversion reach downstream of the canyon section, and the downstream reach from the tailrace to the debris fan apex just downstream of the existing bridge crossing.

The geomorphic assessment generally confirms the observations from previous assessments (NHC 2011, MMA 2013). Beginning at the outlet of the diversion reach canyon section, the channel progresses from a cascade and step-pool morphology, to cascade, then plain-bed. The channel is moderately entrenched by large boulder banks just downstream of the canyon reach, resulting in minimal gravel/cobble deposition. Just above the tailrace, banks are slowly eroding and deposits of gravel, cobble, and large wood pieces are common along the bank and in the near bank floodplain. Downstream of the tailrace, a recovering bankfull channel is forming inset within the engineered channel causing minor erosion of channel banks. The debris fan deposit on the Tzoonie River floodplain has progressed downstream over the past few decades, likely owing to the engineered bank protection in the vicinity of the bridge crossing. The fan appears to remain highly unstable, as evidenced by fresh cobble sized deposits on vegetated islands, bank erosion, and fresh large wood jams. Gravel deposits in the diversion and downstream reaches are generally located in the lee of large boulders and at the downstream margins of small pools.

Gravel deposits are expected to be somewhat transient, and could wash out if the supply of sediment from upstream continues to decrease. Large sediment deposits observed in debris fans upstream of the proposed intake (NHC 2011) will likely maintain gravel supply for many years; however, once full recovery from logging has occurred, the quantity of diversion and downstream reach gravel may be reduced regardless of the Project (MMA 2013). Additionally, alteration of the existing bridge crossing (i.e. removal or restoration) could result in a reduction of gravel deposits in the section of channel immediately downstream of the tailrace. The bridge appears to create a backwatering effect at high flows that promotes deposition. Assessment of Project effects in year 5 will need to take the effects of logging recovery and the existing bridge crossing into consideration. Changes to general bed morphology are expected to be unlikely given the current transport limited condition of the large boulders. It is expected that fines deposition in the low flow channel is unlikely in the lower diversion; however, pools and gravel patches near the channel margins could infill with fine sediment as suggested in (Lacroix *et al.* 2015). Large wood pieces currently provide minimal functionality upstream of the bridge, and therefore changes to their distribution and functionality are expected to be minor.

4.4. Fish Community

4.4.1. Upper Diversion

4.4.1.1. Night Snorkelling Mark-Recapture

2014

Sites were composed of step-pool, riffle, pool and cascade mesohabitats, with step-pool and riffles being the most common in the upper diversion and upstream sites, respectively (Table 15). Average gradient of sites ranged from 1.0 to 7.0%. Substrates were primarily composed of boulder, cobble, and gravel and cover consisted primarily of boulders, cobble and deep pools. Sites ranged from 60 m to 75 m in length and 13.3 m to 16.0 m in width, and had maximum depths that ranged from 0.7 to 2.5 m. Sample site area averaged 872 m^2 and ranged from 714 m^2 to 1,074 m^2. During the 2014 mark-recapture sampling, water temperatures ranged from 7.0 to 10.0°C, water visibility was estimated to be between 6.5 and 9.0 m, and turbidity was assessed to be clear (Table 16). Average flow over the survey period ranged from 0.58 m^3/s during mark events, to 4.48 m^3/s during recapture events. Representative site photographs of all 2014 upper diversion and upstream mark-recapture sampling sites are provided in Appendix H. Habitat suitability transects were not conducted in 2014, therefore habitat usability and wetted usable width (WUW) could not be calculated for this year of sampling.

A summary of 2014 mark-recapture, fish counts, capture efficiencies, population estimates, densities, and biomass densities are presented by site, reach, and age class in Table 17 and each age class grouping in Table 18. Totals of 64 and 63 Dolly Varden were marked within the upper diversion and upstream reach, respectively. During 2014 re-capture events, a total of 64 Dolly Varden were captured or observed within the upper diversion reach, of which 26 were marked, and a total of 63 were captured or observed in the upstream reach, of which 28 were marked. Capture efficiencies in upper diversion sites averaged 0.43, ranging from 0.08 to 0.62. Capture efficiencies in the upstream sites also averaged 0.43, ranging from 0.17 to 0.60.

Densities and biomass densities varied among sites, age classes, and reach, and are presented by the average linear density (fish per 10 m), density per area (fish per 100 m²), linear biomass (g per 10 m), and biomass per area (g per 100 m²) for each age class in each reach in Table 19 and Figure 6. Overall, densities of fry (0+), and to a lesser extent juveniles (1-2+), were higher in the upstream reach than those in the upper diversion reach. Similarly, biomass densities (g/10 m) of fry (0+) were higher in the upstream reach than those in the upper diversion reach, while differences between reaches were minimal for all other age class groupings (Table 19 and Figure 6).

Table 15. **Summary of habitat, cover, and substrate at mark-recapture sampling sites in the upper diversion and upstream reaches of Chickwat Creek in October, 2014.**

Reach	Site	Habitat	Length (m)	Avg. Width (m)[1]	Area (m^2)	Max Depth (m)	Cover		Substrate (%)[3]							Gradient (%)
							Dom.	Sub-dom.	BR	BO	LC	SC	LG	SG	F	
Upper Diversion	CHK-UDVSN01	Riffle	60	15.3	918	1.2	BO	CO	0	40	20	15	10	10	5	3.5
	CHK-UDVSN02	Step Pool	68	13.5	918	1.6	BO	DP	0	30	25	20	15	8	3	4.5
	CHK-UDVSN03	Step Pool	61	14.8	905	2.2	BO	DP	5	35	15	15	15	10	5	3.5
	CHK-UDVSN04	Step Pool	61	11.7	714	1.5	BO	DP	0	45	15	15	10	10	5	7.0
	CHK-UDVSN05	Riffle	60	13.2	792	2.0	BO	DP	0	30	25	15	15	10	5	3.0
Upstream	CHK-USSN01	Pool	65	11.3	741	2.3	DP	BO	5	30	20	15	15	10	5	1.0
	CHK-USSN02	Riffle	67	16.0	1,074	0.7	BO	CO	0	25	20	25	15	10	5	2.0
	CHK-USSN03	Pool/Cascade	75	11.5	859	2.5	DP	BO	0	50	20	10	10	5	5	2.3
	CHK-USSN04	Riffle	73	12.2	891	1.3	BO	CO	3	45	20	15	10	5	3	3.0
	CHK-USSN05	Riffle	71	12.8	909	1.1	BO	DP	0	45	20	15	10	5	5	3.0

[1] Full stream wetted widths were sampled at all sites.

[2] BO = Boulder, CO = Cobble, DP = Deep Pool.

[3] BR = Bedrock, BO = Boulder, LC = Large Cobble, SC = Small Cobble, LG = Large Gravel, SG = Small Gravel, and F = Fines.

Table 16. Summary of site conditions during mark-recapture sampling in the upper diversion and upstream reaches of Chickwat Creek October, 2014.

Reach	Sampling Event	Site	Date	Water Temp. (°C)	Estimated Visibility (m)	Turbidity	Average Flow (m^3/s)[1]
Upper Diversion	Mark	CHK-UDVSN01	7-Oct-14	10.0	9.0	Clear	0.81
		CHK-UDVSN02	7-Oct-14	9.5	9.0	Clear	0.81
		CHK-UDVSN03	7-Oct-14	10.0	9.0	Clear	0.81
		CHK-UDVSN04	8-Oct-14	9.5	9.0	Clear	0.67
		CHK-UDVSN05	8-Oct-14	9.5	9.0	Clear	0.67
	Recapture	CHK-UDVSN01	15-Oct-14	9.0	7.0	Clear	4.48
		CHK-UDVSN02	15-Oct-14	9.0	7.0	Clear	4.48
		CHK-UDVSN03	15-Oct-14	9.5	7.0	Clear	4.48
		CHK-UDVSN04	15-Oct-14	9.0	7.0	Clear	4.48
		CHK-UDVSN05	15-Oct-14	9.0	7.0	Clear	4.48
Upstream	Mark	CHK-USSN01	8-Oct-14	9.0	9.0	Clear	0.67
		CHK-USSN02	8-Oct-14	9.0	9.0	Clear	0.67
		CHK-USSN03	9-Oct-14	9.5	9.0	Clear	0.58
		CHK-USSN04	9-Oct-14	9.5	9.0	Clear	0.58
		CHK-USSN05	9-Oct-14	9.0	9.0	Clear	0.58
	Recapture	CHK-USSN01	16-Oct-14	7.5	6.5	Clear	4.16
		CHK-USSN02	16-Oct-14	7.5	6.5	Clear	4.16
		CHK-USSN03	16-Oct-14	7.5	6.5	Clear	4.16
		CHK-USSN04	16-Oct-14	7.5	6.5	Clear	4.16
		CHK-USSN05	16-Oct-14	7.0	6.5	Clear	4.16

[1] Flow data presented is from the hydrometric gauge located at the Chickwat Intake.

Table 17. Dolly Varden densities and biomass by age class for each sampling site within the upper diversion and upstream reaches of Chickwat Creek, 2014.

Age Class	Reach	Site	M	C	R	CE	Population Size (N)	Density (N/10 m)	Biomass (g/10 m)	Density (N/100m^2)	Biomass (g/100m^2)
Fry (0+)	Upper Diversion	CHK-UDVSN01	9	6	2	0.22	33.2	5.54	18.39	3.61	0.20
		CHK-UDVSN02	1	3	0	0.00	16.6	2.44	8.06	1.81	0.09
		CHK-UDVSN03	0	4	0	-	22.2	3.63	11.17	2.45	0.12
		CHK-UDVSN04	2	1	1	0.50	5.5	0.91	3.45	0.78	0.05
		CHK-UDVSN05	3	1	0	0.00	5.5	0.92	3.88	0.70	0.05
		Average ± SE				**0.18 ± 0.12**		**2.69 ± 0.88**	**8.99 ± 2.75**	**1.87 ± 0.54**	**0.10 ± 0.03**
	Upstream	CHK-USSN01	5	4	1	0.20	80.0	12.23	43.29	10.80	0.58
		CHK-USSN02	1	1	0	0.00	20.0	2.99	8.06	1.86	0.08
		CHK-USSN03	1	1	0	0.00	20.0	2.68	9.26	2.33	0.11
		CHK-USSN04	5	0	0	0.00	0.0	0.00	0.00	0.00	0.00
		CHK-USSN05	0	3	0	-	60.0	8.45	24.79	6.59	0.27
		Average ± SE				**0.05 ± 0.05**		**5.27 ± 2.22**	**17.08 ± 7.68**	**4.31 ± 1.95**	**0.21 ± 0.10**
Juv. (1+)	Upper Diversion	CHK-UDVSN01	7	5	4	0.57	15.6	2.60	52.71	1.69	0.57
		CHK-UDVSN02	10	9	2	0.20	28.0	4.12	62.42	3.05	0.68
		CHK-UDVSN03	2	3	1	0.50	9.3	1.53	26.61	1.03	0.29
		CHK-UDVSN04	3	1	1	0.33	3.1	0.51	9.54	0.44	0.13
		CHK-UDVSN05	4	1	0	0.00	3.1	0.52	9.53	0.39	0.12
		Average ± SE				**0.32 ± 0.10**		**1.86 ± 0.69**	**32.16 ± 10.94**	**1.32 ± 0.49**	**0.36 ± 0.11**
	Upstream	CHK-USSN01	11	10	8	0.73	21.5	3.29	60.37	2.90	0.81
		CHK-USSN02	3	6	1	0.33	12.9	1.92	26.99	1.20	0.25
		CHK-USSN03	5	5	3	0.60	10.7	1.44	22.94	1.25	0.27
		CHK-USSN04	1	2	0	0.00	4.3	0.59	7.91	0.48	0.09
		CHK-USSN05	3	4	2	0.67	8.6	1.21	20.11	0.94	0.22
		Average ± SE				**0.47 ± 0.13**		**1.69 ± 0.45**	**27.66 ± 8.77**	**1.35 ± 0.41**	**0.33 ± 0.13**
Juv. (2+)	Upper Diversion	CHK-UDVSN01	0	0	0	-	0.0	0.00	0.00	0.00	0.00
		CHK-UDVSN02	0	2	2	-	5.5	0.81	30.45	0.60	0.33
		CHK-UDVSN03	7	4	3	0.43	11.0	1.80	77.71	1.21	0.86
		CHK-UDVSN04	3	3	2	0.67	8.2	1.35	70.04	1.15	0.98
		CHK-UDVSN05	2	0	0	0.00	0.0	0.00	0.00	0.00	0.00
		Average ± SE				**0.37 ± 0.20**		**0.79 ± 0.36**	**35.64 ± 16.61**	**0.59 ± 0.26**	**0.43 ± 0.21**
	Upstream	CHK-USSN01	2	1	1	0.50	2.1	0.32	11.08	0.28	0.15
		CHK-USSN02	1	3	0	0.00	6.3	0.93	29.97	0.58	0.28
		CHK-USSN03	4	7	2	0.50	14.6	1.96	82.13	1.70	0.96
		CHK-USSN04	2	3	2	1.00	6.3	0.86	37.62	0.70	0.42
		CHK-USSN05	5	3	2	0.40	6.3	0.88	37.99	0.69	0.42
		Average ± SE				**0.48 ± 0.16**		**0.99 ± 0.27**	**39.76 ± 11.67**	**0.79 ± 0.24**	**0.44 ± 0.14**
Adult (≥3+)	Upper Diversion	CHK-UDVSN01	1	0	0	0.00	0.0	0.00	0.00	0.00	0.00
		CHK-UDVSN02	1	1	1	1.00	1.5	0.22	14.80	0.16	0.16
		CHK-UDVSN03	4	5	4	1.00	7.5	1.23	79.00	0.83	0.87
		CHK-UDVSN04	2	3	2	1.00	4.5	0.74	60.43	0.63	0.85
		CHK-UDVSN05	3	3	1	0.33	4.5	0.75	60.15	0.57	0.76
		Average ± SE				**0.67 ± 0.21**		**0.59 ± 0.22**	**42.88 ± 15.06**	**0.44 ± 0.15**	**0.53 ± 0.19**
	Upstream	CHK-USSN01	2	3	2	1.00	6.9	1.06	67.61	0.93	0.91
		CHK-USSN02	1	1	0	0.00	2.3	0.34	27.11	0.21	0.25
		CHK-USSN03	4	3	2	0.50	6.9	0.93	84.71	0.81	0.99
		CHK-USSN04	3	2	2	0.67	4.6	0.63	52.32	0.52	0.59
		CHK-USSN05	4	1	0	0.00	2.3	0.33	25.29	0.25	0.28
		Average ± SE				**0.43 ± 0.19**		**0.66 ± 0.15**	**51.41 ± 11.50**	**0.55 ± 0.14**	**0.60 ± 0.15**

M = # of fish marked in first sample; C= total # of fish captured in second sample; R = # of fish captured in second sample that were marked; CE = Capture Efficiency; SE = Standard Error.

Table 18. Dolly Varden densities and biomass by age class groupings for each sampling site within the upper diversion and upstream reaches of Chickwat Creek, 2014.

Age Class	Reach	Site	M	C	R	CE	Population Size (N)	Density (N/10 m)	Biomass (g/10 m)	Density ($N/100m^2$)	Biomass ($g/100m^2$)
Juv. (1-2+)	Upper Diversion	CHK-UDVSN01	7	5	4	0.57	13.0	2.17	44.15	1.42	0.48
		CHK-UDVSN02	10	11	4	0.40	28.7	4.22	73.01	3.13	0.80
		CHK-UDVSN03	9	7	4	0.44	18.3	2.99	105.33	2.02	1.16
		CHK-UDVSN04	6	4	3	0.50	10.4	1.71	66.17	1.47	0.93
		CHK-UDVSN05	6	1	0	0.00	2.6	0.43	9.55	0.33	0.12
		Average ± SE				**0.38 ± 0.10**		**2.31 ± 0.63**	**59.64 ± 15.90**	**1.67 ± 0.46**	**0.70 ± 0.18**
	Upstream	CHK-USSN01	13	11	9	0.69	20.6	3.16	64.46	2.79	0.87
		CHK-USSN02	4	9	1	0.25	16.9	2.52	49.39	1.57	0.46
		CHK-USSN03	9	12	5	0.56	22.5	3.02	89.33	2.62	1.04
		CHK-USSN04	3	5	2	0.67	9.4	1.29	41.77	1.05	0.47
		CHK-USSN05	8	7	4	0.50	13.1	1.85	56.92	1.44	0.62
		Average ± SE				**0.53 ± 0.08**		**2.37 ± 0.35**	**60.37 ± 8.17**	**1.89 ± 0.34**	**0.69 ± 0.11**
		Average ± SE				**0.43 ± 0.19**		**0.66 ± 0.15**	**51.41 ± 11.50**	**0.55 ± 0.14**	**0.60 ± 0.15**
Fish (≥1+)	Upper Diversion	CHK-UDVSN01	8	5	4	0.50	10.8	1.81	42.14	1.18	0.46
		CHK-UDVSN02	11	12	5	0.45	26.0	3.83	82.74	2.83	0.90
		CHK-UDVSN03	13	12	8	0.62	26.0	4.27	194.67	2.88	2.15
		CHK-UDVSN04	8	7	5	0.63	15.2	2.49	132.07	2.13	1.86
		CHK-UDVSN05	9	4	1	0.11	8.7	1.45	70.60	1.10	0.89
		Average ± SE				**0.46 ± 0.09**		**2.77 ± 0.55**	**104.44 ± 26.83**	**2.02 ± 0.39**	**1.25 ± 0.32**
	Upstream	CHK-USSN01	15	14	11	0.73	28.3	4.33	120.87	3.82	1.63
		CHK-USSN02	5	10	1	0.20	20.2	3.02	82.95	1.88	0.77
		CHK-USSN03	13	15	7	0.54	30.3	4.07	183.09	3.53	2.13
		CHK-USSN04	6	7	4	0.67	14.2	1.94	100.53	1.59	1.13
		CHK-USSN05	12	8	4	0.33	16.2	2.28	96.94	1.78	1.06
		Average ± SE				**0.49 ± 0.10**		**3.13 ± 0.47**	**116.88 ± 17.63**	**2.52 ± 0.48**	**1.35 ± 0.24**
All Fish	Upper Diversion	CHK-UDVSN01	17	11	6	0.35	26.6	4.43	55.87	2.89	0.61
		CHK-UDVSN02	12	15	5	0.42	36.3	5.33	100.84	3.95	1.10
		CHK-UDVSN03	13	16	8	0.62	38.7	6.34	252.17	4.28	2.79
		CHK-UDVSN04	10	8	6	0.60	19.3	3.17	142.24	2.72	2.00
		CHK-UDVSN05	12	5	1	0.08	12.1	2.01	77.23	1.53	0.98
		Average ± SE				**0.41 ± 0.10**		**4.26 ± 0.77**	**125.67 ± 34.72**	**3.07 ± 0.49**	**1.49 ± 0.40**
	Upstream	CHK-USSN01	20	18	12	0.60	45.8	7.01	155.17	6.19	2.09
		CHK-USSN02	6	11	1	0.17	28.0	4.18	102.68	2.61	0.96
		CHK-USSN03	14	16	7	0.50	40.7	5.47	230.70	4.74	2.69
		CHK-USSN04	11	7	4	0.36	17.8	2.44	93.45	2.00	1.05
		CHK-USSN05	12	11	4	0.33	28.0	3.94	147.40	3.07	1.62
		Average ± SE				**0.39 ± 0.07**		**4.61 ± 0.77**	**145.88 ± 24.39**	**3.72 ± 0.77**	**1.68 ± 0.32**

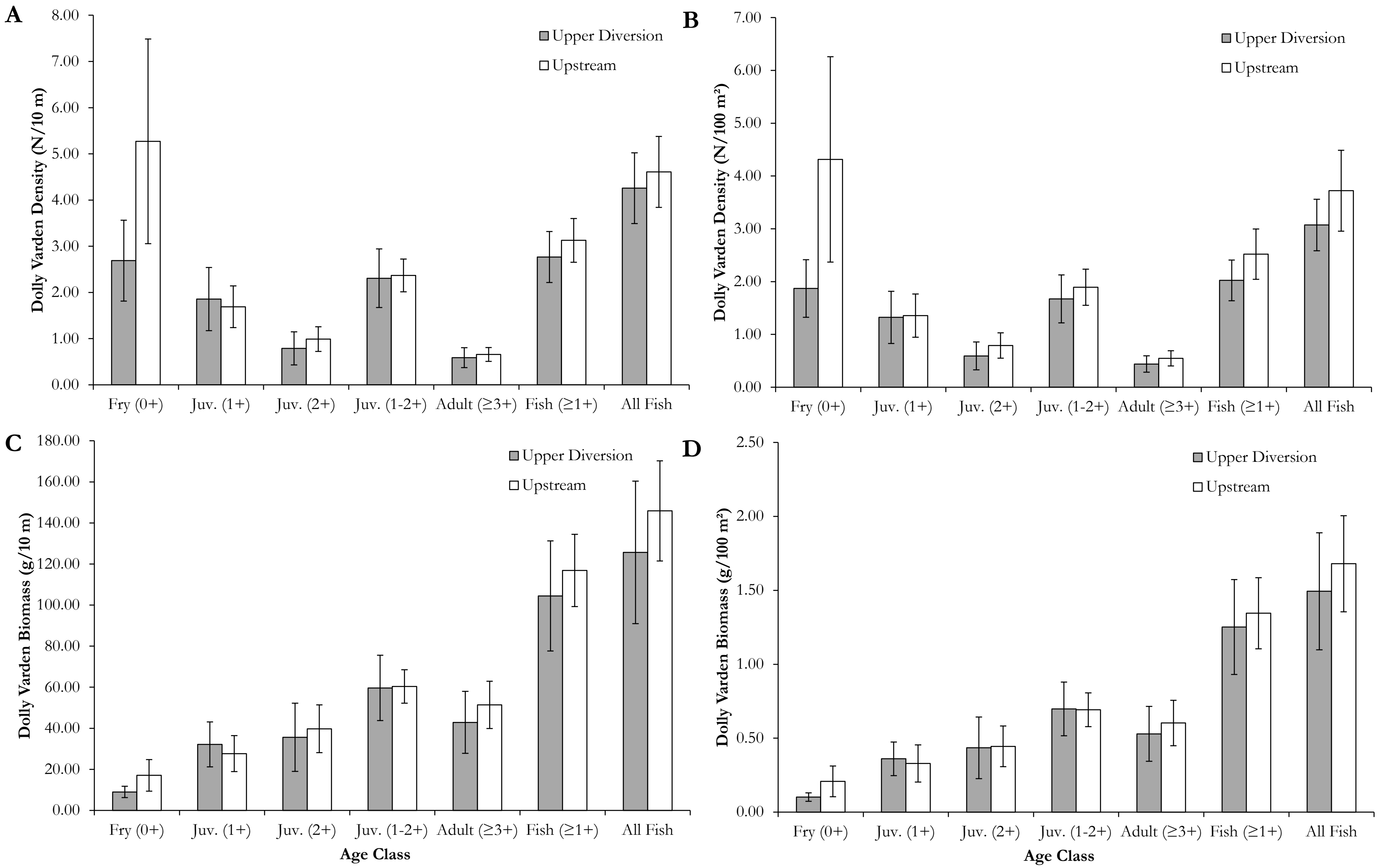
M = # of fish marked in first sample; C= total # of fish captured in second sample; R = # of fish captured in second sample that were marked; CE = Capture Efficiency; SE = Standard Error.

Table 19. Dolly Varden densities and biomass within the upper diversion and upstream reaches of Chickwat Creek, 2014.

Reach	Age Class	Density (N/10 m)	SE (N/10 m)	Density (N/100m^2)	SE (N/100m^2	Biomass (g/10 m)	SE (g/10 m)	Biomass (g/100m^2)	SE (g/100m^2)
Upper Diversion	Fry (0+)	2.69	0.88	1.87	0.54	8.99	2.75	0.10	0.03
	Juv. (1+)	1.86	0.69	1.32	0.49	32.16	10.94	0.36	0.11
	Juv. (2+)	0.79	0.36	0.59	0.26	35.64	16.61	0.43	0.21
	Juv. (1-2+)	2.31	0.63	1.67	0.46	59.64	15.90	0.70	0.18
	Adult (≥3+)	0.59	0.22	0.44	0.15	42.88	15.06	0.53	0.19
	Fish (≥1+)	2.77	0.55	2.02	0.39	104.44	26.83	1.25	0.32
	All Fish	4.26	0.77	3.07	0.49	125.67	34.72	1.49	0.40
Upstream	Fry (0+)	5.27	2.22	4.31	1.95	17.08	7.68	0.21	0.10
	Juv. (1+)	1.69	0.45	1.35	0.41	27.66	8.77	0.33	0.13
	Juv. (2+)	0.99	0.27	0.79	0.24	39.76	11.67	0.44	0.14
	Juv. (1-2+)	2.37	0.35	1.89	0.34	60.37	8.17	0.69	0.11
	Adult (≥3+)	0.66	0.15	0.55	0.14	51.41	11.50	0.60	0.15
	Fish (≥1+)	3.13	0.47	2.52	0.48	116.88	17.63	1.35	0.24
	All Fish	4.61	0.77	3.72	0.77	145.88	24.39	1.68	0.32

SE = standard error.

Figure 6. Dolly Varden A) linear density, B) density per area, C) linear biomass, and D) biomass per area for each age class within the upper diversion and upstream reaches of Chickwat Creek, 2014.



2015

Sites were composed of riffle, pool, cascade, and glide mesohabitats, with riffles and cascades being the most common in the upper diversion and upstream sites, respectively (Table 20). Average gradients of sites ranged from 1.0 to 6.0%. As in 2014, substrates were primarily composed of boulder, cobble, and gravels, and cover consisted primarily of boulders, cobble or deep pools. Sites ranged from 60 m to 79 m in length, 11.4 m to 16.6 m in width, and had maximum depths that ranged from 1.0 to 2.2 m. Sample site area averaged 904 m^2, ranging from 716 m^2 to 1,295 m^2. During the 2015 mark-recapture sampling, water temperatures ranged from 7.3 to 9.5°C, estimated water visibility ranged from 2.0 and 4.0 m, and turbidity was assessed to be clear (Table 21). Average flow over the survey period ranged from 0.56 m^3/s during mark events, to 1.81 m^3/s during recapture events. Representative site photographs of all 2015 upper diversion and upstream mark-recapture sampling sites are provided in Appendix H. Habitat usability and wetted usable width (WUW) based on the habitat suitability transects collected in 2015 varied by site within each reach but the range of usability and WUW were similar between the two reaches (Table 22). Photographs of habitat suitability transects completed in 2015 are presented in Appendix I.

A summary of 2015 mark-recapture, fish counts, capture efficiencies, population estimates, densities, and biomass densities are presented by site, reach, and age class in Table 23 and by age class grouping in Table 24. Totals of 43 and 84 Dolly Varden were marked within upper diversion reach and upstream reach, respectively. During 2015 re-capture events, a total of 32 Dolly Varden were captured within the upper diversion, of which 20 were marked, and a total of 81 Dolly Varden were captured within the upstream reach, of which 54 were marked. Capture efficiencies in the upper diversion reach averaged 0.53, ranging from 0.25 to 1.00. Capture efficiencies were higher in upstream sites in 2015, averaging 0.68 and ranging from 0.35 to 1.00.

Densities and biomass densities also varied among sites, age classes, and reaches in 2015 (Table 25 and Figure 7). As in 2014, overall densities of fish in the upstream reach were greater than those in the upper diversion reach. This relationship was more pronounced for juvenile (1-2+) age classes and all fish combined with upstream densities nearly two times greater in the upstream reach than in the upper diversion in 2015. In contrast with results from 2014 which showed Dolly Varden fry (0+) densities to be higher than those of other age classes, no fry (0+) were captured in the upper diversion reach and only one was captured in the upstream reach in 2015.

Table 20. Summary of habitat, cover, and substrate at mark-recapture sampling sites in the upper diversion and upstream reaches of Chickwat Creek in October, 2015.

Reach	Site	Habitat	Length (m)	Avg. Width (m)[1]	Area (m²)	Max Depth (m)	Cover		Substrate (%)[3]							Gradient (%)
							Dom.	Sub-dom.	BR	BO	LC	SC	LG	SG	F	
Upper Diversion	CHK-UDVSN01	Riffle	63	11.4	716	1.5	BO	DP	0	50	20	13	10	5	2	4.0
	CHK-UDVSN02	Riffle	60	12.5	750	1.3	BO	DP	0	40	15	15	15	10	5	1.8
	CHK-UDVSN03	Pool	67	14.4	963	2.2	DP	BO	0	50	20	15	10	5	0	0.0
	CHK-UDVSN04	Cascade	67	12.9	862	1.1	BO	DP	5	50	10	10	10	10	5	6.0
	CHK-UDVSN05	Riffle	63	12.0	756	1.8	BO	DP	5	40	15	20	10	5	5	1.0
Upstream	CHK-USSN01	Glide	66	13.1	865	1.8	DP	BO, CO , OV	0	20	30	20	15	10	5	1.0
	CHK-USSN02	Riffle	68	12.8	870	1.0	BO	CO, OV	0	25	35	15	10	10	5	2.5
	CHK-USSN03	Cascade	71	13.7	971	1.8	DP	BO, CO , OV	0	40	20	15	13	7	5	4.0
	CHK-USSN04	Cascade	74	12.8	949	1.0	BO	CO , LWD , OV	0	35	25	15	10	10	5	4.5
	CHK-USSN05	Cascade	79	12.0	948	1.5	BO	CO , DP	0	35	15	15	10	10	#	3.5
	CHK-USSN06	Glide	78	16.6	1,295	1.2	BO	CO , LWD	0	20	35	20	10	10	5	1.0

[1] Full stream wetted widths were sampled at all sites.

[2] BO = Boulder, CO = Cobble, DP = Deep Pool, LWD = Large Wood Debris, SWD = Small Wood Debris, OV = Overhanging Vegetation.

[3] BR = Bedrock, BO = Boulder, LC = Large Cobble, SC = Small Cobble, LG = Large Gravel, SG = Small Gravel, and F = Fines.

Table 21. Summary of site conditions during mark-recapture sampling in the upper diversion and upstream reaches of Chickwat Creek October, 2015.

Reach	Sampling Event	Site	Date	Water Temp. (°C)	Estimated Visibility (m)	Turbidity	Average Flow (m^3/s)[1]
Upper Diversion	Mark	CHK-UDVSN01	6-Oct-15	9.5	2.0	Clear	0.56
		CHK-UDVSN02	6-Oct-15	9.5	2.0	Clear	0.56
		CHK-UDVSN03	6-Oct-15	9.5	3.0	Clear	0.56
		CHK-UDVSN04	6-Oct-15	9.0	2.0	Clear	0.56
		CHK-UDVSN05	6-Oct-15	9.0	2.0	Clear	0.56
	Recapture	CHK-UDVSN01	14-Oct-15	8.5	3.0	Clear	1.81
		CHK-UDVSN02	14-Oct-15	8.5	3.0	Clear	1.81
		CHK-UDVSN03	14-Oct-15	8.5	3.0	Clear	1.81
		CHK-UDVSN04	14-Oct-15	8.0	3.0	Clear	1.81
		CHK-UDVSN05	14-Oct-15	8.0	3.0	Clear	1.81
Upstream	Mark	CHK-USSN01	7-Oct-15	9.5	n/c	Clear	0.61
		CHK-USSN02	7-Oct-15	9.5	n/c	Clear	0.61
		CHK-USSN03	7-Oct-15	9.5	n/c	Clear	0.61
		CHK-USSN04	7-Oct-15	9.5	n/c	Clear	0.61
		CHK-USSN05	7-Oct-15	9.0	n/c	Clear	0.61
		CHK-USSN06	7-Oct-15	9.0	n/c	Clear	0.61
	Recapture	CHK-USSN01	15-Oct-15	8.0	4.0	Clear	1.35
		CHK-USSN02	15-Oct-15	8.0	3.0	Clear	1.35
		CHK-USSN03	15-Oct-15	8.0	4.0	Clear	1.35
		CHK-USSN04	15-Oct-15	7.5	3.0	Clear	1.35
		CHK-USSN05	15-Oct-15	7.5	3.0	Clear	1.35
		CHK-USSN06	15-Oct-15	7.3	4.0	Clear	1.35

[1] Flow data is from the hydrometric gauge located at the Chicwat Intake.

Table 22. Wetted usable widths and percent habitat usability calculated from the habitat suitability transects collected at each mark-recapture sampling site in October 2015.

Reach	Site	Date	Wetted Width (m)	DV Fry[1]		DV Juveniles[1]	
				WUW (m)[2]	Usability (%)	WUW (m)[2]	Usability (%)
Upper Diversion	CHK-UDVSN01	15-Oct-15	13.25	6.51	49.1	5.87	44.3
	CHK-UDVSN02	15-Oct-15	15.65	5.92	37.8	3.68	23.5
	CHK-UDVSN03	14-Oct-15	15.22	7.45	48.9	3.62	23.8
	CHK-UDVSN04	15-Oct-15	9.96	6.37	64.0	1.83	18.4
	CHK-UDVSN05	14-Oct-15	13.61	8.43	61.9	2.85	20.9
Upper Diversion Average			**13.54**	**6.94**	**52.36**	**3.57**	**26.2**
Upstream	CHK-USSN01	15-Oct-15	16.29	7.54	46.3	4.02	24.7
	CHK-USSN02	15-Oct-15	15.61	7.18	45.97	4.52	29.0
	CHK-USSN03	15-Oct-15	19.45	8.84	45.42	5.46	28.1
	CHK-USSN04	14-Oct-15	14.09	5.81	41.24	5.96	42.3
	CHK-USSN05	14-Oct-15	14.61	5.59	38.26	3.04	20.8
	CHK-USSN06	14-Oct-15	16.63	5.30	31.89	1.39	8.4
Upstream Average			**16.11**	**6.71**	**41.51**	**4.06**	**25.5**

[1]Criterion used: BT-EMA, 1991

[2]WUW = weighted usable width

Table 23. Dolly Varden densities and biomass by age class for each sampling site within the upper diversion and upstream reaches of Chickwat Creek, 2015.

Age Class	Reach	Site	M	C	R	O	CE	Population Size (N)	Density (N/10 m)	Biomass (g/10m)	Density (N/100m^2)	Biomass (g/100m^2)
Fry (0+)	Upper Diversion	CHK-UDVSN01	0	0	0	0	-	0.00	0.00	0.00	0.00	0.00
		CHK-UDVSN02	0	0	0	0	-	0.00	0.00	0.00	0.00	0.00
		CHK-UDVSN03	0	0	0	0	-	0.00	0.00	0.00	0.00	0.00
		CHK-UDVSN04	0	0	0	0	-	0.00	0.00	0.00	0.00	0.00
		CHK-UDVSN05	0	0	0	0	-	0.00	0.00	0.00	0.00	0.00
		Average ± SE					**-**		**0.00 ± 0.00**	**0.00 ± 0.00**	**0.00 ± 0.00**	**0.00 ± 0.00**
	Upstream	CHK-USSN01	1	1	1	0	1.00	1.00	0.15	1.06	0.12	0.81
		CHK-USSN02	0	0	0	0	-	0.00	0.00	0.00	0.00	0.00
		CHK-USSN03	0	0	0	0	-	0.00	0.00	0.00	0.00	0.00
		CHK-USSN04	0	1	0	0	-	1.00	0.14	0.55	0.11	0.43
		CHK-USSN05	0	0	0	0	-	0.00	0.00	0.00	0.00	0.00
		CHK-USSN06	0	1	0	0	-	1.00	0.13	0.45	0.08	0.27
		Average ± SE					**-**		**0.07 ± 0.03**	**0.34 ± 0.18**	**0.05 ± 0.02**	**0.25 ± 0.13**
Juv. (1+)	Upper Diversion	CHK-UDVSN01	3	3	3	0	1.00	5.53	0.88	11.15	0.77	9.80
		CHK-UDVSN02	6	9	3	1	0.60	16.58	2.76	43.78	2.21	35.03
		CHK-UDVSN03	7	7	4	0	0.57	12.89	1.92	32.78	1.34	22.81
		CHK-UDVSN04	0	1	1	0	-	1.84	0.27	4.98	0.21	3.87
		CHK-UDVSN05	2	0	0	1	0.00	0.00	0.00	0.00	0.00	0.00
		Average ± SE					**0.54 ± 0.21**		**1.17 ± 0.52**	**18.54 ± 8.43**	**0.91 ± 0.40**	**14.30 ± 6.46**
	Upstream	CHK-USSN01	14	13	13	0	0.93	17.14	2.60	34.30	1.98	26.18
		CHK-USSN02	9	10	8	1	1.00	13.18	1.94	27.36	1.51	21.38
		CHK-USSN03	12	13	10	1	0.91	17.14	2.41	37.16	1.76	27.16
		CHK-USSN04	5	3	3	0	0.60	3.95	0.53	7.59	0.42	5.91
		CHK-USSN05	5	4	3	1	0.75	5.27	0.67	11.55	0.56	9.62
		CHK-USSN06	11	13	4	0	0.36	17.14	2.20	33.82	1.32	20.37
		Average ± SE					**0.76 ± 0.10**		**1.72 ± 0.37**	**25.30 ± 5.17**	**1.26 ± 0.26**	**18.44 ± 3.57**
Juv. (2+)	Upper Diversion	CHK-UDVSN01	2	1	1	0	0.50	1.88	0.30	10.45	0.26	9.19
		CHK-UDVSN02	3	1	1	1	0.50	1.88	0.31	9.33	0.25	7.46
		CHK-UDVSN03	3	3	3	0	1.00	5.63	0.84	24.96	0.58	17.37
		CHK-UDVSN04	3	3	2	0	0.67	5.63	0.84	24.15	0.65	18.77
		CHK-UDVSN05	3	1	0	1	0.00	1.88	0.30	9.34	0.25	7.79
		Average ± SE					**0.53 ± 0.16**		**0.52 ± 0.13**	**15.65 ± 3.65**	**0.40 ± 0.09**	**12.11 ± 2.46**
	Upstream	CHK-USSN01	3	2	1	0	0.33	5.00	0.76	21.58	0.58	16.48
		CHK-USSN02	3	2	2	0	0.67	5.00	0.74	22.89	0.57	17.88
		CHK-USSN03	2	1	0	0	0.00	2.50	0.35	9.58	0.26	7.00
		CHK-USSN04	1	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00
		CHK-USSN05	2	2	2	0	1.00	5.00	0.63	19.23	0.53	16.03
		CHK-USSN06	5	6	2	0	0.40	15.00	1.92	52.47	1.16	31.61
		Average ± SE					**0.40 ± 0.16**		**0.73 ± 0.27**	**20.96 ± 7.23**	**0.52 ± 0.16**	**14.83 ± 4.38**
Adult (≥3+)	Upper Diversion	CHK-UDVSN01	0	0	0	0	-	0.00	0.00	0.00	0.00	0.00
		CHK-UDVSN02	2	1	1	0	0.50	2.67	0.44	30.16	0.36	24.13
		CHK-UDVSN03	3	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00
		CHK-UDVSN04	5	1	0	0	0.00	2.67	0.40	23.24	0.31	18.06
		CHK-UDVSN05	1	1	1	0	1.00	2.67	0.42	27.79	0.35	23.16
		Average ± SE					**0.38 ± 0.24**		**0.25 ± 0.10**	**16.24 ± 6.72**	**0.20 ± 0.08**	**13.07 ± 5.43**
	Upstream	CHK-USSN01	0	1	0	0	-	1.40	0.21	12.18	0.16	9.30
		CHK-USSN02	1	3	2	0	2.00	4.19	0.62	39.20	0.48	30.62
		CHK-USSN03	3	2	1	0	0.33	2.79	0.39	27.43	0.29	20.05
		CHK-USSN04	1	2	1	0	1.00	2.79	0.38	26.91	0.29	20.97
		CHK-USSN05	2	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00
		CHK-USSN06	4	1	1	0	0.25	1.40	0.18	12.97	0.11	7.81
		Average ± SE					**0.72 ± 0.36**		**0.30 ± 0.09**	**19.78 ± 5.72**	**0.22 ± 0.07**	**14.79 ± 4.53**

M = # of fish marked in first sample; C= total # of fish captured in second sample; R = # of fish in captured in second sample that were marked; CE = Capture Efficiency; SE = standard error.

Table 24. Dolly Varden densities and biomass by age class groupings for each sampling site within the upper diversion and upstream reaches of Chickwat Creek, 2015.

Age Class	Reach	Site	M	C	R	O	CE	Population Size (N)	Density (N/10 m)	Biomass (g/10m)	Density (N/100m^2)	Biomass (g/100m^2)
Juv. (1-2+)	Upper Diversion	CHK-UDVSN01	5	4	4	0	0.80	6.51	1.03	21.55	0.91	18.96
		CHK-UDVSN02	9	10	4	2	0.57	16.28	2.71	52.03	2.17	41.63
		CHK-UDVSN03	10	10	7	0	0.70	16.28	2.43	50.20	1.69	34.94
		CHK-UDVSN04	3	4	3	0	1.00	6.51	0.97	23.65	0.76	18.38
		CHK-UDVSN05	5	1	0	2	0.00	1.63	0.26	6.81	0.22	5.67
		Average ± SE					**0.61 ± 0.17**		**1.48 ± 0.47**	**30.85 ± 8.77**	**1.15 ± 0.35**	**23.91 ± 6.42**
	Upstream	CHK-USSN01	17	15	14	0	0.82	21.38	3.24	50.51	2.47	38.56
		CHK-USSN02	12	12	10	1	0.91	17.10	2.51	44.67	1.96	34.90
		CHK-USSN03	14	14	10	1	0.77	19.95	2.81	46.69	2.05	34.13
		CHK-USSN04	6	3	3	0	0.50	4.28	0.58	8.92	0.45	6.95
		CHK-USSN05	7	6	5	1	0.83	8.55	1.08	23.45	0.90	19.54
		CHK-USSN06	16	19	6	0	0.38	27.08	3.47	66.41	2.09	40.01
		Average ± SE					**0.70 ± 0.09**		**2.28± 0.48**	**40.11± 8.40**	**1.66± 0.32**	**29.01± 5.32**
Fish (≥1+)	Upper Diversion	CHK-UDVSN01	5	4	4	0	0.80	7.94	1.26	26.28	1.11	23.11
		CHK-UDVSN02	11	11	5	2	0.56	21.83	3.64	91.94	2.91	73.55
		CHK-UDVSN03	13	10	7	0	0.54	19.85	2.96	74.63	2.06	51.94
		CHK-UDVSN04	8	5	3	0	0.38	9.92	1.48	54.63	1.15	42.45
		CHK-UDVSN05	6	2	1	2	0.25	3.97	0.63	21.55	0.53	17.96
		Average ± SE					**0.50 ± 0.09**		**1.99 ± 0.56**	**53.81 ± 13.58**	**1.55 ± 0.42**	**41.80 ± 10.07**
	Upstream	CHK-USSN01	17	16	14	0	0.82	23.66	3.58	60.47	2.74	46.16
		CHK-USSN02	13	15	12	1	1.00	22.18	3.26	76.66	2.55	59.89
		CHK-USSN03	17	16	11	1	0.69	23.66	3.33	81.43	2.44	59.52
		CHK-USSN04	7	5	4	0	0.57	7.39	1.00	29.39	0.78	22.91
		CHK-USSN05	9	6	5	1	0.63	8.87	1.12	28.17	0.94	23.47
		CHK-USSN06	20	20	7	0	0.35	29.58	3.79	102.14	2.28	61.53
		Average ± SE					**0.68 ± 0.09**		**2.68 ± 0.52**	**63.04 ± 12.12**	**1.95 ± 0.35**	**45.58 ± 7.43**
All Fish	Upper Diversion	CHK-UDVSN01	5	4	4	0	0.80	7.94	1.26	26.28	1.11	23.11
		CHK-UDVSN02	11	11	5	2	0.56	21.83	3.64	31.84	2.91	73.55
		CHK-UDVSN03	13	10	7	0	0.54	19.85	2.96	31.75	2.06	51.94
		CHK-UDVSN04	8	5	3	0	0.38	9.92	1.48	46.48	1.15	42.45
		CHK-UDVSN05	6	2	1	2	0.25	3.97	0.63	43.10	0.53	17.96
		Average ± SE					**0.50 ± 0.09**		**1.99 ± 0.56**	**35.89 ± 3.81**	**1.55 ± 0.42**	**41.80 ± 10.07**
	Upstream	CHK-USSN01	18	17	15	0	0.83	25.08	3.80	20.55	2.90	47.29
		CHK-USSN02	13	15	12	1	1.00	22.13	3.25	29.62	2.54	59.74
		CHK-USSN03	17	16	11	1	0.69	23.60	3.32	30.79	2.43	59.38
		CHK-USSN04	7	6	4	0	0.57	8.85	1.20	34.62	0.93	25.61
		CHK-USSN05	9	6	5	1	0.63	8.85	1.12	31.61	0.93	23.42
		CHK-USSN06	20	21	7	0	0.35	30.98	3.97	33.25	2.39	63.12
		Average ± SE					**0.68 ± 0.09**		**2.78 ± 0.52**	**30.07 ± 2.04**	**2.02 ± 0.35**	**46.43 ± 7.27**

M = # of fish marked in first sample; C= total # of fish captured in second sample; R = # of fish in captured in second sample that were marked; CE = Capture Efficiency; SE = standard error.

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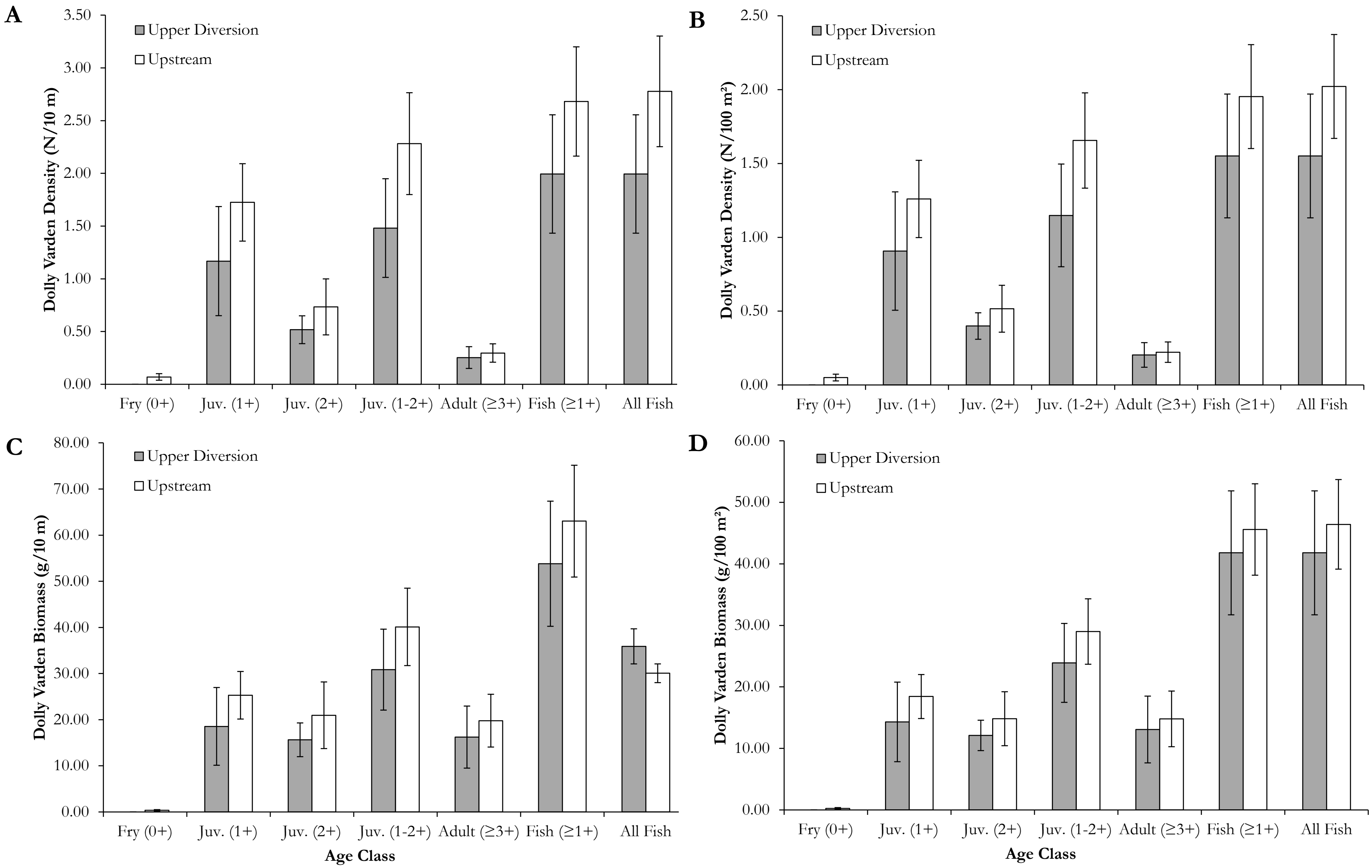
Table 25. Dolly Varden densities and biomass within the upper diversion and upstream reaches of Chickwat Creek, 2015.

Reach	Age Class	Density (N/10 m)	SE (N/10 m)	Density (N/100m^2)	SE (N/100m^2)	Biomass (g/10 m)	SE (g/10 m)	Biomass (g/100m^2)	SE (g/100m^2)
Upper Diversion	Fry (0+)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Juv. (1+)	1.17	0.52	0.91	0.40	18.54	8.43	14.30	6.46
	Juv. (2+)	0.52	0.13	0.40	0.09	15.65	3.65	12.11	2.46
	Juv. (1-2+)	1.48	0.47	1.15	0.35	30.85	8.77	23.91	6.42
	Adult (≥3+	0.25	0.10	0.20	0.08	16.24	6.72	13.07	5.43
	Fish (≥1+)	1.99	0.56	1.55	0.42	53.81	13.58	41.80	10.07
	All Fish	1.99	0.56	1.55	0.42	35.89	3.81	41.80	10.07
Upstream	Fry (0+)	0.07	0.03	0.05	0.02	0.34	0.18	0.25	0.13
	Juv. (1+)	1.72	0.37	1.26	0.26	25.30	5.17	18.44	3.57
	Juv. (2+)	0.73	0.27	0.52	0.16	20.96	7.23	14.83	4.38
	Juv. (1-2+)	2.28	0.48	1.66	0.32	40.11	8.40	29.01	5.32
	Adult (≥3+	0.30	0.09	0.22	0.07	19.78	5.72	14.79	4.53
	Fish (≥1+)	2.68	0.52	1.95	0.35	63.04	12.12	45.58	7.43
	All Fish	2.78	0.52	2.02	0.35	30.07	2.04	46.43	7.27

SE = standard error.

Figure 7. Dolly Varden A) linear density, B) density per area, C) linear biomass, and D) biomass per area for each age class within the upper diversion and upstream reaches of Chickwat Creek, 2015.



4.4.1.2. Minnow Trapping

Sampling effort, site conditions, habitat characteristics, and capture results for minnow trap sampling in 2014 and 2015 within the Chickwat Creek upper diversion and upstream reaches are provided in Appendix P.

2014

A summary of fish captured in minnow traps and associated catch per unit effort (CPUE) in 2014 are presented in (Table 26). Minnow trapping effort ranged from 127.9 trap hours to 131.4 trap hours at individual sites in the upper diversion, and from 111.7 trap hours to 118.8 trap hours in the upstream reach. In total, two Dolly Varden were captured in the upper diversion, both within the same site. In the upstream reach, at total of four Dolly Varden were captured among three sites. Average CPUE was 0.003 fish/trap hr (±0.007 SD) in the upper diversion and 0.007 fish/trap hr (±0.007 SD) in the upstream reach.

2015

A summary of fish captured in minnow traps and associated CPUE in 2015 is presented in (Table 27). Minnow trapping effort ranged from 112.2 trap hours to 113.9 trap hours at individual sites in the upper diversion and effort ranged from 97.6 trap hours to 114.8 trap hours in the upstream reach. A total of 10 Dolly Varden were captured among two sites within the upper diversion reach and a total of eight Dolly Varden were captured among five sites within the upstream reach. Average CPUE for was 0.018 fish/trap hr (± 0.027 SD) in the upper diversion and 0.013 fish/trap hr (±0.010 SD) in the upstream reach.

Table 26. Summary of minnow trapping effort and catch of Dolly Varden from the upper diversion and upstream reaches of Chickwat Creek in October, 2014.

Reach	Site	Trap Set Date	Water Temp. (°C)	# of Traps	Total Set Time (hrs)	Captures (# of fish)	CPUE (# of fish/hr)
Upper Diversion	CHK-UDVMT01	15-Oct-14	9.0	5	128.9	0	0.00
	CHK-UDVMT02	15-Oct-14	9.0	5	131.3	2	0.02
	CHK-UDVMT03	15-Oct-14	9.0	5	131.4	0	0.00
	CHK-UDVMT04	15-Oct-14	9.0	5	127.9	0	0.00
	CHK-UDVMT05	15-Oct-14	9.0	5	128.1	0	0.00
Upstream	CHK-USMT01	14-Oct-14	9.5	5	111.7	2	0.02
	CHK-USMT02	14-Oct-14	9.5	5	113.4	0	0.00
	CHK-USMT03	14-Oct-14	9.5	5	115.5	1	0.01
	CHK-USMT04	14-Oct-14	9.5	5	118.6	1	0.01
	CHK-USMT05	14-Oct-14	9.5	5	118.8	0	0.00

Table 27. Summary of minnow trapping effort and catch of Dolly Varden from the upper diversion and upstream reaches of Chickwat Creek in October, 2015.

Reach	Site	Trap Set Date	Water Temp. (°C)[1]	# of Traps	Total Set Time (hrs)	Captures (# of fish)	CPUE (# of fish/hr)
Upper Diversion	CHK-UDVMT01	6-Oct-15	10.0	5	113.1	0	0.00
	CHK-UDVMT02	6-Oct-15	10.0	5	112.2	3	0.03
	CHK-UDVMT03	6-Oct-15	10.0	5	112.8	0	0.00
	CHK-UDVMT04	6-Oct-15	10.0	5	113.9	0	0.00
	CHK-UDVMT05	6-Oct-15	10.0	5	113.5	7	0.06
Upstream	CHK-USMT01	7-Oct-15	10.0	5	114.8	3	0.03
	CHK-USMT02	7-Oct-15	10.0	5	111.7	1	0.01
	CHK-USMT03	7-Oct-15	10.0	5	108.0	2	0.02
	CHK-USMT04	7-Oct-15	10.0	5	104.5	1	0.01
	CHK-USMT05	7-Oct-15	10.0	5	101.3	0	0.00
	CHK-USMT06	7-Oct-15	10.0	5	97.6	1	0.01

[1] Temperature data for all sites were collected on 7-Oct-15.

4.4.1.3. Individual Fish Data

2014

In 2014, 224 Dolly Varden were captured and processed during baseline monitoring. Data on all individual captured fish (including length, weight, and marks/tags applied) are provided in Appendix Q.

The length-frequency distribution for Dolly Varden in each reach is presented in Figure 8. A total of eight and five fin ray samples were collected and analysed from the upper diversion and upstream reaches, respectively. The length at age relationship of these fish is presented in Figure 9. Based on a review of this aging data and length-frequency histograms, discrete fork length ranges were defined for age classes 0+, 1+, 2+, and ≥3+ (Table 28). Weight was recorded for 104 and 107 fish in the upper diversion and upstream reaches of Chickwat Creek, respectively. The length-weight relationships of these fish are presented in Figure 10. Summaries of fish length, weight, and condition factor are presented for individual age classes in both reaches in Table 29.

Figure 8. Length-frequency histogram for Dolly Varden captured during baseline monitoring in the upper diversion and upstream reaches of Chickwat Creek in October, 2014.

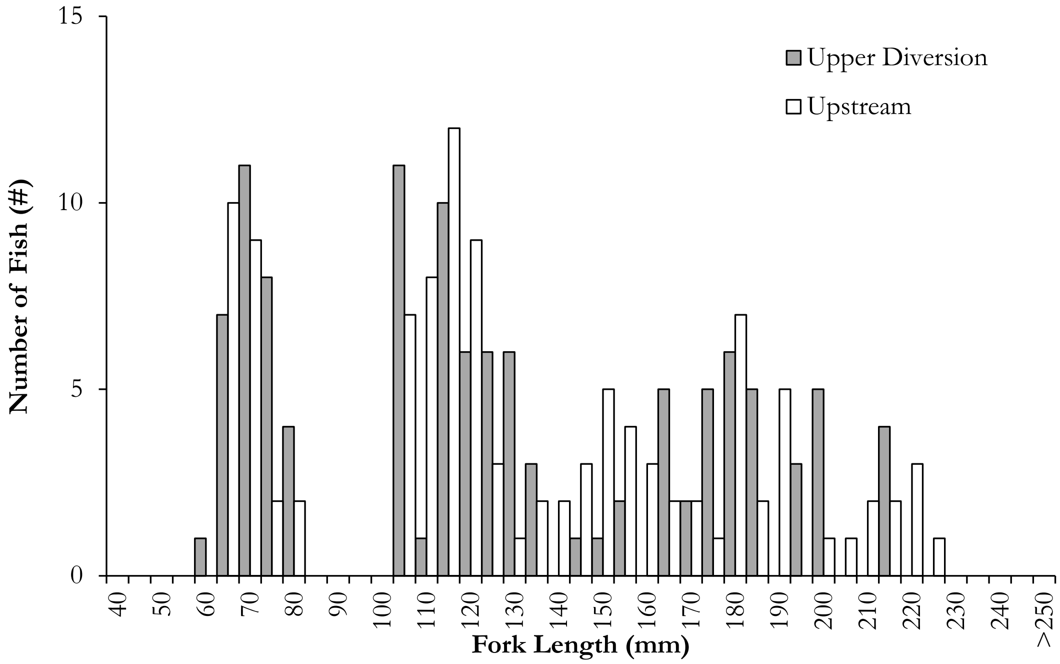


Figure 9. Length at age for Dolly Varden captured in the upper diversion and upstream reaches of Chickwat Creek in October, 2014.

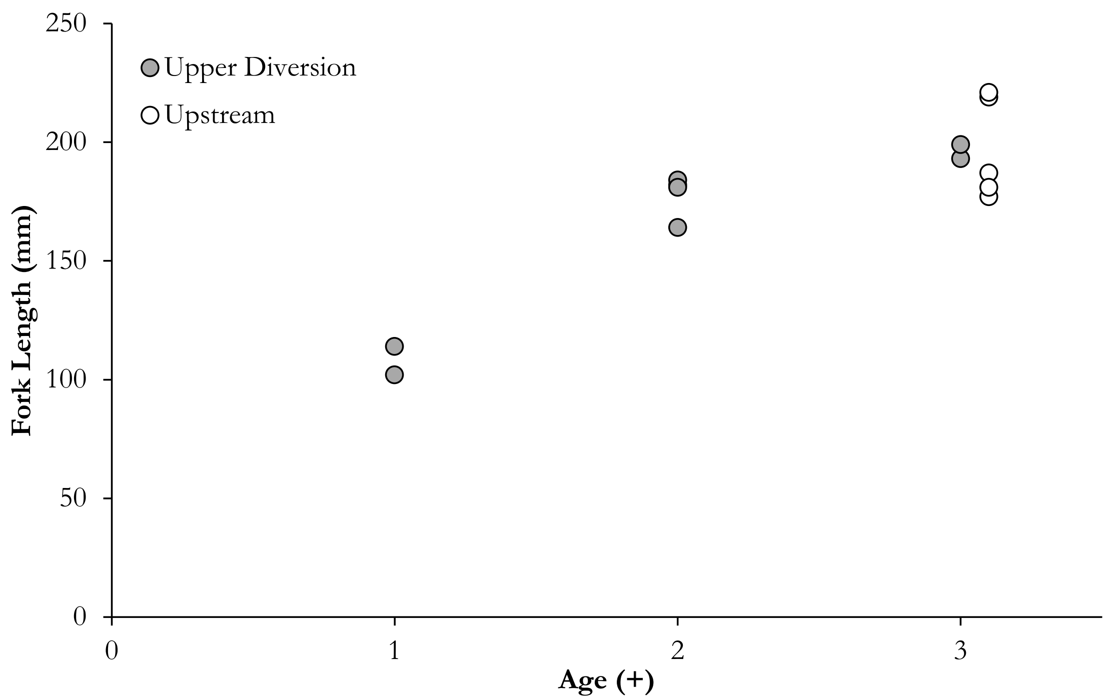


Table 28. Fork length range used to define age classes for Dolly Varden captured in the upper diversion and upstream reaches on Chickwat Creek in October, 2014.

Age Class	Fork Length Range (mm)
Fry (0+)	59-101
Juv. (1+)	102-135
Juv. (2+)	136-177
Adult (≥3+)	178+

Figure 10. Length-weight regression for Dolly Varden captured in the upper diversion and upstream reaches of Chickwat Creek in October, 2014.

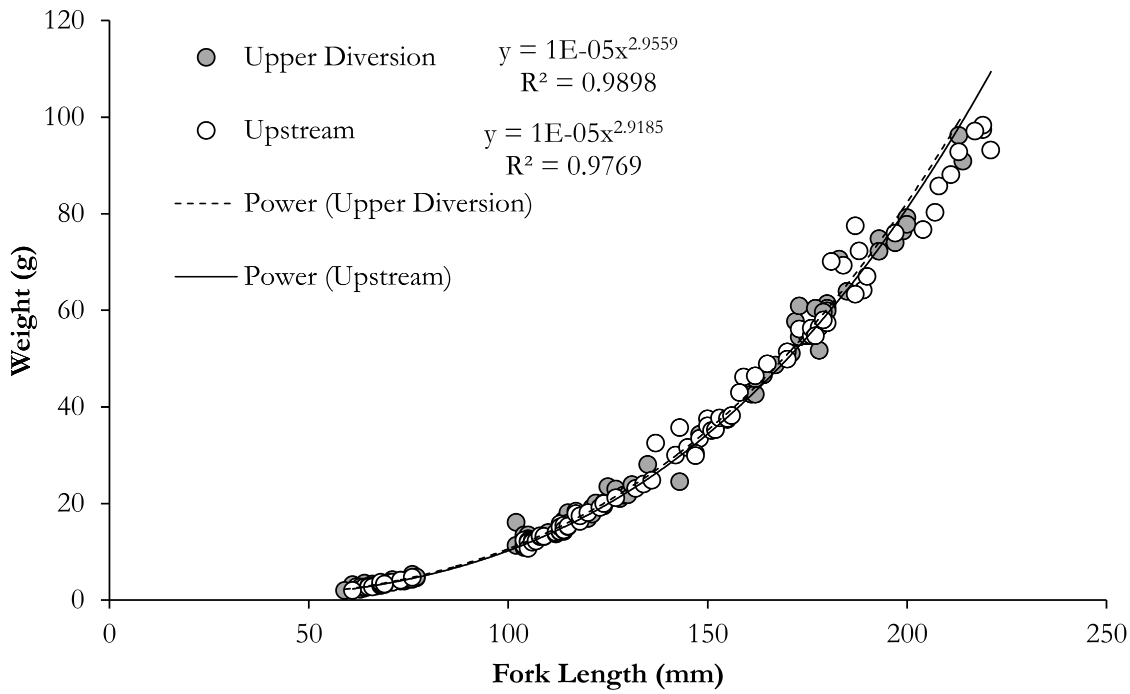


Table 29. Summary of fork length, weight, condition, and percent fat for Dolly Varden captured in the upper diversion and upstream reaches on Chickwat Creek in October, 2014.

Waterbody	Age Class	Fork Length (mm)				Weight (g)				Condition Factor (K)				Body Fat (%)			
		n	Average	Min	Max	n	Average	Min	Max	n	Average	Min	Max	n	Average	Min	Max
Upper Diversion	Fry (0+)	31	68	59	77	31	3.5	2.0	5.3	31	1.06	0.96	1.41	0	n/a	n/a	n/a
	Juv. (1+)	43	117	102	135	42	17.5	11.3	28.1	42	1.09	0.96	1.52	0	n/a	n/a	n/a
	Juv. (2+)	17	164	143	177	16	46.4	24.5	60.9	16	1.04	0.84	1.18	0	n/a	n/a	n/a
	Adult (≥3+)	22	193	178	214	15	71.3	51.7	96.2	15	1.01	0.92	1.15	0	n/a	n/a	n/a
	All	113	125	59	214	104	25.5	2.0	96.2	104	1.06	0.84	1.52	0	n/a	n/a	n/a
Upstream	Fry (0+)	23	67	61	76	22	3.1	2.0	4.7	22	1.02	0.88	1.18	0	n/a	n/a	n/a
	Juv. (1+)	42	114	104	134	40	15.4	10.7	24.0	40	1.02	0.92	1.15	0	n/a	n/a	n/a
	Juv. (2+)	25	156	136	177	25	40.5	24.8	56.3	25	1.05	0.94	1.26	0	n/a	n/a	n/a
	Adult (≥3+)	21	197	178	221	20	77.1	56.5	98.3	20	0.99	0.86	1.19	0	n/a	n/a	n/a
	All	111	129	61	221	107	30.3	2.0	98.3	107	1.02	0.86	1.26	0	n/a	n/a	n/a

n/a - not applicable, as no fish were assessed within these age classes.

2015

In 2015, 224 Dolly Varden were captured and processed during baseline monitoring. Data on all individual captured fish (including length, weight, and marks/tags applied) are provided in Appendix Q.

The length-frequency distribution for Dolly Varden in each reach is presented in Figure 11. A total of 23 and 12 fin ray samples were collected and analysed from the upper diversion and upstream reaches respectively. The length at age relationship of these fish is presented in Figure 12. Based on a review of this aging data and length-frequency histograms, discrete fork length ranges were defined for age classes 0+, 1+, 2+, and ≥3+ (Table 30). Weight was recorded for 78 and 151 fish in the upper diversion and upstream reaches of Chickwat Creek, respectively. The length-weight relationships of these fish are presented in Figure 13. A summary of fish length, weight, and condition factor are presented for individual age classes in both reaches in Table 31.

Figure 11. Length-frequency historgram for Dolly Varden captured during Year 2 baseline monitoring in the upper diversion and upstream reaches of Chickwat Creek in October, 2015.

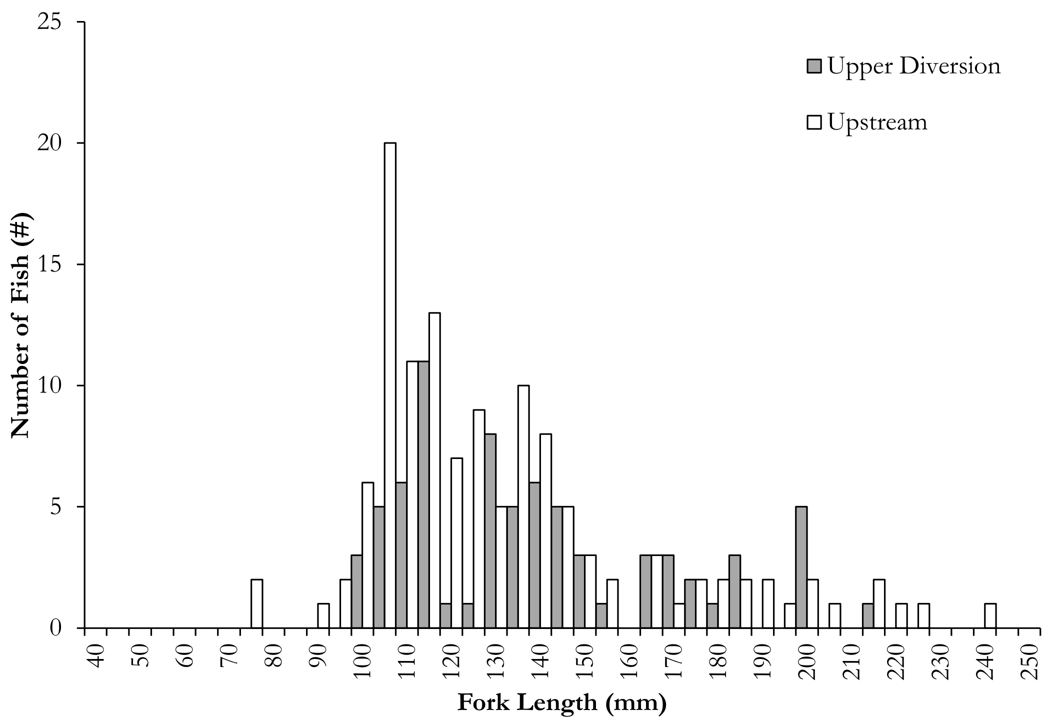


Figure 12. Length at age for Dolly Varden captured in the upper diversion and upstream reaches of Chickwat Creek in October, 2015.

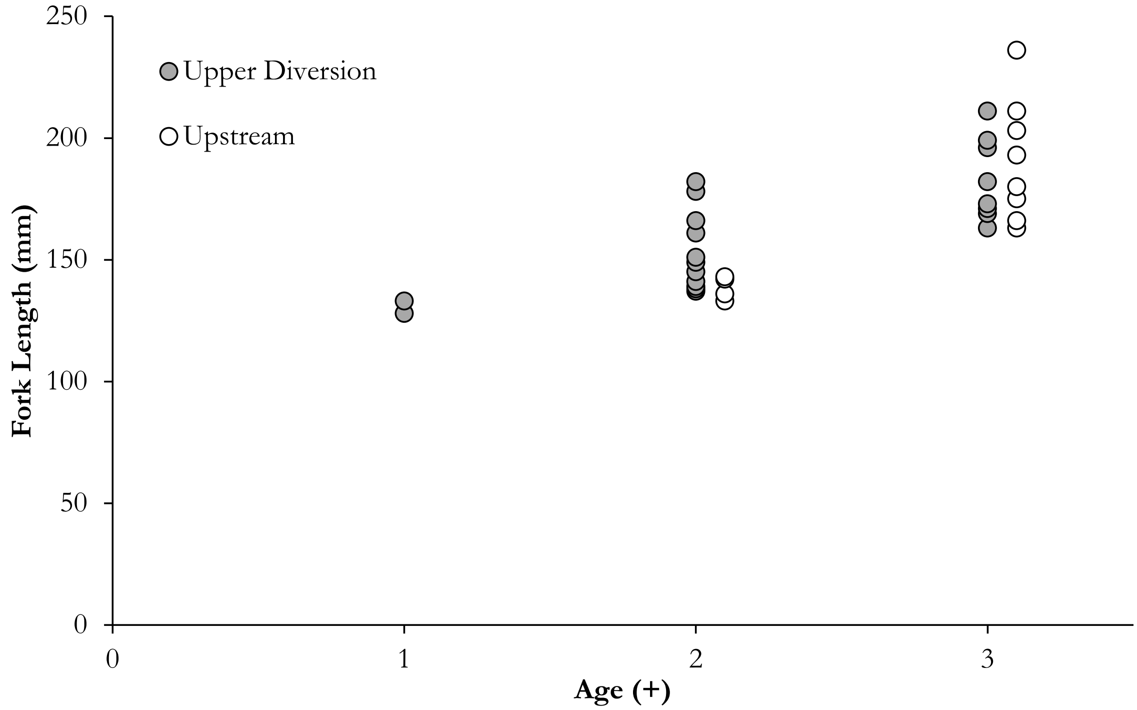


Table 30. Fork length range used to define age classes for Dolly Varden captured in the upper diversion and upstream reaches on Chickwat Creek in October, 2015.

Age Class	Fork Length Range (mm)
Fry (0+)	70-91
Juv. (1+)	92-133
Juv. (2+)	134-163
Adult (≥3+)	164+

Figure 13. Length-weight regression for Dolly Varden captured in the upper diversion and upstream reaches of Chickwat Creek in October, 2015.

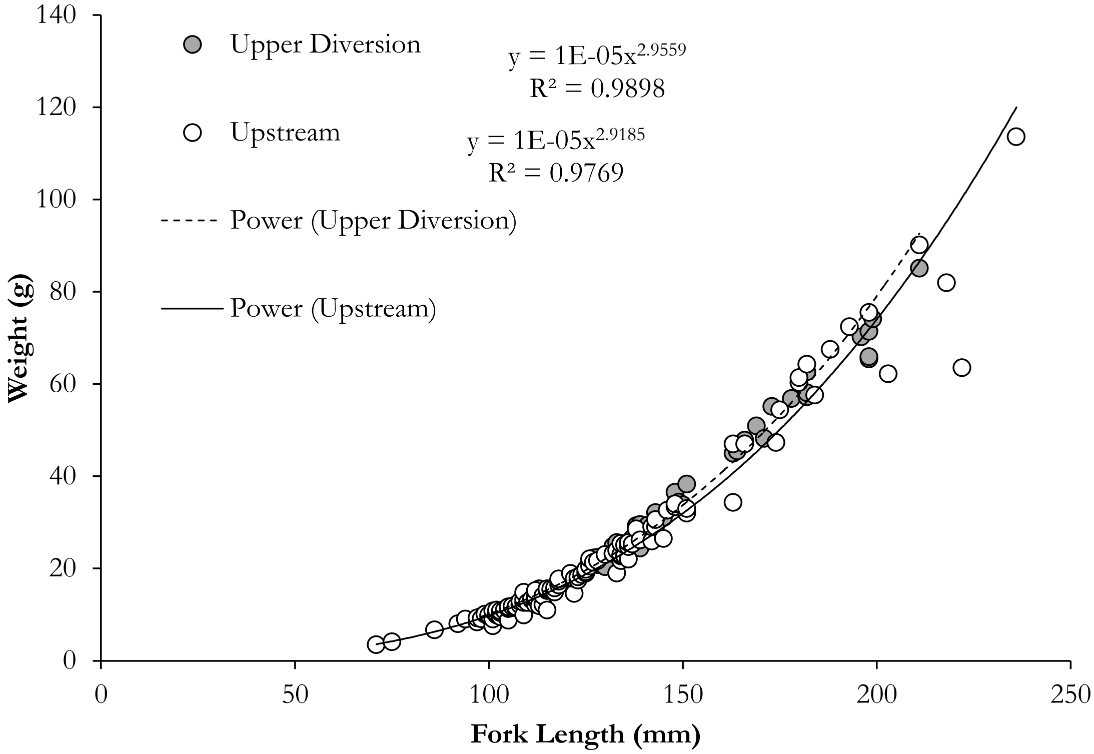


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Table 31. Summary of fork length, weight, condition, and percent fat for Dolly Varden captured in the upper diversion and upstream reaches on Chickwat Creek in October, 2015.

Reach	Age Class	Fork Length (mm)				Weight (g)				Condition Factor (K)				Body Fat (%)			
		n	Average	Min	Max	n	Average	Min	Max	n	Average	Min	Max	n	Average	Min	Max
Upper Diversion	Fry (0+)	0	n/a	n/a	n/a	0	n/a	n/a	n/a	0	n/a	n/a	n/a	0	n/a	n/a	n/a
	Juv. (1+)	39	115	98	133	34	15.7	9.1	25.6	34	1.01	0.90	1.11	0	n/a	n/a	n/a
	Juv. (2+)	17	143	134	161	16	30.1	24.4	38.3	16	1.05	0.91	1.13	1	4.7	4.7	4.7
	Adult (≥3+)	17	182	163	211	16	60.0	45.0	85.1	16	0.97	0.84	1.06	4	3.8	3.6	3.9
	All	73	137	98	211	66	29.9	9.1	85.1	66	1.01	0.84	1.13	5	4.0	3.6	4.7
Upstream	Fry (0+)	3	77	71	86	3	4.8	3.5	6.7	3	1.00	0.97	1.05	0	n/a	n/a	n/a
	Juv. (1+)	76	111	92	133	74	13.8	7.6	23.9	74	0.97	0.72	1.14	0	n/a	n/a	n/a
	Juv. (2+)	25	140	134	151	24	27.0	21.7	34.0	24	0.98	0.87	1.09	0	n/a	n/a	n/a
	Adult (≥3+)	21	191	163	236	17	64.7	34.3	113.6	17	0.93	0.58	1.09	8	4.9	3.4	6.6
	All	125	130	71	236	118	23.6	3.5	113.6	118	0.97	0.58	1.14	8	4.9	3.4	6.6

n/a - not applicable, as no fish were assessed within these age classes.

4.4.1.4. Power Analysis

The power to detect a 50% effect based on the 2014 and 2015 baseline density (FPU_{obs}) data varied widely among age classes (Table 32). Power is less than 0.8 for fry (0+) and adult fish (≥3+), ranging from 0.24 to 0.39 (at α = 0.05). The power to detect a 50% effect on combined age class metrics (e.g. ≥1+ and All fish) is considerably higher, approaching 1.0, with detectable effect sizes as low as 21%, based on five years of monitoring. Therefore, the estimated power and detectable effect size for combined age classes (those that are typically used in examining project effects) are consistent with the minimum 0.8 power recommended by monitoring guidelines and suggests that the existing study design and baseline data collection will be adequate to detect a 50% reduction in Dolly Varden densities after 5 years of monitoring. Given these results, the fish community sampling plan outlined in the Chickwat Creek OEMP should achieve sufficient power to detect an effect size of 50% (Faulkner *et al.* 2016).

Table 32. Estimated power to detect 50% reduction of Dolly Varden observed density in Chickwat Creek. Powers less than 0.8 for 50% effect size are highlighted in red.

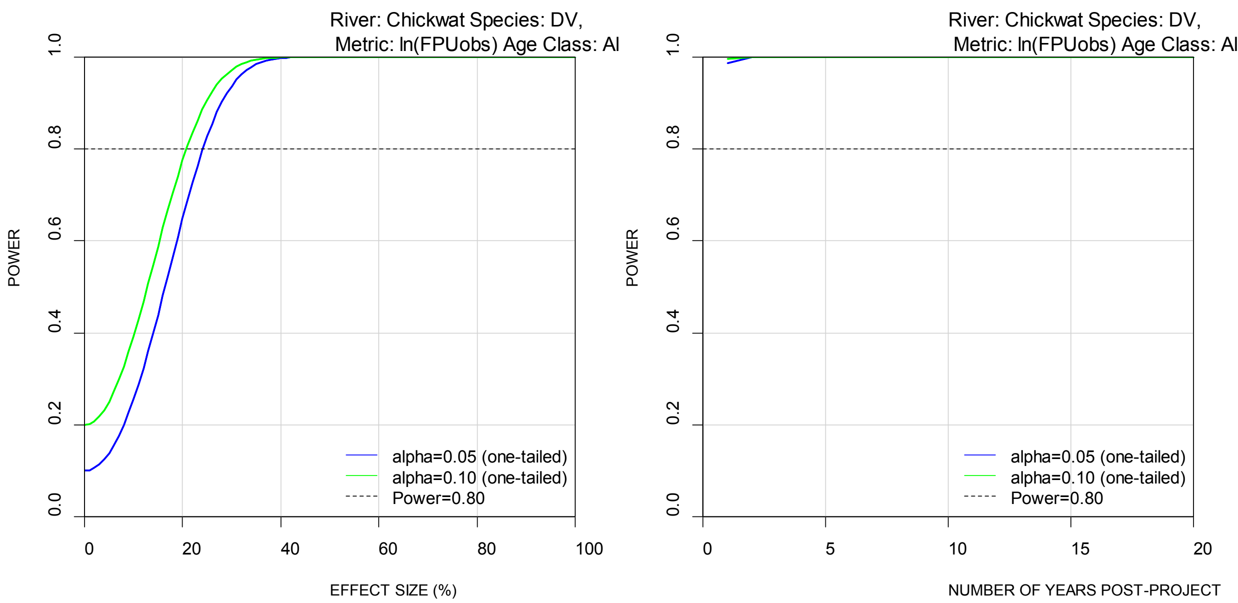
River	Metric	Life Stage	α (1-tailed)	Power[1]	Detectable Effect Size[1,2]
Chickwat Creek	FPU observed	Fry (0+)	0.05	0.24	> 100%
			0.10	0.37	99%
		Juv. (1-2+)	0.05	1.00	23%
			0.10	1.00	20%
		Adult (≥3+)	0.05	0.39	86%
			0.10	0.54	75%
		Fish (≥1+)	0.05	1.00	21%
			0.10	1.00	18%
		All	0.05	1.00	25%
			0.10	1.00	21%

[1] Based on five (5) years of monitoring

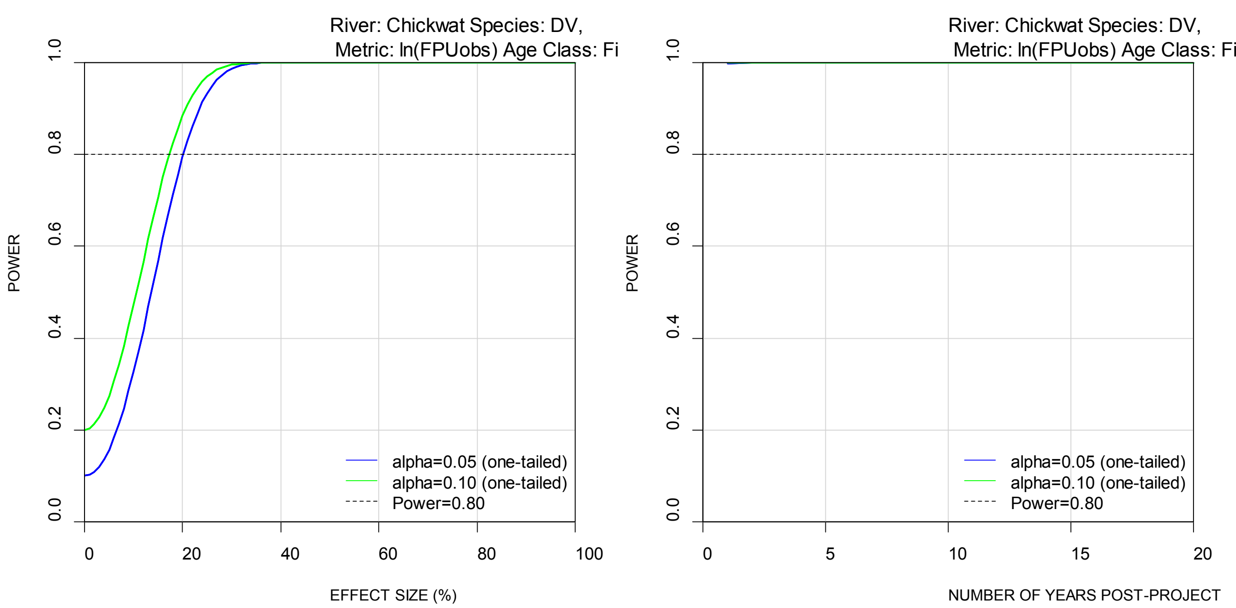
[2] Minimum detectable effect with 80% power

Figure 14. Power to detect changes in Chickwat Creek diversion reach observed Dolly Varden density (log transformed) as a function of effect size (assuming five years of operational monitoring) and as a function of years of monitoring (50% effect size) for a) All Fish and b) Fish ≥1+

a) All Fish



b) Fish ≥1+



4.4.2. Lower Diversion

4.4.2.1. Night Snorkelling Mark-Recapture

Sites were composed of a combination of riffle, pool, and cascade mesohabitats, with cascades and pools being the most common in both systems (Table 33). Average gradients of sites ranged from 4.0% to 7.5% and 2.0 to 5.0% in the lower diversion of Chickwat Creek and the Tzoonie River, respectively. Sites within the lower diversion reach of Chickwat Creek ranged from 36 m to 55 m in length and 12.3 m to 25 m in width, with total site areas ranging from 469 m^2 to 1,125 m^2, and maximum depths that ranged from 1.0 m to 2.2 m. Sites within the Tzoonie River ranged from 25 m to 38 m in length, 12.7 m to 26.3 m in width, with total areas ranging from 358 m^2 to 823 m^2, and maximum depths ranging from 0.8 m to 1.6 m.

Within the Chickwat Creek lower diversion sites, water temperatures ranged from 9.3°C to 10°C, estimated water visibility ranged from 4 m to 6 m, and turbidity was assessed as clear (Table 34). Within the Tzoonie River sites, water temperatures ranged from 8.5°C to 9.0°C, estimated visibility ranged from 4 m to 6 m, and turbidity was assessed as clear. Average flow over the survey period ranged from 0.92 m^3/s to 1.09 m^3/s during mark events and from 0.90 m^3/s to 1.44 m^3/s during recapture events within the Chickwat Creek lower diversion and the Tzoonie River, respectively. Representative site photographs of all 2016 mark-recapture sampling sites within the Chickwat Creek lower diversion and Tzoonie River are provided in Appendix H. Habitat usability and wetted usable width (WUW) based on the habitat suitability transects data varied by site but the range of usability and WUW were similar between the two systems (Table 35). Photographs of habitat suitability transects completed in 2016 are presented in Appendix I.

Night snorkel mark-recapture results are discussed separately for each species and age class below. For a breakdown of age class determination refer to Section 4.4.2.3. A second year of baseline sampling is scheduled for the fall of 2017, which together with 2016 will form the baseline for the AMP comparisons.

Table 33. Summary of habitat, cover, and substrate at mark-recapture sampling sites in the lower diversion Chickwat Creek and Tzoonie River in October 2016.

Waterbody	Site	Habitat	Length (m)	Avg. Width (m)[1]	Area (m^2)	Max Depth (m)	Cover[2]		Substrate (%)[3]							Gradient (%)
							Dom.	Sub-dom.	BR	BO	LC	SC	LG	SG	F	
Chickwat Creek	CHK-LDVSN01	Cascade/Pool	36	17.7	636	1.0	BO	CO	0	45	20	15	10	5	5	5.0
	CHK-LDVSN02	Cascade/Pool	55	14.0	770	1.5	BO	DP	0	40	20	15	15	7	3	4.5
	CHK-LDVSN03	Cascade/Pool	52	17.0	884	1.4	BO	DP	5	45	20	10	10	8	2	7.0
	CHK-LDVSN04	Cascade	45	25.0	1,125	1.1	BO	CO	0	40	15	15	15	10	5	7.5
	CHK-LDVSN05	Cascade/Pool	38	12.3	469	2.2	DP	BO	5	45	20	15	7	5	3	4.0
Tzoonie River	TZN-SN01	Cascade/Riffle	34	14.3	487	0.8	BO	CO	0	40	30	15	5	5	5	3.0
	TZN-SN02	Cascade/Pool	25	14.3	358	1.0	BO	CO	0	45	30	10	5	5	5	4.5
	TZN-SN03	Cascade/Riffle	38	21.7	823	1.2	BO	CO	0	45	35	10	5	3	2	5.0
	TZN-SN04	Cascade/Pool	31	26.3	816	1.3	BO	CO	0	45	25	15	5	5	5	4.0
	TZN-SN05	Cascade/Pool	36	12.7	456	1.6	BO	CO	0	40	30	10	10	5	5	2.0

[1] Full stream wetted widths were sampled at all sites.

[2] BO = Boulder, CO = Cobble, DP = Deep Pool.

[3] BR = Bedrock, BO = Boulder, LC = Large Cobble, SC = Small Cobble, LG = Large Gravel, SG = Small Gravel, and F = Fines.

Table 34. Summary of site conditions during mark-recapture sampling in the lower diversion of Chickwat Creek and Tzoonie River in October 2016.

Waterbody	Sampling Event	Site	Date	Water Temp. (°C)	Estimated Visibility (m)[1]	Average Flow (m³/s)[2]
Chickwat Creek	Mark	CHK-LDVSN01	27-Sep-16	10.0	6.0	1.09
		CHK-LDVSN02	27-Sep-16	10.0	6.0	1.09
		CHK-LDVSN03	27-Sep-16	10.0	6.0	1.09
		CHK-LDVSN04	28-Sep-16	10.0	6.0	0.92
		CHK-LDVSN05	28-Sep-16	10.0	6.0	0.92
	Recapture	CHK-LDVSN01	4-Oct-16	9.5	6.0	1.44
		CHK-LDVSN02	4-Oct-16	9.5	6.0	1.44
		CHK-LDVSN03	4-Oct-16	9.3	4.0	1.44
		CHK-LDVSN04	3-Oct-16	9.3	n/c	0.90
		CHK-LDVSN05	3-Oct-16	9.3	5.0	0.90
Tzoonie River	Mark	TZN-SN01	29-Sep-16	9.0	6.0	6.31
		TZN-SN02	29-Sep-16	9.0	6.0	6.31
		TZN-SN03	29-Sep-16	9.0	n/c	6.31
		TZN-SN04	29-Sep-16	9.0	n/c	6.31
		TZN-SN05	28-Sep-16	8.5	6.0	0.92
	Recapture	TZN-SN01	5-Oct-16	9.3	4.0	1.49
		TZN-SN02	5-Oct-16	9.3	4.0	1.49
		TZN-SN03	5-Oct-16	9.0	4.0	1.49
		TZN-SN04	5-Oct-16	9.0	4.0	1.49
		TZN-SN05	5-Oct-16	9.0	4.0	1.49

[1] n/c = not collected.

[2] Flow data is from the hydrometric gauges located at the Chickwat Intake and Tzoonie River T2.

Table 35. Wetted usable widths and percent habitat usability calculated from the habitat suitability transects collected at each Chickwat Creek lower diversion and Tzoonie River mark-recapture sampling site in October 2016.

Waterbody	Site	Date	Total Wetted Width (m)	SH Fry[1]		SH Parr[1]		CO Fry[1]	
				WUW (m)[2]	Usability (%)	WUW (m)[2]	Usability (%)	WUW (m)[2]	Usability (%)
Chickwat Creek	CHK-LDVSN01	29-Sep-16	15.97	6.20	38.8	7.29	45.6	10.03	62.8
	CHK-LDVSN02	29-Sep-16	10.90	3.95	36.2	5.19	47.6	7.43	68.2
	CHK-LDVSN03	29-Sep-16	10.56	3.61	34.2	4.87	46.1	7.39	70.0
	CHK-LDVSN04	29-Sep-16	13.85	5.54	40.0	6.00	43.3	5.74	41.5
	CHK-LDVSN05	29-Sep-16	10.00	2.88	28.8	4.78	47.8	6.85	68.5
		Average	**12.26**	**4.44**	**35.62**	**5.63**	**46.10**	**7.49**	**62.17**
		SD	**2.56**	**1.38**	**4.42**	**1.05**	**1.81**	**1.58**	**11.89**
Tzoonie River	TZN-SN01	6-Oct-16	13.05	2.90	22.2	8.29	63.5	4.98	38.2
	TZN-SN02	6-Oct-16	11.86	2.77	23.4	6.41	54.0	4.63	39.0
	TZN-SN03	6-Oct-16	17.17	6.84	39.8	9.24	53.8	6.09	35.5
	TZN-SN04	6-Oct-16	22.36	7.77	34.8	10.99	49.2	6.90	30.9
	TZN-SN05	5-Oct-16	13.72	3.51	25.6	10.46	76.2	5.62	41.0
		Average	**15.63**	**4.76**	**29.16**	**9.08**	**59.34**	**5.64**	**36.89**
		SD	**4.25**	**2.36**	**7.74**	**1.83**	**10.78**	**0.90**	**3.91**

[1] Criterion used: Water use plan Delphi Curves from Ptolemy (2001) derived for Steelhead fry and parr, and Coho fry.
[2] WUW = weighted usable widths

Rainbow Trout and Cutthroat Trout

Due to the inability to accurately determine the species of fry (0+) of Rainbow Trout and Cutthroat Trout in the field all age classes are presented together and separately for each species for ≥1+ fish. further, there were several individual fish identified as potential hybrids based on morphological traits (e.g., having Rainbow Trout characteristics but with a faint slash mark on the throat) captured in the Chickwat Creek lower diversion reach. These fish were included as Cutthroat in the species specific comparisons. Whereas, Cutthroat Trout, Rainbow Trout, and hybrids were identified in Chickwat Creek only Cutthroat Trout were identified in the Tzoonie River.

A summary of 2016 mark-recapture fish counts, capture efficiencies, population estimates and linear and per area densities and biomass densities of Rainbow Trout, Cutthroat Trout and both species combined are presented by site, waterbody, and age class in Table 36 (including AMP metric 3: adult steelhead/Rainbow Trout) and each age class grouping in Table 37 (including AMP metric 1: ≥ 1+ steelhead/Rainbow Trout). Totals of 202 Cutthroat and Rainbow Trout and 79 Cutthroat Trout were marked within the Chickwat lower diversion and Tzoonie River, respectively. During re-capture events, a total of 227 of the two Trout species were captured or observed within the Chickwat lower diversion reach, of which 87 were marked, and a total of 82 Cutthroat Trout were captured or observed in the Tzoonie River sites, of which 43 were marked. Capture efficiencies in the Chickwat Creek lower diversion sites averaged 0.45, ranging from 0.33 to 0.67. Capture efficiencies in Tzoonie River control sites were higher, averaging 0.55 and ranging from 0.27 to 0.92.

Densities and biomass densities varied among sites, age classes, and reach, and are presented by the average linear density (fish per 10 m), density per area (fish per 100 m²), linear biomass (g per 10 m), and biomass per area (g per 100 m²) for each age class in each reach in Table 38 and Figure 15. Overall, densities of fry (0+), and to a lesser extent juvenile (1-2+) trout, were much higher in the Chickwat Creek Lower diversion than those in the Tzoonie River reach. Similarly, biomass densities (g/10 m) of fry (0+) and juvenile (1-2+) trout were higher in the lower diversion reach of Chickwat Creek than those in the Tzoonie River reach. In contrast, linear and per area densities and biomass of adult (≥3+) trout were very similar in the two systems.

Table 36. Cutthroat and Rainbow Trout densities and biomass by age class for each sampling site within the Chickwat Creek lower diversion and Tzoonie River in 2016.

Age Class	Waterbody	Species	Site	M	C	R	CE	Population Size (N)	Density (N/10 m)	Biomass (g/10m)	Density (N/100m²)	Biomass (g/100m²)
Fry (0+)	**Chickwat Creek**	**CT + RB**	CHK-LDVSN01	6	22	3	0.50	106.18	29.49	66.15	16.69	37.44
			CHK-LDVSN02	10	7	0	0.00	33.78	6.14	15.54	4.39	11.10
			CHK-LDVSN03	16	18	3	0.19	86.87	16.71	37.54	9.83	22.08
			CHK-LDVSN04	11	8	2	0.18	38.61	8.58	19.06	3.43	7.62
			CHK-LDVSN05	6	3	1	0.17	14.48	3.81	7.83	3.09	6.35
			Average ± SE				**0.21 ± 0.08**		**12.95 ± 4.67**	**29.22 ± 10.44**	**7.49 ± 2.60**	**16.92 ± 5.83**
	Tzoonie River	**CT**	TZN-SN01	2	1	0	0.00	1.00	0.29	1.20	0.21	0.83
			TZN-SN02	0	1	0	-	1.00	0.40	2.82	0.28	1.97
			TZN-SN03	1	0	0	0.00	1.00	0.26	1.00	0.12	0.46
			TZN-SN04	0	1	0	-	1.00	0.32	0.81	0.12	0.31
			TZN-SN05	0	0	0	-	0.00	0.00	0.00	0.00	0.00
			Average ± SE				**0.00 ± 0.00**		**0.26 ± 0.07**	**1.17 ± 0.46**	**0.15 ± 0.05**	**0.71 ± 0.34**
Juv. (1+)	**Chickwat Creek**	**CT + RB**	CHK-LDVSN01	12	17	8	0.67	35.65	9.90	166.32	5.61	94.13
			CHK-LDVSN02	17	17	7	0.41	35.65	6.48	117.03	4.63	83.59
			CHK-LDVSN03	18	23	4	0.22	48.24	9.28	156.84	5.46	92.26
			CHK-LDVSN04	9	12	6	0.67	25.17	5.59	91.19	2.24	36.48
			CHK-LDVSN05	12	16	5	0.42	33.56	8.83	161.23	7.16	130.76
			Average ± SE				**0.48 ± 0.09**		**8.02 ± 0.84**	**138.52 ± 14.71**	**5.02 ± 0.81**	**87.44 ± 15.09**
		CT	CHK-LDVSN01	2	4	2	1.00	7.06	1.96	33.46	1.11	18.94
			CHK-LDVSN02	2	5	2	1.00	8.82	1.60	28.65	1.15	20.46
			CHK-LDVSN03	2	0	0	0.00	0.00	0.00	0.00	0.00	0.00
			CHK-LDVSN04	3	3	1	0.33	5.29	1.18	19.67	0.47	7.87
			CHK-LDVSN05	6	10	3	0.50	17.65	4.64	79.03	3.77	64.10
			Average ± SE				**0.57 ± 0.19**		**1.88 ± 0.77**	**32.16 ± 13.04**	**1.30 ± 0.65**	**22.27 ± 11.11**
		RB	CHK-LDVSN01	10	13	6	0.60	27.66	7.68	128.48	4.35	72.71
			CHK-LDVSN02	15	12	5	0.33	25.53	4.64	84.04	3.32	60.03
			CHK-LDVSN03	16	23	4	0.25	48.94	9.41	161.70	5.54	95.12
			CHK-LDVSN04	6	9	5	0.83	19.15	4.26	68.68	1.70	27.47
			CHK-LDVSN05	6	6	2	0.33	12.77	3.36	66.88	2.72	54.24
			Average ± SE				**0.47 ± 0.11**		**5.87 ± 1.15**	**101.96 ± 18.62**	**3.53 ± 0.66**	**61.91 ± 11.11**
	Tzoonie River	**CT**	TZN-SN01	7	8	5	0.71	17.78	5.23	90.32	3.65	63.03
			TZN-SN02	4	7	1	0.25	15.56	6.22	90.83	4.34	63.38
			TZN-SN03	7	3	2	0.29	6.67	1.75	29.74	0.81	13.72
			TZN-SN04	6	5	1	0.17	11.11	3.58	66.83	1.36	25.38
			TZN-SN05	6	8	5	0.83	17.78	4.94	88.64	3.90	69.96
			Average ± SE				**0.45 ± 0.13**		**4.35 ± 0.77**	**73.27 ± 11.77**	**2.81 ± 0.72**	**47.10 ± 11.46**

M = # of fish marked in first sample; C= total # of fish captured in second sample; R = # of fish in captured in second sample that were marked; CE = Capture Efficiency; SE = standard error.

Table 36. Continued.

Age Class	Waterbody	Species	Site	M	C	R	CE	Population Size (N)	Density (N/10 m)	Biomass (g/10m)	Density ($N/100m^2$)	Biomass ($g/100m^2$)
Juv. (2+)	**Chickwat Creek**	**CT + RB**	CHK-LDVSN01	5	9	5	1.00	15.00	4.17	155.87	2.36	88.21
			CHK-LDVSN02	7	6	4	0.57	10.00	1.82	70.46	1.30	50.33
			CHK-LDVSN03	12	14	7	0.58	23.33	4.49	157.51	2.64	92.65
			CHK-LDVSN04	10	6	3	0.30	10.00	2.22	79.65	0.89	31.86
			CHK-LDVSN05	11	12	6	0.55	20.00	5.26	181.03	4.27	146.82
			Average ± SE				**0.60 ± 0.11**		**3.59 ± 0.67**	**128.90 ± 22.48**	**2.29 ± 0.59**	**81.97 ± 19.84**
		CT	CHK-LDVSN01	0	2	0	-	3.89	1.08	34.46	0.61	19.50
			CHK-LDVSN02	0	1	0	-	1.94	0.35	12.37	0.25	8.84
			CHK-LDVSN03	2	4	2	1.00	7.78	1.50	45.27	0.88	26.63
			CHK-LDVSN04	7	2	1	0.14	3.89	0.86	29.46	0.35	11.78
			CHK-LDVSN05	5	6	2	0.40	11.67	3.07	96.63	2.49	78.37
			Average ± SE				**0.51 ± 0.25**		**1.37 ± 0.46**	**43.64 ± 14.27**	**0.92 ± 0.41**	**29.02 ± 12.72**
		RB	CHK-LDVSN01	5	7	5	1.00	10.28	2.86	109.45	1.62	61.94
			CHK-LDVSN02	7	5	4	0.57	7.34	1.34	52.16	0.95	37.25
			CHK-LDVSN03	10	10	5	0.50	14.69	2.82	103.23	1.66	60.73
			CHK-LDVSN04	3	4	2	0.67	5.87	1.31	49.73	0.52	19.89
			CHK-LDVSN05	6	6	4	0.67	8.81	2.32	85.98	1.88	69.73
			Average ± SE				**0.68 ± 0.09**		**2.13 ± 0.34**	**80.11 ± 12.52**	**1.33 ± 0.25**	**49.91 ± 9.26**
	Tzoonie River	**CT**	TZN-SN01	3	5	3	1.00	8.00	2.35	69.71	1.64	48.64
			TZN-SN02	4	3	3	0.75	4.80	1.92	57.60	1.34	40.20
			TZN-SN03	4	4	2	0.50	6.40	1.68	51.89	0.78	23.95
			TZN-SN04	4	4	1	0.25	6.40	2.06	69.75	0.78	26.49
			TZN-SN05	0	3	0	-	4.80	1.33	48.93	1.05	38.62
			Average ± SE				**0.63 ± 0.16**		**1.87 ± 0.17**	**59.58 ± 4.37**	**1.12 ± 0.17**	**35.58 ± 4.58**
Adult (≥3+)	**Chickwat Creek**	**CT + RB**	CHK-LDVSN01	7	4	4	0.57	6.79	1.89	126.45	1.07	71.56
			CHK-LDVSN02	8	7	3	0.38	11.88	2.16	171.93	1.54	122.81
			CHK-LDVSN03	9	8	6	0.67	13.58	2.61	254.22	1.54	149.54
			CHK-LDVSN04	6	7	5	0.83	11.88	2.64	199.36	1.06	79.74
			CHK-LDVSN05	10	11	5	0.50	18.67	4.91	367.72	3.98	298.23
			Average ± SE				**0.59 ± 0.08**		**2.84 ± 0.54**	**223.94 ± 41.47**	**1.84 ± 0.55**	**144.38 ± 41.01**
		CT	CHK-LDVSN01	0	0	0	-	0.00	0.00	0.00	0.00	0.00
			CHK-LDVSN02	1	3	1	1.00	4.11	0.75	59.32	0.53	42.37
			CHK-LDVSN03	3	3	2	0.67	4.11	0.79	89.33	0.47	52.55
			CHK-LDVSN04	2	2	2	1.00	2.74	0.61	57.26	0.24	22.91
			CHK-LDVSN05	4	4	1	0.25	5.49	1.44	119.10	1.17	96.59
			Average ± SE				**0.73 ± 0.18**		**0.72 ± 0.23**	**65.00 ± 19.79**	**0.48 ± 0.20**	**42.88 ± 16.15**
		RB	CHK-LDVSN01	7	4	4	0.57	6.80	1.89	126.71	1.07	71.71
			CHK-LDVSN02	7	4	2	0.29	6.80	1.24	98.58	0.88	70.42
			CHK-LDVSN03	6	5	4	0.67	8.50	1.64	145.37	0.96	85.51
			CHK-LDVSN04	4	5	3	0.75	8.50	1.89	127.22	0.76	50.89
			CHK-LDVSN05	6	7	4	0.67	11.90	3.13	219.74	2.54	178.22
			Average ± SE				**0.59 ± 0.08**		**1.96 ± 0.32**	**143.52 ± 20.47**	**1.24 ± 0.33**	**91.35 ± 22.41**
	Tzoonie River	**CT**	TZN-SN01	7	6	4	0.57	10.40	3.06	372.01	2.13	259.61
			TZN-SN02	5	2	1	0.20	3.47	1.39	137.58	0.97	96.01
			TZN-SN03	7	7	5	0.71	12.13	3.19	282.22	1.47	130.24
			TZN-SN04	5	2	2	0.40	3.47	1.12	85.36	0.42	32.42
			TZN-SN05	7	11	7	1.00	19.06	5.29	492.96	4.18	389.07
			Average ± SE				**0.58 ± 0.14**		**2.81 ± 0.75**	**274.03 ± 74.77**	**1.84 ± 0.65**	**181.47 ± 63.78**

M = # of fish marked in first sample; C= total # of fish captured in second sample; R = # of fish in captured in second sample that were marked; CE = Capture Efficiency; SE = standard error.

Table 37. Cutthroat and Rainbow Trout densities and biomass by age class grouping for each sampling site within the Chickwat Creek lower diversion and Tzoonie River in 2016.

Age Class	Waterbody	Species	Site	M	C	R	CE	Population Size (N)	Density (N/10 m)	Biomass (g/10m)	Density (N/100m^2)	Biomass (g/100m^2)
Juv. (1-2+)	Chickwat Creek	CT + RB	CHK-LDVSN01	17	26	13	0.76	51.15	14.21	333.96	8.04	189.00
			CHK-LDVSN02	24	23	11	0.46	45.25	8.23	195.62	5.88	139.73
			CHK-LDVSN03	30	37	11	0.37	72.79	14.00	335.50	8.23	197.35
			CHK-LDVSN04	19	18	9	0.47	35.41	7.87	194.79	3.15	77.91
			CHK-LDVSN05	23	28	11	0.48	55.08	14.50	370.16	11.76	300.21
			Average ± SE				**0.51 ± 0.07**		**11.76 ± 1.52**	**286.01 ± 37.63**	**7.41 ± 1.42**	**180.84 ± 36.65**
		CT	CHK-LDVSN01	2	6	2	1.00	9.51	2.64	54.88	1.50	31.06
			CHK-LDVSN02	2	6	2	1.00	9.51	1.73	34.58	1.24	24.70
			CHK-LDVSN03	4	4	2	0.50	6.34	1.22	31.20	0.72	18.35
			CHK-LDVSN04	10	5	2	0.20	7.93	1.76	47.80	0.70	19.12
			CHK-LDVSN05	11	16	5	0.45	25.36	6.67	152.88	5.41	123.99
			Average ± SE				**0.63 ± 0.16**		**2.80 ± 0.99**	**64.27 ± 22.57**	**1.91 ± 0.89**	**43.44 ± 20.27**
		RB	CHK-LDVSN01	15	20	11	0.73	36.15	10.04	242.29	5.68	137.12
			CHK-LDVSN02	22	17	9	0.41	30.73	5.59	137.17	3.99	97.98
			CHK-LDVSN03	26	33	9	0.35	59.65	11.47	272.41	6.75	160.24
			CHK-LDVSN04	9	13	7	0.78	23.50	5.22	120.76	2.09	48.30
			CHK-LDVSN05	12	12	6	0.50	21.69	5.71	162.63	4.63	131.90
			Average ± SE				**0.55 ± 0.09**		**7.61 ± 1.31**	**187.05 ± 29.85**	**4.63 ± 0.79**	**115.11 ± 19.44**
	Tzoonie River	CT	TZN-SN01	10	13	8	0.80	24.10	7.09	152.90	4.95	106.70
			TZN-SN02	8	10	4	0.50	18.54	7.42	152.67	5.17	106.54
			TZN-SN03	11	7	4	0.36	12.98	3.42	78.93	1.58	36.42
			TZN-SN04	10	9	2	0.20	16.69	5.38	134.67	2.04	51.15
			TZN-SN05	6	11	5	0.83	20.39	5.66	120.43	4.47	95.05
			Average ± SE				**0.54 ± 0.12**		**5.79 ± 0.71**	**127.92 ± 13.67**	**3.64 ± 0.76**	**79.17 ± 14.78**
Fish (≥1+)	Chickwat Creek	CT + RB	CHK-LDVSN01	24	30	17	0.71	57.11	15.86	513.64	8.98	290.68
			CHK-LDVSN02	32	30	14	0.44	57.11	10.38	387.15	7.42	276.53
			CHK-LDVSN03	39	45	17	0.44	85.66	16.47	639.59	9.69	376.23
			CHK-LDVSN04	25	25	14	0.56	47.59	10.58	401.39	4.23	160.56
			CHK-LDVSN05	33	39	16	0.48	74.24	19.54	779.95	15.85	632.56
			Average ± SE				**0.53 ± 0.05**		**14.57 ± 1.78**	**544.34 ± 74.39**	**9.23 ± 1.90**	**347.31 ± 79.15**
		CT	CHK-LDVSN01	2	6	2	1.00	9.08	2.52	52.39	1.43	29.65
			CHK-LDVSN02	3	9	3	1.00	13.62	2.48	98.45	1.77	70.32
			CHK-LDVSN03	7	7	4	0.57	10.59	2.04	128.33	1.20	75.49
			CHK-LDVSN04	12	7	4	0.33	10.59	2.35	96.98	0.94	38.79
			CHK-LDVSN05	15	20	6	0.40	30.26	7.96	290.88	6.46	235.91
			Average ± SE				**0.66 ± 0.14**		**3.47 ± 1.13**	**133.40 ± 41.19**	**2.36 ± 1.03**	**90.03 ± 37.52**
		RB	CHK-LDVSN01	22	24	15	0.68	42.98	11.94	410.63	6.76	232.39
			CHK-LDVSN02	29	21	11	0.38	37.61	6.84	250.86	4.88	179.19
			CHK-LDVSN03	32	38	13	0.41	68.05	13.09	444.78	7.70	261.63
			CHK-LDVSN04	13	18	10	0.77	32.23	7.16	257.59	2.87	103.03
			CHK-LDVSN05	18	19	10	0.56	34.02	8.95	386.18	7.26	313.20
			Average ± SE				**0.56 ± 0.08**		**9.60 ± 1.26**	**350.01 ± 40.21**	**5.89 ± 0.90**	**217.89 ± 35.98**
	Tzoonie River	CT	TZN-SN01	17	19	12	0.71	34.17	10.05	580.04	7.01	404.77
			TZN-SN02	13	12	5	0.38	21.58	8.63	367.87	6.02	256.71
			TZN-SN03	18	14	9	0.50	25.18	6.63	342.45	3.06	158.03
			TZN-SN04	15	11	4	0.27	19.78	6.38	247.87	2.42	94.14
			TZN-SN05	13	22	12	0.92	39.56	10.99	639.76	8.67	504.94
			Average ± SE				**0.56 ± 0.12**		**8.54 ± 0.91**	**435.60 ± 74.52**	**5.44 ± 1.18**	**283.72 ± 76.18**
All Fish	Chickwat Creek	CT + RB	CHK-LDVSN01	30	52	20	0.67	115.87	32.18	583.87	18.21	330.43
			CHK-LDVSN02	42	37	14	0.33	82.44	14.99	424.13	10.71	302.95
			CHK-LDVSN03	55	63	20	0.36	140.38	27.00	763.58	15.88	449.16
			CHK-LDVSN04	36	33	16	0.44	73.53	16.34	459.39	6.54	183.76
			CHK-LDVSN05	39	42	17	0.44	93.58	24.63	879.54	19.97	713.34
			Average ± SE				**0.45 ± 0.06**		**23.03 ± 3.25**	**622.10 ± 87.58**	**14.26 ± 2.48**	**395.93 ± 89.87**
	Tzoonie River	CT	TZN-SN01	19	20	12	0.63	36.28	10.67	594.88	7.45	415.13
			TZN-SN02	13	14	6	0.46	25.39	10.16	418.98	7.09	292.38
			TZN-SN03	19	14	9	0.47	25.39	6.68	376.62	3.08	173.80
			TZN-SN04	15	12	4	0.27	21.77	7.02	251.54	2.67	95.53
			TZN-SN05	13	22	12	0.92	39.91	11.08	645.26	8.75	509.28
			Average ± SE				**0.55 ± 0.11**		**9.12 ± 0.94**	**457.45 ± 72.31**	**5.81 ± 1.23**	**297.22 ± 75.76**

M = # of fish marked in first sample; C= total # of fish captured in second sample; R = # of fish in captured in second sample that were marked; CE = Capture Efficiency; SE = standard error.

Table 38. Average Cutthroat and Rainbow Trout densities and biomass by age class within the Chickwat Creek lower diversion and Tzoonie River in 2016.

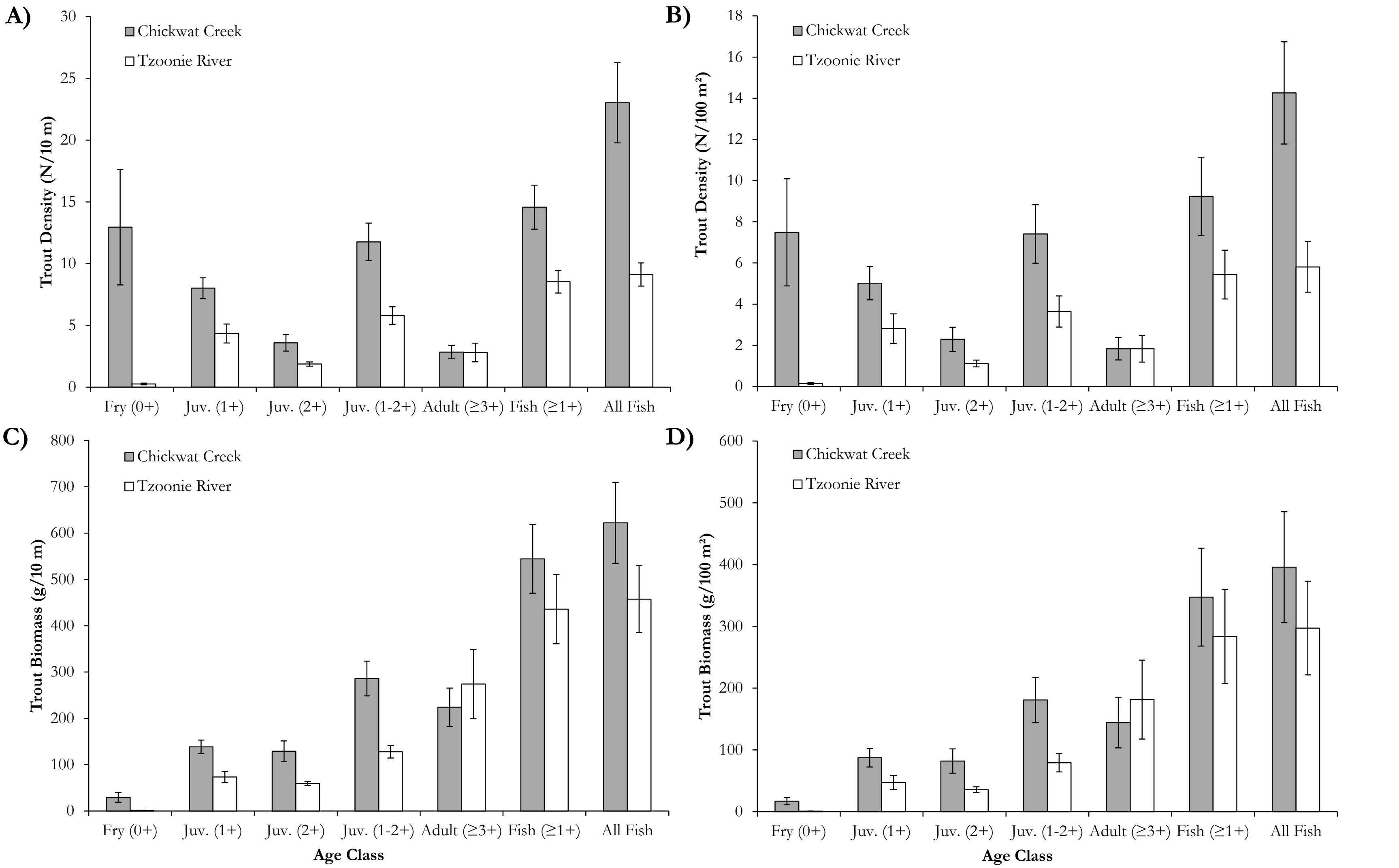
Waterbody	Species[1]	Age Class	CE[2]	Population Size (N)	SE (N)	Density (N/10 m)	SE (N/10 m)	Density (N/100m^2)	SE (N/100m^2)	Biomass (g/10 m)	SE (g/10 m)	Biomass (g/100m^2)	SE (g/100m^2)
Chickwat Creek	RB + CT	Fry (0+)	0.21	55.99	17.31	12.95	4.67	7.49	2.60	29.22	10.44	16.92	5.83
		Juv. (1+)	0.48	35.65	3.69	8.02	0.84	5.02	0.81	138.52	14.71	87.44	15.09
		Juv. (2+)	0.60	15.67	2.67	3.59	0.67	2.29	0.59	128.90	22.48	81.97	19.84
		Juv. (1-2+)	0.51	51.93	6.18	11.76	1.52	7.41	1.42	286.01	37.63	180.84	36.65
		Adult (≥3+)	0.59	12.56	1.90	2.84	0.54	1.84	0.55	223.94	41.47	144.38	41.01
		Fish (≥1+)	0.53	64.34	6.85	14.57	1.78	9.23	1.90	544.34	74.39	347.31	79.15
		All Fish	0.45	101.16	12.09	23.03	3.25	14.26	2.48	622.10	87.58	395.93	89.87
	CT	Juv. (1+)	0.57	7.76	2.88	1.88	0.77	1.30	0.65	32.16	13.04	22.27	11.11
		Juv. (2+)	0.51	5.83	1.74	1.37	0.46	0.92	0.41	43.64	14.27	29.02	12.72
		Juv. (1-2+)	0.63	11.73	3.46	2.80	0.99	1.91	0.89	64.27	22.57	43.44	20.27
		Adult (≥3+)	0.73	3.29	0.93	0.72	0.23	0.48	0.20	65.00	19.79	42.88	16.15
		Fish (≥1+)	0.66	14.83	3.93	3.47	1.13	2.36	1.03	133.40	41.19	90.03	37.52
	RB	Juv. (1+)	0.47	26.81	6.11	5.87	1.15	3.53	0.66	101.96	18.62	61.91	11.11
		Juv. (2+)	0.68	9.40	1.51	2.13	0.34	1.33	0.25	80.11	12.52	49.91	9.26
		Juv. (1-2+)	0.55	34.34	6.83	7.61	1.31	4.63	0.79	187.05	29.85	115.11	19.44
		Adult (≥3+)	0.59	8.50	0.93	1.96	0.32	1.24	0.33	143.52	20.47	91.35	22.41
		Fish (≥1+)	0.56	42.98	6.53	9.60	1.26	5.89	0.90	350.01	40.21	217.89	35.98
Tzoonie River	CT	Fry (0+)	0.00	0.80	0.07	0.26	0.07	0.15	0.05	1.17	0.46	0.71	0.34
		Juv. (1+)	0.45	13.78	2.15	4.35	0.77	2.81	0.72	73.27	11.77	47.10	11.46
		Juv. (2+)	0.63	6.08	0.60	1.87	0.17	1.12	0.17	59.58	4.37	35.58	4.58
		Juv. (1-2+)	0.54	18.54	1.85	5.79	0.71	3.64	0.76	127.92	13.67	79.17	14.78
		Adult (≥3+)	0.58	9.70	2.93	2.81	0.75	1.84	0.65	274.03	74.77	181.47	63.78
		Fish (≥1+)	0.56	28.06	3.80	8.54	0.91	5.44	1.18	435.60	74.52	283.72	76.18
		All Fish	0.55	29.75	3.52	9.12	0.94	5.81	1.23	457.45	72.31	297.22	75.76

[1] CT = Cutthroat Trout, RB = Rainbow Trout

[2] CE = Capture Efficiency

SE = standard error.

Figure 15. Trout (Cutthroat and Rainbow) A) linear density, B) density per area, C) linear biomass, and D) biomass per area for each age class within the Chickwat Creek lower diversion and Tzoonie River in 2016.



Density and biomass estimates include Cutthroat and Rainbow Trout, as well as hybrids of the two species and steelhead in the Chickwat Creek lower diversion, and Cutthroat Trout only in Tzooie River.

Dolly Varden

A summary of 2016 mark-recapture fish counts, population estimates and linear and per area densities and biomass densities of Dolly Varden are presented by site, waterbody, and age class in Table 39. Only one and two Dolly Varden were marked within the lower diversion of Chickwat Creek and Tzoonie River, respectively during mark events, and only two and four were captured during recapture events, respectively, of which only one in the Tzoonie River was a recapture. Due to the low captures, it was not possible to calculate capture efficiencies for this species, so the average capture efficiency of all trout species combined were used to estimate abundance for this species. In cases where no fish were captured during the recapture event, the capture during the mark event was used to calculate abundance. No fry or 2+ juveniles were captured in either waterbody in 2016.

Densities and biomass densities were similarly low for both age classes where present in individual sites and, and are presented by the average linear and per area density and biomass for each age class in each waterbody in Table 41 and Figure 16. Overall densities and biomass of juvenile 1+ fish were higher in the Tzoonie River, while adults were only captured in the Chickwat Creek lower diversion.

Table 39. Dolly Varden densities and biomass by age class for each sampling site within the Chickwat Creek lower diversion and Tzoonie River in 2016.

Age Class	Waterbody	Site	M	C	R	Population Size (N)	Density (N/10 m)	Biomass (g/10m)	Density (N/100m^2)	Biomass (g/100m^2)
Fry (0+)	**Chickwat Creek**	CHK-LDVSN01	0	0	0	0.00	0.00	0.00	0.00	0.00
		CHK-LDVSN02	0	0	0	0.00	0.00	0.00	0.00	0.00
		CHK-LDVSN03	0	0	0	0.00	0.00	0.00	0.00	0.00
		CHK-LDVSN04	0	0	0	0.00	0.00	0.00	0.00	0.00
		CHK-LDVSN05	0	0	0	0.00	0.00	0.00	0.00	0.00
		Average ± SE					**0.00 ± 0.00**	**0.00 ± 0.00**	**0.00 ± 0.00**	**0.00 ± 0.00**
	Tzoonie River	TZN-SN01	0	0	0	0.00	0.00	0.00	0.00	0.00
		TZN-SN02	0	0	0	0.00	0.00	0.00	0.00	0.00
		TZN-SN03	0	0	0	0.00	0.00	0.00	0.00	0.00
		TZN-SN04	0	0	0	0.00	0.00	0.00	0.00	0.00
		TZN-SN05	0	0	0	0.00	0.00	0.00	0.00	0.00
		Average ± SE					**0.00 ± 0.00**	**0.00 ± 0.00**	**0.00 ± 0.00**	**0.00 ± 0.00**
Juv. (1+)	**Chickwat Creek**	CHK-LDVSN01	0	0	0	0.00	0.00	0.00	0.00	0.00
		CHK-LDVSN02	0	0	0	0.00	0.00	0.00	0.00	0.00
		CHK-LDVSN03	1	0	0	2.11	0.41	8.51	0.24	5.01
		CHK-LDVSN04	0	1	0	2.11	0.47	5.29	0.19	2.12
		CHK-LDVSN05	0	0	0	0.00	0.00	0.00	0.00	0.00
		Average ± SE					**0.17 ± 0.11**	**2.76 ± 1.77**	**0.09 ± 0.05**	**1.42 ± 0.98**
	Tzoonie River	TZN-SN01	0	1	0	2.25	0.66	7.82	0.46	5.45
		TZN-SN02	0	0	0	0.00	0.00	0.00	0.00	0.00
		TZN-SN03	1	1	1	2.25	0.59	9.75	0.27	4.50
		TZN-SN04	0	1	0	2.25	0.73	13.15	0.28	4.99
		TZN-SN05	1	1	0	2.25	0.63	10.82	0.49	8.54
		Average ± SE					**0.52 ± 0.13**	**8.31 ± 2.25**	**0.30 ± 0.09**	**4.70 ± 1.37**
Juv. (2+)	**Chickwat Creek**	CHK-LDVSN01	0	0	0	0.00	0.00	0.00	0.00	0.00
		CHK-LDVSN02	0	0	0	0.00	0.00	0.00	0.00	0.00
		CHK-LDVSN03	0	0	0	0.00	0.00	0.00	0.00	0.00
		CHK-LDVSN04	0	0	0	0.00	0.00	0.00	0.00	0.00
		CHK-LDVSN05	0	0	0	0.00	0.00	0.00	0.00	0.00
		Average ± SE					**0.00 ± 0.00**	**0.00 ± 0.00**	**0.00 ± 0.00**	**0.00 ± 0.00**
	Tzoonie River	TZN-SN01	0	0	0	0.00	0.00	0.00	0.00	0.00
		TZN-SN02	0	0	0	0.00	0.00	0.00	0.00	0.00
		TZN-SN03	0	0	0	0.00	0.00	0.00	0.00	0.00
		TZN-SN04	0	0	0	0.00	0.00	0.00	0.00	0.00
		TZN-SN05	0	0	0	0.00	0.00	0.00	0.00	0.00
		Average ± SE					**0.00 ± 0.00**	**0.00 ± 0.00**	**0.00 ± 0.00**	**0.00 ± 0.00**
Adult (≥3+)	**Chickwat Creek**	CHK-LDVSN01	0	0	0	0.00	0.00	0.00	0.00	0.00
		CHK-LDVSN02	0	0	0	0.00	0.00	0.00	0.00	0.00
		CHK-LDVSN03	0	0	0	0.00	0.00	0.00	0.00	0.00
		CHK-LDVSN04	0	0	0	0.00	0.00	0.00	0.00	0.00
		CHK-LDVSN05	0	1	0	1.70	0.45	23.04	0.36	18.69
		Average ± SE					**0.09 ± 0.09**	**4.61 ± 4.61**	**0.07 ± 0.07**	**3.74 ± 3.74**
	Tzoonie River	TZN-SN01	0	0	0	0.00	0.00	0.00	0.00	0.00
		TZN-SN02	0	0	0	0.00	0.00	0.00	0.00	0.00
		TZN-SN03	0	0	0	0.00	0.00	0.00	0.00	0.00
		TZN-SN04	0	0	0	0.00	0.00	0.00	0.00	0.00
		TZN-SN05	0	0	0	0.00	0.00	0.00	0.00	0.00
		Average ± SE					**0.00 ± 0.00**	**0.00 ± 0.00**	**0.00 ± 0.00**	**0.00 ± 0.00**

M = # of fish marked in first sample; C= total # of fish captured in second sample; R = # of fish in captured in second sample that were marked; SE = standard error. Captures were too low to calculate capture efficiency for this species so age class specific values for all trout combined were used to calculate population estimates.

Table 40. Dolly Varden densities and biomass by age class grouping for each sampling site within the Chickwat Creek lower diversion and Tzoonie River in 2016.

Age Class	Waterbody	Site	M	C	R	Population Size (N)	Density (N/10 m)	Biomass (g/10m)	Density (N/100m^2)	Biomass (g/100m^2)
Juv. (1-2+)	**Chickwat Creek**	CHK-LDVSN01	0	0	0	0.00	0.00	0.00	0.00	0.00
		CHK-LDVSN02	0	0	0	0.00	0.00	0.00	0.00	0.00
		CHK-LDVSN03	1	0	0	1.98	0.38	7.98	0.22	4.70
		CHK-LDVSN04	0	1	0	1.98	0.44	4.96	0.18	1.99
		CHK-LDVSN05	0	0	0	0.00	0.00	0.00	0.00	0.00
		Average ± SE					**0.16 ± 0.10**	**2.59 ± 1.66**	**0.08 ± 0.05**	**1.34 ± 0.92**
	Tzoonie River	TZN-SN01	0	1	0	1.90	0.56	6.60	0.39	4.60
		TZN-SN02	0	0	0	0.00	0.00	0.00	0.00	0.00
		TZN-SN03	1	1	1	1.90	0.50	8.23	0.23	3.80
		TZN-SN04	0	1	0	1.90	0.61	11.10	0.23	4.21
		TZN-SN05	1	1	0	1.90	0.53	9.13	0.42	7.21
		Average ± SE					**0.44 ± 0.11**	**7.01 ± 1.90**	**0.25 ± 0.07**	**3.96 ± 1.16**
Fish (≥1+)	**Chickwat Creek**	CHK-LDVSN01	0	0	0	0.00	0.00	0.00	0.00	0.00
		CHK-LDVSN02	0	0	0	0.00	0.00	0.00	0.00	0.00
		CHK-LDVSN03	1	0	0	1.91	0.37	7.72	0.22	4.54
		CHK-LDVSN04	0	1	0	1.91	0.42	4.80	0.17	1.92
		CHK-LDVSN05	0	1	0	1.91	0.50	25.96	0.41	21.05
		Average ± SE					**0.26 ± 0.11**	**7.70 ± 4.80**	**0.16 ± 0.08**	**5.50 ± 3.98**
	Tzoonie River	TZN-SN01	0	1	0	1.82	0.54	6.33	0.37	4.42
		TZN-SN02	0	0	0	0.00	0.00	0.00	0.00	0.00
		TZN-SN03	1	1	1	1.82	0.48	7.90	0.22	3.64
		TZN-SN04	0	1	0	1.82	0.59	10.65	0.22	4.05
		TZN-SN05	1	1	0	1.82	0.51	8.77	0.40	6.92
		Average ± SE					**0.42 ± 0.11**	**6.73 ± 1.82**	**0.24 ± 0.07**	**3.81 ± 1.11**
All Fish	**Chickwat Creek**	CHK-LDVSN01	0	0	0	0.00	0.00	0.00	0.00	0.00
		CHK-LDVSN02	0	0	0	0.00	0.00	0.00	0.00	0.00
		CHK-LDVSN03	1	0	0	2.23	0.43	9.02	0.25	5.31
		CHK-LDVSN04	0	1	0	2.23	0.50	5.61	0.20	2.24
		CHK-LDVSN05	0	1	0	2.23	0.59	30.34	0.48	24.61
		Average ± SE					**0.30 ± 0.13**	**9.00 ± 5.61**	**0.19 ± 0.09**	**6.43 ± 4.65**
	Tzoonie River	TZN-SN01	0	1	0	1.84	0.54	6.39	0.38	4.46
		TZN-SN02	0	0	0	0.00	0.00	0.00	0.00	0.00
		TZN-SN03	1	1	1	1.84	0.48	7.99	0.22	3.69
		TZN-SN04	0	1	0	1.84	0.59	10.75	0.23	4.08
		TZN-SN05	1	1	0	1.84	0.51	8.84	0.40	6.98
		Average ± SE					**0.43 ± 0.11**	**6.79 ± 1.84**	**0.25 ± 0.07**	**3.84 ± 1.12**

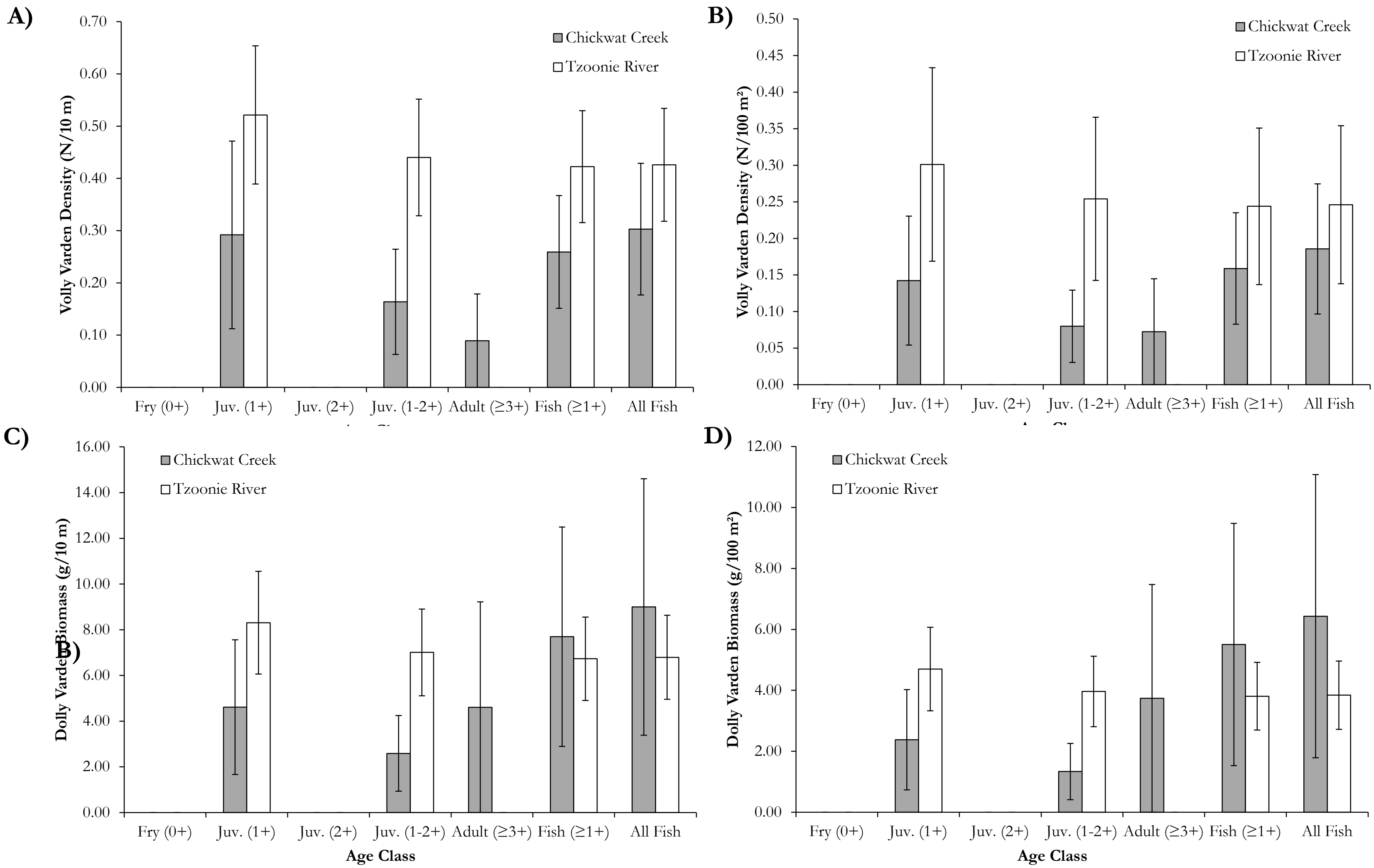
M = # of fish marked in first sample; C= total # of fish captured in second sample; R = # of fish in captured in second sample that were marked; SE = standard error. Captures were too low to calculate capture efficiency for this species so age class specific values for all trout combined were used to calculate population estimates.

Table 41. Dolly Varden densities and biomass by age class and age class grouping within the Chickwat Creek lower diversion and Tzoonie River in 2016.

Waterbody	Age Class	Density (N/10 m)	SE (N/10	Density (N/100m^2	SE (N/100m^2)	Biomass (g/10 m)	SE (g/10	Biomass (g/100m^2)	SE (g/100m^2)
Chickwat Creek	Fry (0+)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Juv. (1+)	0.29	0.18	0.14	0.09	4.61	2.95	2.38	1.65
	Juv. (2+)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Juv. (1-2+)	0.16	0.10	0.08	0.05	2.59	1.66	1.34	0.92
	Adult (≥3+)	0.09	0.09	0.07	0.07	4.61	4.61	3.74	3.74
	Fish (≥1+)	0.26	0.11	0.16	0.08	7.70	4.80	5.50	3.98
	All Fish	0.30	0.13	0.19	0.09	9.00	5.61	6.43	4.65
Tzoonie River	Fry (0+)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Juv. (1+)	0.52	0.13	0.30	0.09	8.31	2.25	4.70	1.37
	Juv. (2+)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Juv. (1-2+)	0.44	0.11	0.25	0.07	7.01	1.90	3.96	1.16
	Adult (≥3+)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fish (≥1+)	0.42	0.11	0.24	0.07	6.73	1.82	3.81	1.11
	All Fish	0.43	0.11	0.25	0.07	6.79	1.84	3.84	1.12

SE = standard error.

Figure 16. Dolly Varden A) linear densities, B) density per area, C linear biomass, and D) biomass per area by age class within the Chickwat Creek lower diversion and Tzoonie River in 2016.



Coho Salmon

A summary of 2016 mark-recapture fish counts, capture efficiencies, population estimates and linear and per area densities and biomass densities of Coho fry are presented by site in Table 42. A total of 11 Coho fry were marked within the lower diversion of Chickwat Creek. A total of 21 were captured during recapture events, of which only two were marked. Captures were too low to calculate capture efficiencies so the average capture efficiency of Cutthroat and Rainbow Trout fry (0.21; Table 38) were used to estimate population sizes. In cases where no fish were captured during the recapture event, the capture during the mark event was used to calculate population size. Densities and biomass densities were highest in the lowermost sites within the lower diversion, while no Coho fry were captured in the two uppermost mark-recapture sites.

No Coho Salmon were detected in the Tzoonie River.

Table 42. Coho Salmon fry densities and biomass for each sampling site within the Chickwat Creek lower diversion in 2016.

Site	M	C	R	CE	Population Size (N)	Density (N/10 m)	Biomass (g/10m)	Density (N/100m^2)	Biomass (g/100m^2)
CHK-LDVSN01	7	9	2	0.29	43.44	12.07	66.76	6.83	37.78
CHK-LDVSN02	3	10	0	0.00	48.26	8.78	63.27	6.27	45.19
CHK-LDVSN03	1	2	0	0.00	9.65	1.86	14.60	1.09	8.59
CHK-LDVSN04	0	0	0	-	0.00	0.00	0.00	0.00	0.00
CHK-LDVSN05	0	0	0	-	0.00	0.00	0.00	0.00	0.00
Average ± SE				**0.10 ± 0.10**		**4.54 ± 2.48**	**28.93 ± 14.98**	**2.84 ± 1.53**	**18.31 ± 9.66**

M = # of fish marked in first sample; C= total # of fish captured in second sample; R = # of fish in captured in second sample that were marked; CE = Capture Efficiency; SE = standard error. Captures were too low to accurately calculate capture efficiency for this species so that of trout fry were used to calculate population estimates.

Species Combined (AMP Metrics 2 and 4)

A summary of 2016 mark-recapture fish counts, capture efficiencies, population estimates and linear and per area densities and biomass densities of combined trout (Rainbow Trout, Cutthroat Trout, and Dolly Varden) juveniles (1-2+; Metric 2) and adults (≥3+; Metric 4) are presented by site and waterbody in Table 43. Totals of 114 and 47 juveniles were marked within the lower diversion of Chickwat Creek and Tzoonie River, respectively. During re-capture events, a total of 133 juveniles were captured within the Chickwat Creek lower diversion, of which 55 were marked, and a total of 54 were captured within the Tzoonie River, of which 24 were marked. Capture efficiencies in the lower diversion reach of Chickwat Creek averaged 0.51 (±0.07 SE). Capture efficiencies were similar in Tzoonie River sites, averaging 0.53 (±0.11 SE). Totals of 40 and 31 adults were marked within the lower diversion of Chickwat Creek and Tzoonie River, respectively. During re-capture events, a total of 38 adults were captured within the Chickwat Creek lower diversion, of which 23 were marked, and a total of 28 were captured within the Tzoonie River, of which 19 were marked. Adult capture efficiencies in the lower diversion reach of Chickwat Creek averaged 0.59 (±0.08 SE). Capture efficiencies were similar in Tzoonie River sites, averaging 0.58 (±0.14 SE).

Densities and biomass densities also varied among sites and waterbodies, and are presented by the average linear and per area density and biomass of juvenile and adult trout in each waterbody in Table 45 and Figure 17. Both linear and per area densities of juvenile trout were roughly two to four times that of adults and were roughly two times higher in the Chickwat lower diversion reach than in the Tzoonie River; in contrast, densities of adult trout were very similar in the two systems. In contrast to trends in density, biomass of juveniles and adults were very similar, but as with density estimates, juvenile biomass were, on average, roughly two times higher than those in the Tzoonie River, while adult biomass in the two systems were very similar.

Table 43. Combined trout (Cutthroat and Rainbow) and char (Dolly Varden) densities and biomass of all age classes for each sampling site within the Chickwat Creek lower diversion and Tzoonie River in 2016. Adults (≥3+; AMP Metric 4) are highlighted at the bottom.

Age Class	Waterbody	Site	M	C	R	CE	Population Size (N)	Density (N/10 m)	Biomass (g/10m)	Density (N/100m^2)	Biomass (g/100m^2)
Fry (0+)	Chickwat Creek	CHK-LDVSN01	6	22	3	0.50	106.18	29.49	66.15	16.69	37.44
		CHK-LDVSN02	10	7	0	0.00	33.78	6.14	15.54	4.39	11.10
		CHK-LDVSN03	16	18	3	0.19	86.87	16.71	37.54	9.83	22.08
		CHK-LDVSN04	11	8	2	0.18	38.61	8.58	19.06	3.43	7.62
		CHK-LDVSN05	6	3	1	0.17	14.48	3.81	7.83	3.09	6.35
		Average ± SE				**0.21 ± 0.08**		**12.95 ± 4.67**	**29.22 ± 10.44**	**7.49 ± 2.60**	**16.92 ± 5.83**
	Tzoonie River	TZN-SN01	2	1	0	0.00	1.00	0.29	1.20	0.21	0.83
		TZN-SN02	0	1	0	-	1.00	0.40	2.82	0.28	1.97
		TZN-SN03	1	0	0	0.00	1.00	0.26	1.00	0.12	0.46
		TZN-SN04	0	1	0	-	1.00	0.32	0.81	0.12	0.31
		TZN-SN05	0	0	0	-	0.00	0.00	0.00	0.00	0.00
		Average ± SE				**0.00 ± 0.00**		**0.26 ± 0.07**	**1.17 ± 0.46**	**0.15 ± 0.05**	**0.71 ± 0.34**
Juv. (1+)	Chickwat Creek	CHK-LDVSN01	12	17	8	0.67	35.83	9.95	167.14	5.63	94.59
		CHK-LDVSN02	17	17	7	0.41	35.83	6.51	117.61	4.65	84.01
		CHK-LDVSN03	19	23	4	0.21	48.48	9.32	158.52	5.48	93.25
		CHK-LDVSN04	9	13	6	0.67	27.40	6.09	97.89	2.44	39.16
		CHK-LDVSN05	12	16	5	0.42	33.72	8.87	162.02	7.20	131.40
		Average ± SE				**0.47 ± 0.09**		**8.15 ± 0.78**	**140.64 ± 13.85**	**5.08 ± 0.78**	**88.48 ± 14.76**
	Tzoonie River	TZN-SN01	7	9	5	0.71	20.27	5.96	100.93	4.16	70.43
		TZN-SN02	4	7	1	0.25	15.76	6.31	92.05	4.40	64.23
		TZN-SN03	8	4	3	0.38	9.01	2.37	39.98	1.09	18.45
		TZN-SN04	6	6	1	0.17	13.51	4.36	81.07	1.66	30.79
		TZN-SN05	7	9	5	0.71	20.27	5.63	100.60	4.44	79.40
		Average ± SE				**0.44 ± 0.12**		**4.93 ± 0.72**	**82.93 ± 11.33**	**3.15 ± 0.73**	**52.66 ± 11.86**
Juv. (2+)	Chickwat Creek	CHK-LDVSN01	5	9	5	1.00	15.00	4.17	155.87	2.36	88.21
		CHK-LDVSN02	7	6	4	0.57	10.00	1.82	70.46	1.30	50.33
		CHK-LDVSN03	12	14	7	0.58	23.33	4.49	157.51	2.64	92.65
		CHK-LDVSN04	10	6	3	0.30	10.00	2.22	79.65	0.89	31.86
		CHK-LDVSN05	11	12	6	0.55	20.00	5.26	181.03	4.27	146.82
		Average ± SE				**0.60 ± 0.11**		**3.59 ± 0.67**	**128.90 ± 22.48**	**2.29 ± 0.59**	**81.97 ± 19.84**
	Tzoonie River	TZN-SN01	3	5	3	1.00	8.00	2.35	69.71	1.64	48.64
		TZN-SN02	4	3	3	0.75	4.80	1.92	57.60	1.34	40.20
		TZN-SN03	4	4	2	0.50	6.40	1.68	51.89	0.78	23.95
		TZN-SN04	4	4	1	0.25	6.40	2.06	69.75	0.78	26.49
		TZN-SN05	0	3	0	-	4.80	1.33	48.93	1.05	38.62
		Average ± SE				**0.63 ± 0.16**		**1.87 ± 0.17**	**59.58 ± 4.37**	**1.12 ± 0.17**	**35.58 ± 4.58**
Adult (≥3+)	Chickwat Creek	CHK-LDVSN01	7	4	4	0.57	6.79	1.89	126.45	1.07	71.56
		CHK-LDVSN02	8	7	3	0.38	11.88	2.16	171.93	1.54	122.81
		CHK-LDVSN03	9	8	6	0.67	13.58	2.61	254.22	1.54	149.54
		CHK-LDVSN04	6	7	5	0.83	11.88	2.64	199.36	1.06	79.74
		CHK-LDVSN05	10	12	5	0.50	20.36	5.36	395.48	4.35	320.75
		Average ± SE				**0.59 ± 0.08**		**2.93 ± 0.62**	**229.49 ± 46.37**	**1.91 ± 0.62**	**148.88 ± 45.26**
	Tzoonie River	TZN-SN01	7	6	4	0.57	10.40	3.06	372.01	2.13	259.61
		TZN-SN02	5	2	1	0.20	3.47	1.39	137.58	0.97	96.01
		TZN-SN03	7	7	5	0.71	12.13	3.19	282.22	1.47	130.24
		TZN-SN04	5	2	2	0.40	3.47	1.12	85.36	0.42	32.42
		TZN-SN05	7	11	7	1.00	19.06	5.29	492.96	4.18	389.07
		Average ± SE				**0.58 ± 0.14**		**2.81 ± 0.75**	**274.03 ± 74.77**	**1.84 ± 0.65**	**181.47 ± 63.78**

M = # of fish marked in first sample; C= total # of fish captured in second sample; R = # of fish in captured in second sample that were marked; CE = Capture Efficiency; SE = standard error.

Table 44. Combined trout (Cutthroat and Rainbow) and char (Dolly Varden) densities and biomass of all age class groupings for each sampling site within the Chickwat Creek lower diversion and Tzoonie River in 2016. Juveniles (1-2+; AMP Metric 2) are highlighted at the top.

Age Class	Waterbody	Site	M	C	R	CE	Population Size (N)	Density (N/10 m)	Biomass (g/10m)	Density (N/100m^2)	Biomass (g/100m^2)
Juv. (1-2+)	**Chickwat Creek**	CHK-LDVSN01	17	26	13	0.76	51.39	14.27	335.52	8.08	189.88
		CHK-LDVSN02	24	23	11	0.46	45.46	8.27	196.53	5.90	140.38
		CHK-LDVSN03	31	37	11	0.35	73.13	14.06	336.46	8.27	197.92
		CHK-LDVSN04	19	19	9	0.47	37.55	8.34	203.62	3.34	81.45
		CHK-LDVSN05	23	28	11	0.48	55.34	14.56	371.89	11.81	301.61
		Average ± SE				**0.51 ± 0.07**		**11.90 ± 1.47**	**288.80 ± 36.83**	**7.48 ± 1.40**	**182.25 ± 36.38**
	Tzoonie River	TZN-SN01	10	14	8	0.80	26.61	7.83	165.60	5.46	115.57
		TZN-SN02	8	10	4	0.50	19.00	7.60	156.50	5.30	109.21
		TZN-SN03	12	8	5	0.42	15.20	4.00	89.80	1.85	41.44
		TZN-SN04	10	10	2	0.20	19.00	6.13	151.27	2.33	57.45
		TZN-SN05	7	12	5	0.71	22.81	6.33	132.03	5.00	104.21
		Average ± SE				**0.53 ± 0.11**		**6.38 ± 0.68**	**139.04 ± 13.48**	**3.99 ± 0.78**	**85.58 ± 15.07**
Fish (≥1+)	**Chickwat Creek**	CHK-LDVSN01	24	30	17	0.71	57.35	15.93	515.78	9.02	291.89
		CHK-LDVSN02	32	30	14	0.44	57.35	10.43	388.76	7.45	277.69
		CHK-LDVSN03	40	45	17	0.43	86.02	16.54	638.78	9.73	375.75
		CHK-LDVSN04	25	26	14	0.56	49.70	11.04	413.41	4.42	165.36
		CHK-LDVSN05	33	40	16	0.48	76.46	20.12	806.50	16.32	654.10
		Average ± SE				**0.52 ± 0.05**		**14.81 ± 1.81**	**552.65 ± 77.29**	**9.39 ± 1.96**	**352.96 ± 82.40**
	Tzoonie River	TZN-SN01	17	20	12	0.71	36.49	10.73	606.07	7.49	422.94
		TZN-SN02	13	12	5	0.38	21.89	8.76	373.18	6.11	260.42
		TZN-SN03	19	15	10	0.53	27.37	7.20	357.28	3.32	164.87
		TZN-SN04	15	12	4	0.27	21.89	7.06	268.89	2.68	102.12
		TZN-SN05	14	23	12	0.86	41.96	11.66	652.73	9.20	515.18
		Average ± SE				**0.55 ± 0.11**		**9.08 ± 0.92**	**451.63 ± 75.08**	**5.76 ± 1.23**	**293.11 ± 77.51**
All Fish	**Chickwat Creek**	CHK-LDVSN01	30	52	20	0.67	116.20	32.28	585.57	18.27	331.39
		CHK-LDVSN02	42	37	14	0.33	82.68	15.03	425.36	10.74	303.83
		CHK-LDVSN03	56	63	20	0.36	140.78	27.07	764.14	15.93	449.49
		CHK-LDVSN04	36	34	16	0.44	75.98	16.88	470.63	6.75	188.25
		CHK-LDVSN05	39	43	17	0.44	96.09	25.29	908.00	20.51	736.41
		Average ± SE				**0.45 ± 0.06**		**23.31 ± 3.23**	**630.74 ± 90.70**	**14.44 ± 2.51**	**401.87 ± 93.38**
	Tzoonie River	TZN-SN01	19	21	12	0.63	38.65	11.37	609.94	7.93	425.64
		TZN-SN02	13	14	6	0.46	25.76	10.31	425.08	7.19	296.64
		TZN-SN03	20	15	10	0.50	27.60	7.26	390.10	3.35	180.02
		TZN-SN04	15	13	4	0.27	23.92	7.72	269.96	2.93	102.53
		TZN-SN05	14	23	12	0.86	42.33	11.76	658.42	9.28	519.67
		Average ± SE				**0.54 ± 0.10**		**9.68 ± 0.93**	**470.70 ± 71.94**	**6.14 ± 1.27**	**304.90 ± 76.59**

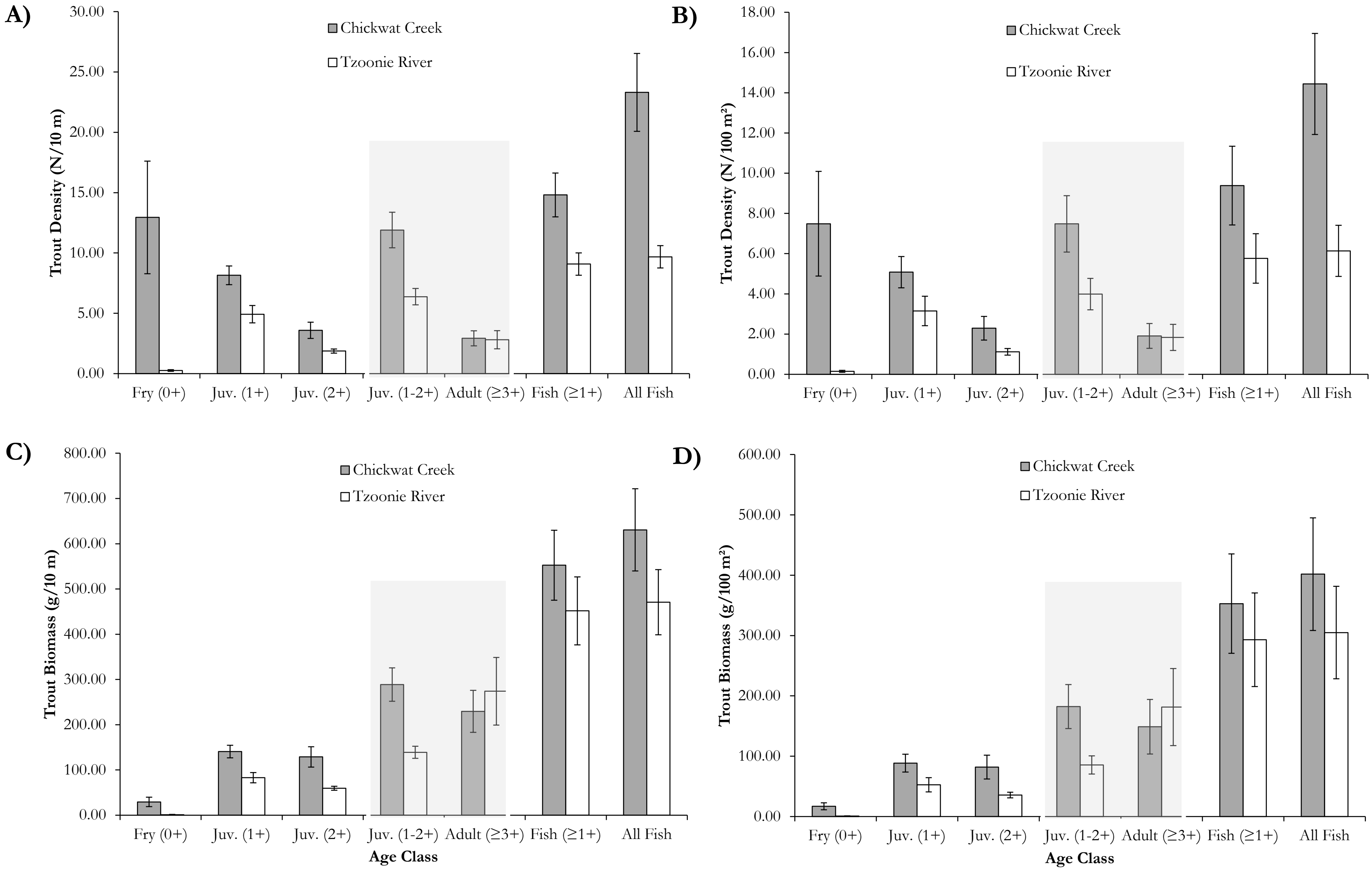
M = # of fish marked in first sample; C= total # of fish captured in second sample; R = # of fish in captured in second sample that were marked; CE = Capture Efficiency; SE = standard error.

Table 45. Combined trout (Cutthroat and Rainbow) and char (Dolly Varden) densities and biomass of all age classes and age class groupings within the Chickwat Creek lower diversion and Tzoonie River in 2016. Juveniles (1-2+; AMP Metric 2) and adults (≥3+; AMP Metric 4) are highlighted.

Waterbody/ Metric	Age Class	Density (N/10 m)	SE (N/10	Density ($N/100m^2$)	SE ($N/100m^2$)	Biomass (g/10 m)	SE (g/10 m)	Biomass ($g/100m^2$)	SE ($g/100m^2$)
Chickwat Creek	Fry (0+)	12.95	4.67	7.49	2.60	29.22	10.44	16.92	5.83
	Juv. (1+)	8.15	0.78	5.08	0.78	140.64	13.85	88.48	14.76
	Juv. (2+)	3.59	0.67	2.29	0.59	128.90	22.48	81.97	19.84
Metric 2	Juv. (1-2+)	11.90	1.47	7.48	1.40	288.80	36.83	182.25	36.38
Metric 4	Adult (≥3+)	2.93	0.62	1.91	0.62	229.49	46.37	148.88	45.26
	Fish (≥1+)	14.81	1.81	9.39	1.96	552.65	77.29	352.96	82.40
	All Fish	23.31	3.23	14.44	2.51	630.74	90.70	401.87	93.38
Tzoonie River	Fry (0+)	0.26	0.07	0.15	0.05	1.17	0.46	0.71	0.34
	Juv. (1+)	4.93	0.72	3.15	0.73	82.93	11.33	52.66	11.86
	Juv. (2+)	1.87	0.17	1.12	0.17	59.58	4.37	35.58	4.58
Metric 2	Juv. (1-2+)	6.38	0.68	3.99	0.78	139.04	13.48	85.58	15.07
Metric 4	Adult (≥3+)	2.81	0.75	1.84	0.65	274.03	74.77	181.47	63.78
	Fish (≥1+)	9.08	0.92	5.76	1.23	451.63	75.08	293.11	77.51
	All Fish	9.68	0.93	6.14	1.27	470.70	71.94	304.90	76.59

SE = standard error.

Figure 17. Combined trout (Cutthroat and Rainbow) and char (Dolly Varden) A) linear densities, B) density per area, C) linear biomass, and D) biomass per area by age class and age class grouping within the Chickwat Creek lower diversion and Tzoonie River in 2016. Juveniles (1-2+; AMP Metric 2) and adults (≥3+; AMP Metric 4) are highlighted.



4.4.2.2. Reconnaissance Electrofishing

Single-pass reconnaissance electrofishing was conducted along the margins of all mark-recapture snorkelling sites within the Chickwat Creek lower diversion and Tzoonie River on October 5-6, 2016, following the mark-recapture surveys (Table 46). Individual site areas averaged 117 m² and 33 m², and effort at individual sites averaged 300 seconds and 294 seconds in the lower diversion of Chickwat Creek and the Tzoonie River, respectively. Cutthroat Trout were the most abundant species in sites within both systems, followed by Coho fry and Rainbow Trout in the lower diversion of Chickwat Creek, and Dolly Varden within Tzoonie River sites. Total Trout captures were higher on average in the Chickwat Creek lower diversion with average densities per 100 m² over twice as high as those within Tzoonie River sites. Data from individual fish are presented in Section 4.4.2.3 along with those from mark-recapture snorkel surveys.

Table 46. Summary of site conditions, effort, and fish captures from reconnaissance electrofishing in the lower diversion of Chickwat Creek and Tzoonie River in October 2016.

Waterbody	Site	Sampling Date	Sampling Area (m^2)	Effort (sec)	Catch[1]						Density (# of fish/100 m²)[1]						CPUE (# of fish/sec)[1]					
					CC	CO	CT	DV	RB	Total TR	CC	CO	CT	DV	RB	Total TR	CC	CO	CT	DV	RB	Total TR
Chickwat Creek	CHK-LDVEF01	5-Oct-2016	72	254	1	0	5	0	0	5	1.39	0.00	6.94	0.00	0.00	6.94	0.004	0.000	0.020	0.000	0.000	0.020
	CHK-LDVEF02	5-Oct-2016	110	285	0	3	5	0	1	6	0.00	2.73	4.55	0.00	0.91	5.45	0.000	0.011	0.018	0.000	0.004	0.021
	CHK-LDVEF03	5-Oct-2016	104	316	0	1	11	0	0	11	0.00	0.96	10.58	0.00	0.00	10.58	0.000	0.003	0.035	0.000	0.000	0.035
	CHK-LDVEF04	5-Oct-2016	225	399	0	0	7	0	3	10	0.00	0.00	3.11	0.00	1.33	4.44	0.000	0.000	0.018	0.000	0.008	0.025
	CHK-LDVEF05	5-Oct-2016	76	248	0	0	1	0	0	1	0.00	0.00	1.32	0.00	0.00	1.32	0.000	0.000	0.004	0.000	0.000	0.004
		Total	**587**	**1,502**	**1**	**4**	**29**	**0**	**4**	**33**	**0.17**	**0.68**	**4.94**	**0.00**	**0.68**	**5.62**	**0.001**	**0.003**	**0.019**	**0.000**	**0.003**	**0.022**
		Average	**117**	**300**	**0**	**1**	**6**	**0**	**1**	**7**	**0.17**	**0.68**	**4.94**	**0.00**	**0.68**	**5.62**	**0.001**	**0.003**	**0.019**	**0.000**	**0.003**	**0.022**
Tzoonie River	TZN-EF01	6-Oct-2016	34	331	0	0	3	1	0	4	0.00	0.00	8.82	2.94	0.00	11.76	0.000	0.000	0.009	0.003	0.000	0.012
	TZN-EF02	6-Oct-2016	25	295	0	0	0	1	0	1	0.00	0.00	0.00	4.00	0.00	4.00	0.000	0.000	0.000	0.003	0.000	0.003
	TZN-EF03	6-Oct-2016	38	259	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000
	TZN-EF04	6-Oct-2016	31	365	0	0	2	2	0	4	0.00	0.00	6.45	6.45	0.00	12.90	0.000	0.000	0.005	0.005	0.000	0.011
	TZN-EF05	6-Oct-2016	36	183	0	0	2	0	0	2	0.00	0.00	5.56	0.00	0.00	5.56	0.000	0.000	0.011	0.000	0.000	0.011
		Total	**164**	**1,433**	**0**	**0**	**7**	**4**	**0**	**11**	**0.00**	**0.00**	**4.27**	**2.44**	**0.00**	**6.71**	**0.000**	**0.000**	**0.005**	**0.003**	**0.000**	**0.008**
		Average	**33**	**287**	**0**	**0**	**1**	**1**	**0**	**2**	**0.00**	**0.00**	**4.27**	**2.44**	**0.00**	**6.71**	**0.000**	**0.000**	**0.005**	**0.003**	**0.000**	**0.008**
		Combined Total	**751**	**2,935**	**1**	**4**	**36**	**4**	**4**	**44**	**0.13**	**0.53**	**4.79**	**0.53**	**0.53**	**5.86**	**0.000**	**0.001**	**0.012**	**0.001**	**0.001**	**0.015**
		Combined Average	**75**	**294**	**0**	**0**	**4**	**0**	**0**	**4**	**0.13**	**0.53**	**4.79**	**0.53**	**0.53**	**5.86**	**0.000**	**0.001**	**0.012**	**0.001**	**0.001**	**0.015**

[1] CC = Sculpin sp., CO = Coho Salmon, CT = Cutthroat Trout, DV = Dolly Varden, RB = Rainbow Trout, TR = Trout sp.

4.4.2.3. Individual Fish Data

A total of 408 and 132 fish were captured and processed during baseline monitoring in the lower diversion of Chickwat Creek and Tzoonie River, respectively in 2016. Data on all individual captured fish (including length, weight, and marks/tags applied) are provided in Appendix Q.

Cutthroat Trout

In 2016, 143 and 124 Cutthroat Trout were captured and processed during baseline monitoring in the Chickwat Creek lower diversion and Tzoonie River, respectively. The length-frequency distribution for Cutthroat Trout in each waterbody is presented in Figure 18. The length-weight relationships of these fish are presented in Figure 19. A total of 31 and 44 scale samples were collected, of which seven and 16 were analysed from the Chickwat Creek lower diversion and Tzoonie River, respectively. The length at age relationship of these fish is presented in Figure 20. Based on a review of this aging data and length-frequency histograms, discrete fork length ranges were defined for age classes 0+, 1+, 2+, and ≥3+ (Table 47). These discrete fork length ranges were then used to assign un-aged fish to an age class based on fork length, in order to summarize individual fish metrics and mark-recapture population estimates for specific age classes. A summary of fish length, weight, condition factor, and percent body fat are presented for individual age classes in both systems in Table 48.

Figure 18. Fork length frequency for Cutthroat Trout captured in the Chickwat Creek lower diversion and Tzoonie River in 2016.

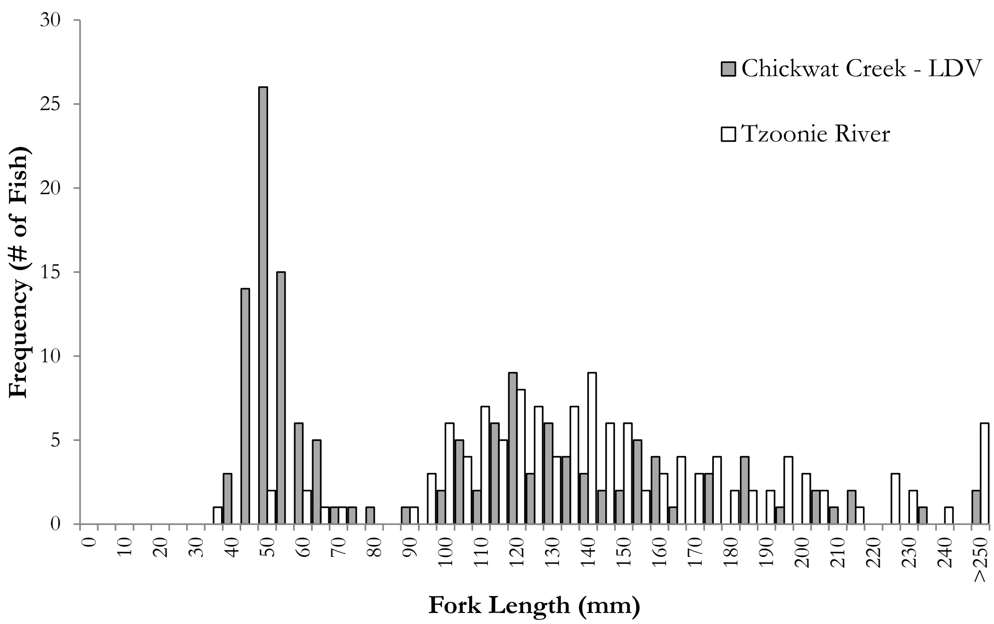


Figure 19. Length-weight regression for Cutthroat Trout captured in the Chickwat Creek lower diversion and Tzoonie River in 2016.

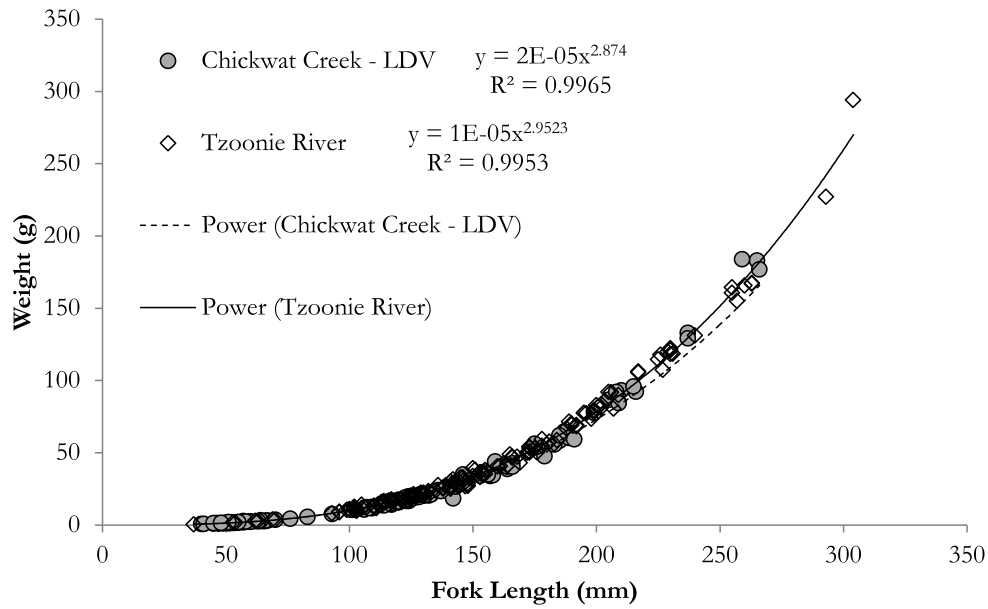


Figure 20. Length at age for Cutthroat Trout captured in the Chickwat Creek lower diversion and Tzoonie River in 2016.

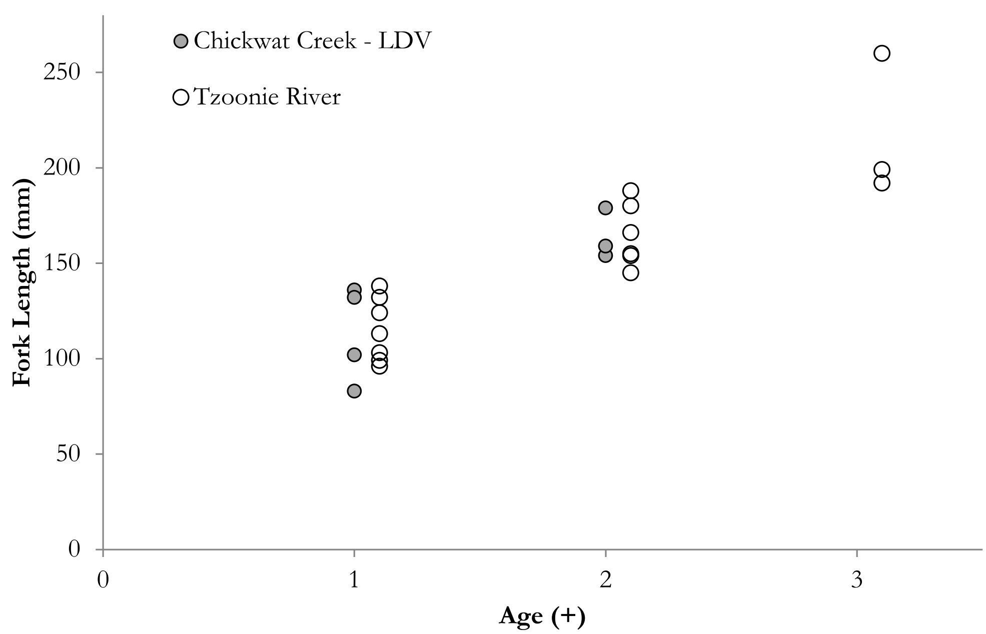


Table 47. Fork length range used to define age classes for Cutthroat Trout captured in the Chickwat Creek lower diversion and Tzoonie River in 2016.

Age Class	Fork Length Range (mm)	
	Chickwat Creek - LDV	Tzoonie River
Fry (0+)	40-93	37-93
Juv. (1+)	101-132	94-138
Juv. (2+)	133-166	139-161
Adult (≥3+)	≥167	≥162

Table 48. Summary of fork length, weight, condition and percent body fat for Cutthroat Trout captured in the Chickwat Creek lower diversion and Tzoonie River in 2016.

Waterbody	Age Class	Fork Length (mm)				Weight (g)				Condition Factor (K)				Body Fat (%)			
		n	Average	Min	Max	n	Average	Min	Max	n	Average	Min	Max	n	Average	Min	Max
Chickwat Creek - LDV	Fry (0+)	73	55	40	93	73	1.9	0.8	7.5	73	1.09	0.83	1.51	0	n/a	n/a	n/a
	Juv. (1+)	30	118	101	132	30	16.1	10.4	22.0	30	0.95	0.87	1.04	0	n/a	n/a	n/a
	Juv. (2+)	24	149	133	166	24	32.0	21.0	43.9	24	0.94	0.87	1.12	5	2.2	1.8	2.7
	Adult (≥3+)	16	206	175	265	16	89.6	47.6	183.9	16	0.97	0.83	1.06	11	1.4	1.3	1.7
	All	143	101	40	265	143	19.7	0.8	183.9	143	1.03	0.83	1.51	16	1.7	1.3	2.7
Tzoonie River	Fry (0+)	8	63	37	93	8	3.1	0.4	8.2	8	1.07	0.79	1.28	0	n/a	n/a	n/a
	Juv. (1+)	49	118	96	138	49	16.8	8.8	27.6	49	1.00	0.86	1.22	0	n/a	n/a	n/a
	Juv. (2+)	27	147	139	161	27	31.9	25.1	40.7	27	1.00	0.90	1.16	0	n/a	n/a	n/a
	Adult (≥3+)	40	205	164	304	40	93.4	41.0	294.0	40	0.99	0.89	1.09	31	1.8	1.2	2.6
	All	124	149	37	304	124	43.9	0.4	294.0	124	1.00	0.79	1.28	31	1.8	1.2	2.6

Rainbow Trout/steelhead

In 2016, 228 Rainbow Trout were captured and processed during baseline monitoring in the Chickwat Creek lower diversion, while none were captured in the Tzoonie River. The length-frequency distribution for these Rainbow Trout is presented in Figure 21. The length-weight relationship of these fish is presented in Figure 22. A total of 27 scale samples were collected, of which 12 were analysed. The length at age relationship of these fish is presented in Figure 23. Based on a review of this aging data and length-frequency histograms, discrete fork length ranges were defined for age classes 0+, 1+, 2+, and ≥3+ (Table 49). These discrete fork length ranges were then used to assign un-aged fish to an age class based on fork length, in order to summarize individual fish metrics and mark-recapture population estimates for specific age classes. A summary of fish length, weight, condition factor, and percent body fat are presented for individual age classes in Table 50.

Figure 21. Fork length frequency for Rainbow Trout captured in the Chickwat Creek lower diversion in 2016.

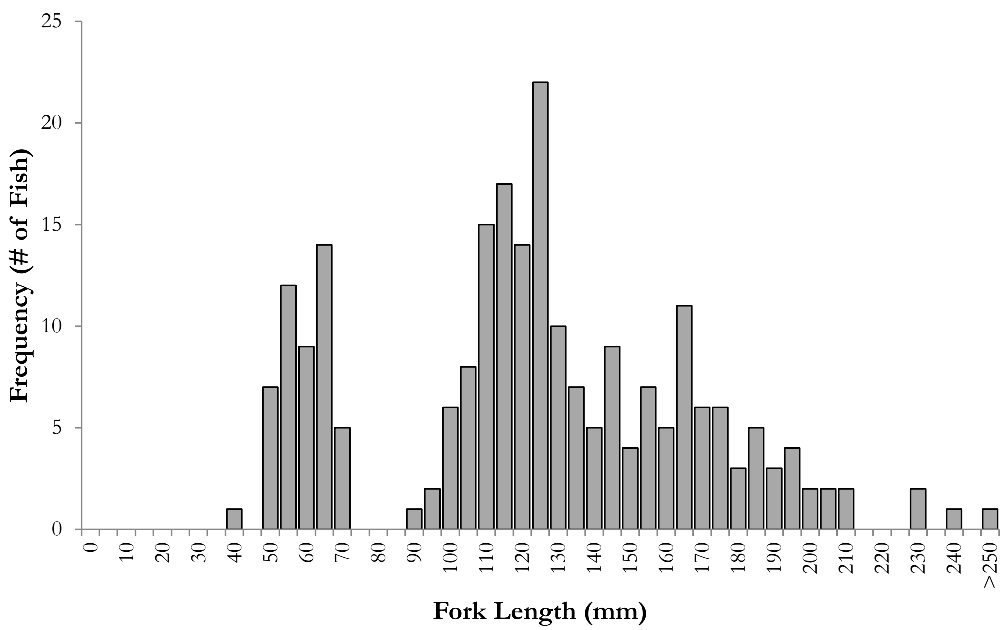


Figure 22. Length-weight regression for Rainbow Trout captured in the Chickwat Creek lower diversion in 2016.

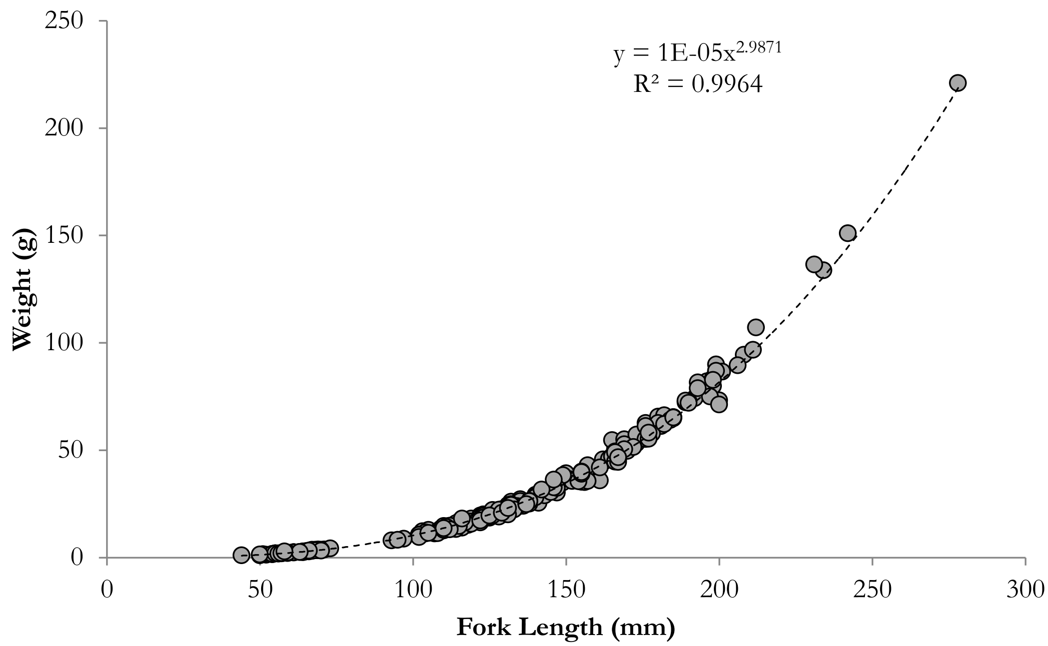


Figure 23. Length at age for Rainbow Trout captured in the Chickwat Creek lower diversion in 2016.

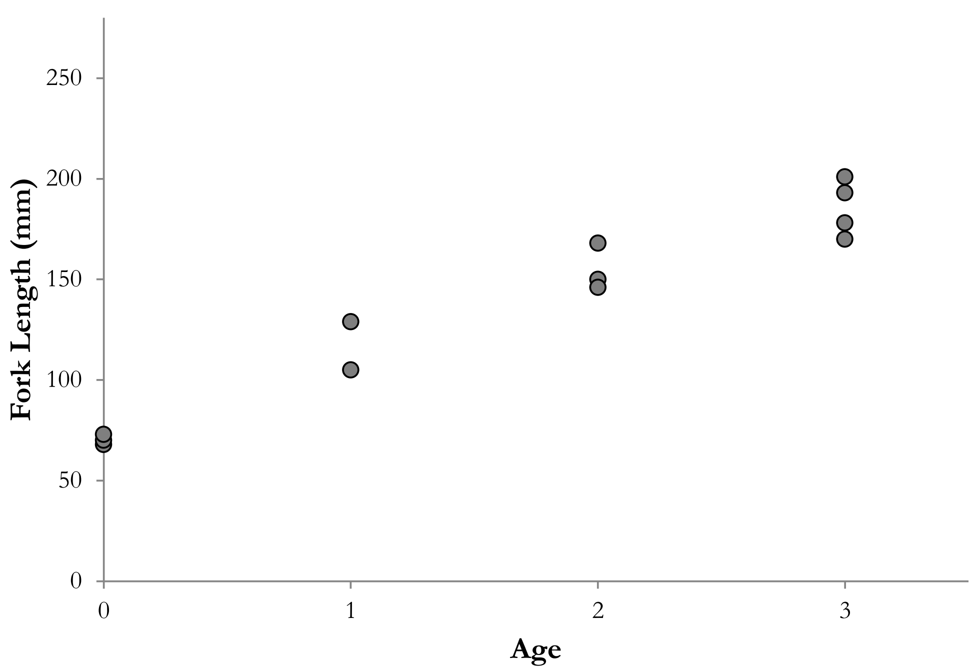


Table 49. Fork length range used to define age classes for Rainbow Trout captured in the Chickwat Creek lower diversion in 2016.

Age Class	Fork Length Range (mm
Fry (0+)	44-97
Juv. (1+)	98-135
Juv. (2+)	136-168
Adult (≥3+)	≥169

Table 50. Summary of fork length, weight, condition and percent fat for Rainbow Trout captured in the Chickwat Creek lower diversion in 2016.

Age Class	Fork Length (mm)				Weight (g)				Condition Factor (K)				Body Fat (%)			
	n	Average	Min	Max	n	Average	Min	Max	n	Average	Min	Max	n	Average	Min	Max
Fry (0+)	51	63	44	97	51	2.9	1.0	8.8	51	1.07	0.88	1.49	0	n/a	n/a	n/a
Juv. (1+)	94	120	102	135	94	17.5	9.5	27.2	94	1.01	0.90	1.17	2	1.7	1.7	1.7
Juv. (2+)	44	153	136	168	43	37.5	24.1	54.7	43	1.04	0.86	1.22	11	1.8	1.4	2.1
Adult (≥3+)	39	192	169	278	39	78.4	49.8	221.0	39	1.06	0.92	1.15	22	1.9	1.3	3.4
All	228	126	44	278	227	28.5	1.0	221.0	227	1.04	0.86	1.49	35	1.9	1.3	3.4

Dolly Varden

In 2016, three and eight Dolly Varden were captured and processed during baseline monitoring in the Chickwat Creek lower diversion and Tzoonie River, respectively. The length-frequency distributions for these fish are presented in Figure 24. The length-weight relationships of these fish are presented in Figure 25. Only five fin ray samples and three scale samples were collected from both waterbodies combined, considering that such low numbers would not adequately allow discrete fork length ranges to be defined, these samples were not processed, and instead, fork length ranges defined for Dolly Varden in the upper diversion and upstream reaches of Chickwat Creek in 2015 (Table 30) were used to assign ages to all individuals based on fork length, in order to summarize individual fish metrics and mark-recapture population estimates for specific age classes. A summary of fish length, weight, and condition factor are presented for individual age classes in both systems in Table 51.

Figure 24. Fork length frequency for Dolly Varden captured in the Chickwat Creek lower diversion and Tzoonie River in 2016.

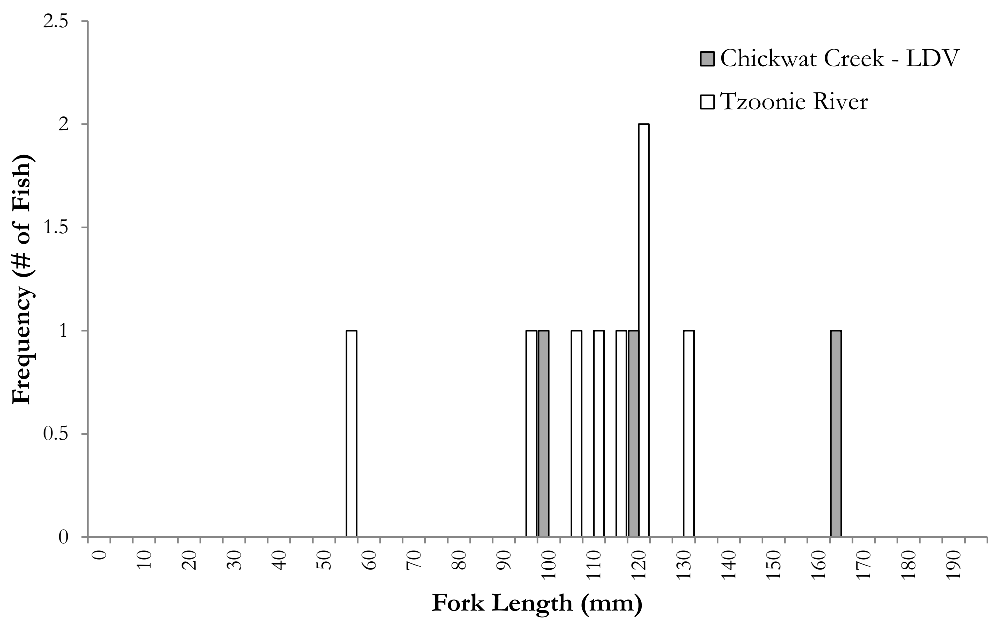


Figure 25. Length-weight regression for Dolly Varden captured in the Chickwat Creek lower diversion and Tzoonie River in 2016.

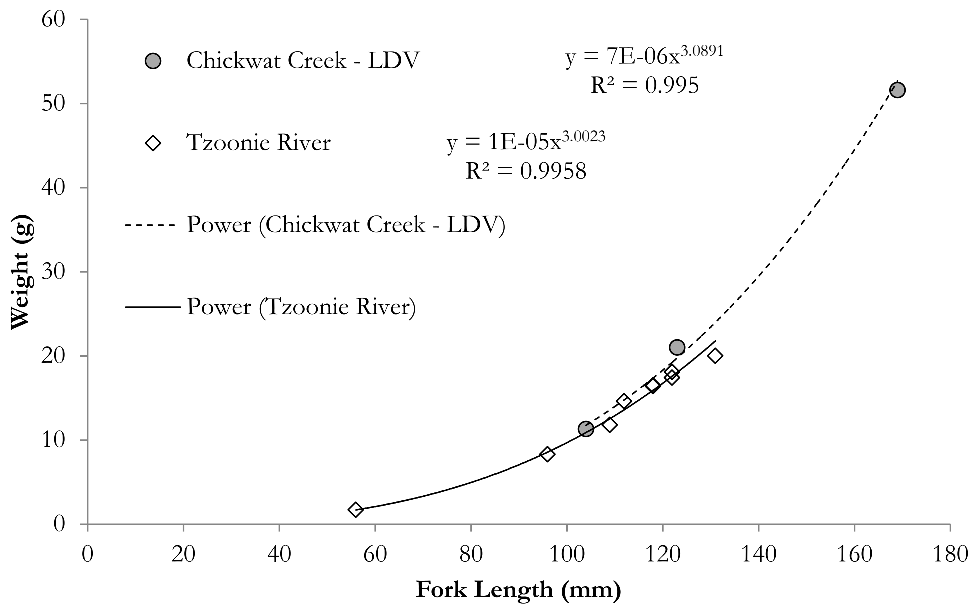


Table 51. Summary of fork length, weight, condition and percent fat for Dolly Varden captured in the Chickwat Creek lower diversion in 2016.

Waterbody	Age Class	Fork Length (mm)				Weight (g)				Condition Factor (K)			
		n	Average	Min	Max	n	Average	Min	Max	n	Average	Min	Max
Chickwat Creek - LDV	Fry (0+)	0	n/a	n/a	n/a	0	n/a	n/a	n/a	0	n/a	n/a	n/a
	Juv. (1+)	2	114	104	123	2	16.2	11.3	21.0	2	1.07	1.00	1.13
	Juv. (2+)	0	n/a	n/a	n/a	0	n/a	n/a	n/a	0	n/a	n/a	n/a
	Adult (≥3+)	1	169	169	169	1	51.6	51.6	51.6	1	1.07	1.07	1.07
	All	3	132	104	169	3	28.0	11.3	51.6	3	1.07	1.00	1.13
Tzoonie River	Fry (0+)	1	56	56	56	1	1.7	1.7	1.7	1	0.97	0.97	0.97
	Juv. (1+)	7	116	96	131	7	15.2	8.3	20.0	7	0.96	0.89	1.04
	Juv. (2+)	0	n/a	n/a	n/a	0	n/a	n/a	n/a	0	n/a	n/a	n/a
	Adult (≥3+)	0	n/a	n/a	n/a	0	n/a	n/a	n/a	0	n/a	n/a	n/a
	All	8	108	56	131	8	13.5	1.7	20.0	8	0.96	0.89	1.04

Coho Salmon

In 2016, 34 Coho Salmon fry were captured and processed during baseline monitoring in the Chickwat Creek lower diversion, while none were captured in the Tzoonie River. The length-frequency distribution for these fish is presented in Figure 26. The length-weight relationship of these fish is presented in Figure 27. No age samples were collected for these fish as they were all assumed to be 0+ fry. A summary of length, weight, and condition factor of these fish is presented in Table 52.

Figure 26. Fork length frequency for Coho fry captured in the Chickwat Creek lower diversion in 2016.

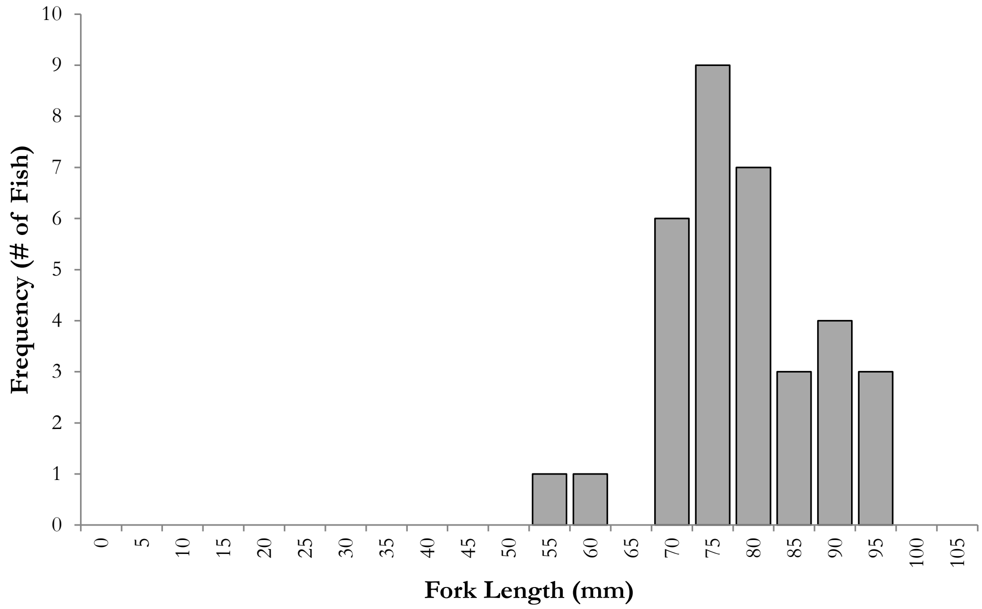


Figure 27. Length-weight regression for Coho fry captured in the Chickwat Creek lower diversion in 2016.

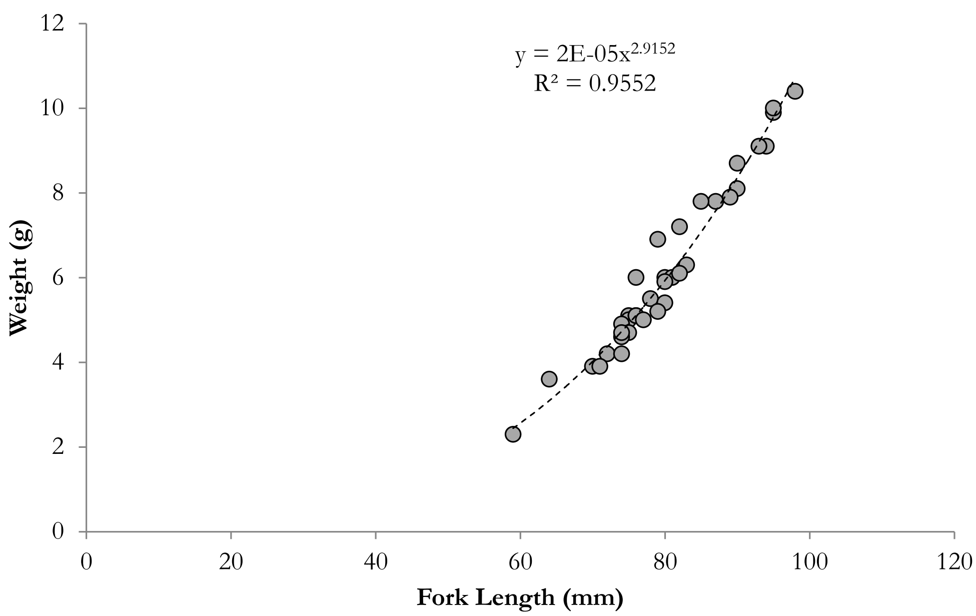


Table 52. Summary of fork length, weight, condition and percent fat for Coho fry captured in the Chickwat Creek lower diversion in 2016.

Age Class	Fork Length (mm)				Weight (g)				Condition Factor (K)			
	n	Average	Min	Max	n	Average	Min	Max	n	Average	Min	Max
Fry (0+)	34	80	59	98	34	6.3	2.3	10.4	34	1.17	1.04	1.40

Species Combined (AMP Metrics 2 and 4)

In 2016, 374 and 132 combined trout (Rainbow Trout, Cutthroat Trout, and Dolly Varden were captured and processed during baseline monitoring in the Chickwat Creek lower diversion and Tzoonie River, respectively. The length-frequency distribution for combined trout in each waterbody is presented in Figure 28. The length-weight and length at age relationships, as well as discrete fork length ranges are presented for each individual species above. These discrete fork length ranges for each species were used to assign un-aged fish to an age class based on fork length, in order to summarize individual fish metrics and mark-recapture population estimates for specific age classes of combined trout species. A summary of fish length, weight, condition factor, and percent body fat are presented for individual age classes in both systems in Table 53.

Figure 28. Fork length frequency for combined trout (Rainbow Trout, Cutthroat Trout, and Dolly Varden) captured in the Chickwat Creek lower diversion and Tzoonie River in 2016.

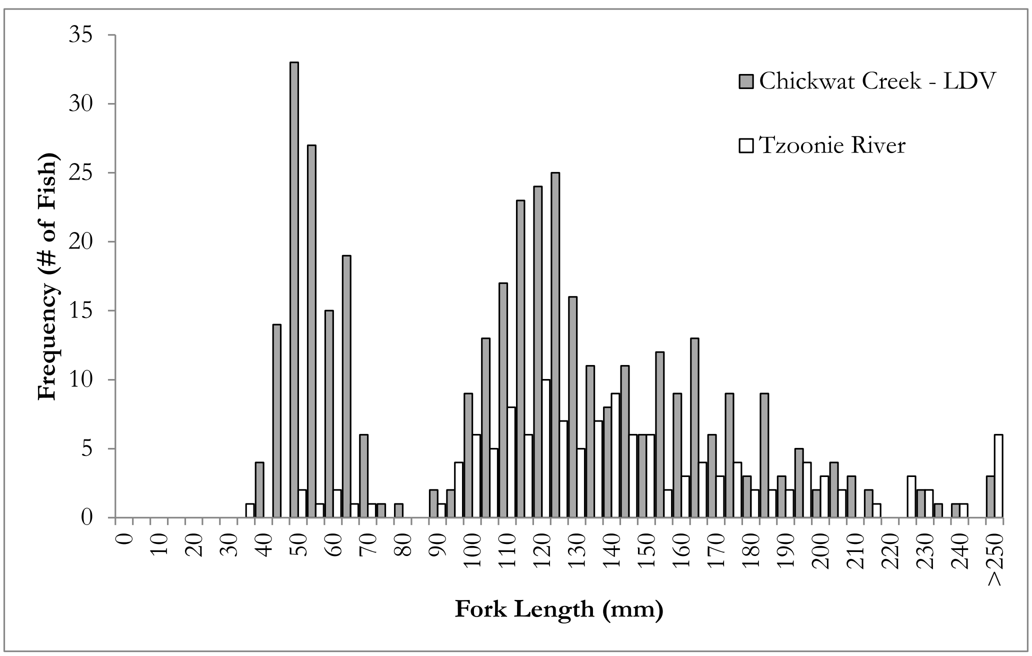


Table 53. Summary of fork length, weight, condition, and percent fat for combined trout (Rainbow Trout, Cutthroat Trout, and Dolly Varden) captured in the Chickwat Creek lower diversion and Tzoonie River in 2016. Juveniles (1-2+; AMP Metric 2) and adults (≥3+; AMP Metric 4) are highlighted.

Waterbody	Age Class	Fork Length (mm)				Weight (g)				Condition Factor (K)				Body Fat (%)			
		n	Average	Min	Max	n	Average	Min	Max	n	Average	Min	Max	n	Average	Min	Max
Chickwat Creek - LDV	Fry (0+)	124	58	40	97	124	2.3	0.8	8.8	124	1.08	0.83	1.51	0	n/a	n/a	n/a
	Juv. (1+)	126	119	101	135	126	17.2	9.5	27.2	126	1.00	0.87	1.17	2	1.7	1.7	1.7
	Juv. (2+)	68	152	133	168	67	35.5	21.0	54.7	67	1.00	0.86	1.22	16	1.9	1.4	2.7
Metric 2	Juv. (1-2+)	192	131	101	168	191	23.6	9.5	54.7	191	1.00	0.86	1.22	18	1.9	1.4	2.7
Metric 4	Adult (≥3+)	56	196	169	278	56	81.1	47.6	221.0	56	1.03	0.83	1.15	33	1.7	1.3	3.4
	Fish (≥1+)	247	145	101	278	246	36.6	9.5	221.0	246	1.01	0.83	1.22	51	1.8	1.3	3.4
	All Fish	374	116	40	278	373	25.1	0.8	221.0	373	1.03	0.83	1.51	51	1.8	1.3	3.4
Tzoonie River	Fry (0+)	9	62	37	93	9	3.0	0.4	8.2	9	1.05	0.79	1.28	0	n/a	n/a	n/a
	Juv. (1+)	56	118	96	138	56	16.6	8.3	27.6	56	1.00	0.86	1.22	0	n/a	n/a	n/a
	Juv. (2+)	27	147	139	161	27	31.9	25.1	40.7	27	1.00	0.90	1.16	0	n/a	n/a	n/a
Metric 2	Juv. (1-2+)	76	128	96	161	76	22.2	8.8	40.7	76	1.00	0.86	1.22	0	n/a	n/a	n/a
Metric 4	Adult (≥3+)	40	205	164	304	40	93.4	41.0	294.0	40	0.99	0.89	1.09	31	1.8	1.2	2.6
	Fish (≥1+)	116	155	96	304	116	46.7	8.8	294.0	116	1.00	0.86	1.22	31	1.8	1.2	2.6
	All Fish	132	146	37	304	132	42.1	0.4	294.0	132	1.00	0.79	1.28	31	1.8	1.2	2.6

4.4.2.4. Anadromous Spawner Surveys

Summaries of environmental conditions during snorkel surveys in the spring and fall are presented in Table 54 and Table 55, respectively. Water temperatures were highly variable within each season, ranging from 2.7°C to 13.0°C, and from 6.0°C to 10.0°C in Chickwat Creek and Tzoonie River, respectively during spring surveys, and from 1.9°C to 12.8°C, and 5.0°C to 11°C in Chickwat Creek and the Tzoonie River, respectively during fall surveys. Similarly, estimated visibility during spring and fall surveys also varied widely, ranging from 0.5 m to 9.0 m and from 2.0 m to 10.0 m in Chickwat Creek and the Tzoonie River, respectively in the spring, and from 1.5 m to 10.0 m and from 2.5 m to 10 m in Chickwat Creek and the Tzoonie River in the fall. Flows during surveys in Chickwat Creek ranged from 0.0 m^3/s to 19.6 m^3/s and 0.35 m^3/s to 62.4 m^3/s during surveys in the spring and fall, respectively. Flows during surveys in the Tzoonie River ranged from 11.7 m^3/s to 31.1 m^3/s.

Counts by size class and species of juvenile and adult fish observed during spring and fall anadromous spawner surveys are presented in Appendix J, and adult counts of each species are summarized in Table 56. Species observed include Cutthroat Trout, Rainbow Trout, Dolly Varden, Coho Salmon (fry and adults) and steelhead. The most commonly observed species in both seasons were Rainbow Trout, followed by Cutthroat Trout within the lower diversion and downstream reaches of Chickwat Creek and Tzoonie River, with counts being higher in the fall than in the spring. Rainbow Trout ranged from an average count of 16 ± 18 SD in the lower diversion and 7 ± 8 SD in the downstream of Chickwat Creek during spring counts, to 22 ± 23 SD and 16 ± 18 SD in the lower diversion and downstream reaches of Chickwat Creek, respectively during fall surveys. In contrast, none were observed at the Chickwat-Tzoonie confluence in the spring, while an average of 3 ± 2 SD were observed in the fall in this area, and an average of 3 and 23 Rainbow Trout were observed during individual snorkel surveys in the spring and fall, respectively within Tzoonie River reaches. Cutthroat Trout ranged from an average count of 4 ± 2 SD in the lower diversion and 1 ± 1 SD in the downstream of Chickwat Creek, and 2 ± 1 SD at the Chickwat-Tzoonie confluence during spring counts, to 5 ± 4 SD and 4 ± 4 SD in the lower diversion and downstream reaches of Chickwat Creek, respectively during fall surveys. Only two Cutthroat Trout have been observed at the Chickwat-Tzoonie confluence in the fall. Counts were more variable in the Tzoonie River reaches, with an average of 3 and 15 Cutthroat Trout observed during individual snorkel surveys in the spring and fall. In contrast to Rainbow and Cutthroat Trout, over all years of surveys, only 28 and three adult Dolly Varden were observed in these reaches of Chickwat Creek and in the Tzoonie River, respectively, of which only 15 and two sightings occurred in the fall. On average, only zero to one Dolly Varden were observed during a given survey in either season or reach of Chickwat Creek, with the highest count in a single survey being four individuals. Dolly Varden were particularly rare in the Tzoonie River, with no more than one individual ever observed in a given snorkel survey. Over all surveys, only two and four steelhead were observed in the spring within the downstream reach of Chickwat Creek and within the Tzoonie River, respectively. No adult steelhead have been observed in the lower diversion reach of Chickwat Creek. Few Coho Salmon were observed in the lower diversion or downstream reaches of Chickwat Creek during snorkel surveys (i.e., zero to one on average, and a maximum of 11 during a given survey). In contrast Coho Salmon were observed in relatively high numbers within the fall in Tzoonie River sites, ranging from an average count of 7 ± 9 SD to 20 ± 19 SD during a given survey.

To examine the utility of these snorkel data for use in the AMP we specifically examined the adult steelhead/Rainbow Trout counts (Metric 3; Table 57). Average counts were higher in the fall than in the spring, and highest in the Tzoonie River AMP control reach and Chickwat Creek lower diversion, moderate in the Chickwat Creek downstream reach, and lowest at the confluence of Chickwat Creek and the Tzoonie River. In Chickwat Creek, counts ranged from an average of 16 ± 18 SD and 7 ± 8 SD in the lower diversion and downstream reaches, respectively in the spring, to 22 ± 23 SD and 16 ± 18 SD in the lower diversion and downstream reaches, respectively in the fall. Counts were much lower on average at the Chickwat-Tzoonie confluence in both seasons at an average of 1 ± 1 SD and 3 ± 2 SD in the spring and fall, respectively. Similarly, counts were lower on average in the spring within the Tzoonie River reaches, averaging only three individuals observed during a given survey, but much higher during the fall, averaging 31 individuals observed during a given survey. All species combined adult counts (Metric 4; Table 58) were similar to those for steelhead/Rainbow trout with counts being higher during fall surveys than during spring surveys, and the highest counts in the Tzoonie River AMP Control reach and Chickwat Creek lower diversion. In Chickwat Creek, counts ranged from an average of 10 ± 15 SD and 5 ± 7 SD in the lower diversion and downstream reaches, respectively in the spring, to 12 ± 19 SD and 7 ± 14 SD in the lower diversion and downstream reaches, respectively in the fall. Counts were only 1 ± 1 SD and 7 ± 7 SD on average at the Chickwat-Tzoonie confluence in the spring and fall, respectively. Counts were similarly low in the spring within the Tzoonie River reaches, averaging only two individuals observed during a given survey, and again, much higher during the fall, averaging 16 individuals observed during a given survey. These adult snorkel counts show high variability, which limit statistical power to detect a Project related effect. Therefore, we propose to focus on the mark-recapture based adult abundance estimates for monitoring of the AMP.

Table 54. Environmental Conditions during spring daytime anadromous snorkel surveys conducted between 2013, 2015, and 2016.

Year	Waterbody	Date	Water Temp. (ºC)[1]	Estimated Visibility (m)[1]	Flow (m^3/s)
2013	Chickwat Creek	25-Mar-13	4.0	6.0	1.69
		11-Apr-13	4.0	6.0	7.51
		18-Apr-13	5.0	9.0	2.64
		24-Apr-13	3.5	6.0	3.73
		3-May-13	4.0	4.0	4.21
		10-May-13	5.0	4.0	19.60
		17-May-13	6.0	7.0	9.82
		28-May-13	6.5	6.0	13.64
		3-Jun-13	6.0	8.0	10.27
		12-Jun-13	7.0	7.0	6.76
2015	Chickwat Creek	2-Apr-15	2.7	7.0	3.14
		2-May-15	6.9	6.0	3.59
		22-May-15	10.5	4.0	5.84
		29-May-15	11.0	-	3.95
		4-Jun-15	10.5	2.5	3.29
		12-Jun-15	11.5	4.0	1.59
		18-Jun-15	12.0	4.0	1.13
		25-Jun-15	13.0	6.0	0.92
2016	Chickwat Creek	22-Mar-16	5.0	-	4.15
		6-Apr-16	5.0	1.0	5.52
		20-Apr-16	6.0	0.5	7.37
		5-May-16	7.0	2.0	0.00
		18-May-16	9.0	8.0	5.93
		1-Jun-16	9.0	7.0	4.92
		15-Jun-16	8.1	-	3.36
	Tzoonie River	22-Mar-16	6.0	6.0	11.69
		6-Apr-16	7.5	2.0	15.34
		20-Apr-16	8.0	2.0	31.12
		6-May-16	9.0	4.0	-
		18-May-16	9.0	10.0	20.08
		1-Jun-16	10.0	10.0	14.99
		15-Jun-16	9.0	-	14.78

[1] "-" = data not available

Table 55. Environmental Conditions during fall daytime anadromous snorkel surveys conducted in 2011, and 2013 – 2016.

Year	Waterbody	Date	Water Temp. (°C)[1]	Estimated Visibility (m)[1]	Flow (m^3/s)
2011	Chickwat Creek	7-Sep-11	12.8	5.0	1.81
		9-Sep-11	-	7.0	1.82
		13-Sep-11	-	5.0	1.71
		19-Sep-11	-	7.0	1.97
		30-Sep-11	8.0	6.0	2.45
		7-Oct-11	-	5.0	2.69
		17-Oct-11	8.0	5.0	1.62
		27-Oct-11	5.6	8.0	1.85
		4-Nov-11	-	8.0	1.72
		20-Nov-11	-	8.0	1.32
		8-Dec-11	2.1	8.0	1.29
2014	Chickwat Creek	15-Sep-14	12.0	8.0	0.35
		30-Sep-14	12.0	4.5	1.81
		6-Oct-14	9.5	6.0	1.27
		16-Oct-14	10.5	8.0	4.78
		8-Nov-14	6.5	6.0	5.98
		25-Nov-14	5.0	7.0	5.27
		3-Dec-14	1.9	8.0	2.05
		17-Dec-14	4.0	8.0	2.56
2016	Chickwat Creek	2-Sep-16	12.5	8.0	2.49
		15-Sep-16	12.0	8.0	0.53
		29-Sep-16	9.5	6.0	0.89
		12-Oct-16	7.0	6.0	1.38
		26-Oct-16	7.8	-	6.00
		18-Nov-16	4.5	1.5	2.41
		30-Nov-16	5.0	10.0	2.09
		20-Dec-16	2.0	10.0	1.03
	Tzoonie River	2-Sep-16	11.5	6.0	10.68
		15-Sep-16	11.5	8.0	4.11
		30-Sep-16	9.0	6.0	6.00
		12-Oct-16	9.0	6.0	9.55
		26-Oct-16	8.0	-	21.82
		18-Nov-16	6.5	2.5	11.81
		1-Dec-16	7.0	-	9.34
		20-Dec-16	5.0	10.0	3.86

[1] "-" = data not available

Table 56. Summary by species, season, and reach of adults and spawners observed during snorkel surveys in Chickwat Creek and the Tzoonie River between 2011 and 2016.

Species[1]	Waterbody	Season	Reach	Surveys (n)	Spawner Count Total	Average	SD	Min	Max
CT	Chickwat Creek	Spring	Lower Diversion	25	32	3.6	2.1	1	7
			Downstream	25	28	1.3	1.2	0	6
		Fall	Lower Diversion	27	54	4.5	3.7	0	13
			Downstream	27	126	3.7	3.7	0	18
	Tzoonie River	Spring	Chickwat Confluence	24	2	1.0	0.0	1	1
			AMP Control	7	20	3.3	3.0	0	7
			Tyson Confluence	7	13	2.6	3.4	0	8
		Fall	Chickwat Confluence	25	161	7.3	6.7	1	22
			AMP Control	9	218	21.8	13.5	2	40
			Tyson Confluence	7	53	7.6	3.0	4	12
RB	Chickwat Creek	Spring	Lower Diversion	25	393	15.7	17.8	0	86
			Downstream	25	369	7.4	8.3	0	42
		Fall	Lower Diversion	27	791	22.0	22.9	0	70
			Downstream	27	1,076	16.3	18.2	0	101
	Tzoonie River	Spring	Chickwat Confluence	24	0	0.0	0.0	0	0
			AMP Control	7	14	3.5	1.7	1	5
			Tyson Confluence	7	8	2.7	3.8	0	7
		Fall	Chickwat Confluence	25	23	2.9	1.8	1	6
			AMP Control	9	274	39.1	52.7	2	126
			Tyson Confluence	7	31	7.8	9.7	0	22
ST	Chickwat Creek	Spring	Lower Diversion	25	0	0.0	0.0	0	0
			Downstream	25	2	0.7	0.6	0	1
		Fall	Lower Diversion	27	0	0.0	0.0	0	0
			Downstream	27	0	0.0	0.0	0	0
	Tzoonie River	Spring	Chickwat Confluence	24	4	1.0	0.0	1	1
			AMP Control	7	0	0.0	0.0	0	0
			Tyson Confluence	7	0	0.0	0.0	0	0
		Fall	Chickwat Confluence	25	0	0.0	0.0	0	0
			AMP Control	9	0	0.0	0.0	0	0
			Tyson Confluence	7	0	0.0	0.0	0	0
DV	Chickwat Creek	Spring	Lower Diversion	25	10	1.1	1.5	0	4
			Downstream	25	3	0.6	0.9	0	2
		Fall	Lower Diversion	27	7	0.6	0.8	0	2
			Downstream	27	8	0.4	1.0	0	4
	Tzoonie River	Spring	Chickwat Confluence	24	0	0.0	0.0	0	0
			AMP Control	7	0	0.0	0.0	0	0
			Tyson Confluence	7	1	1.0	0.0	1	1
		Fall	Chickwat Confluence	25	0	0.0	0.0	0	0
			AMP Control	9	0	0.0	0.0	0	0
			Tyson Confluence	7	2	1.0	0.0	1	1
CO	Chickwat Creek	Spring	Lower Diversion	25	0	0.0	0.0	0	0
			Downstream	25	0	0.0	0.0	0	0
		Fall	Lower Diversion	27	4	0.4	0.7	0	2
			Downstream	27	36	0.7	2.0	0	11
	Tzoonie River	Spring	Chickwat Confluence	24	0	0.0	0.0	0	0
			AMP Control	7	0	0.0	0.0	0	0
			Tyson Confluence	7	0	0.0	0.0	0	0
		Fall	Chickwat Confluence	25	188	9.0	9.0	0	27
			AMP Control	9	59	6.6	9.3	0	28
			Tyson Confluence	7	156	19.5	19.3	0	45

[1] CT = Cutthroat Trout, RB = Rainbow Trout, ST = Steelhead, DV = Dolly Varden, CO = Coho Salmon.

Table 57. Summary by season, and reach of adult steelhead/Rainbow Trout observed during snorkel surveys in Chickwat Creek and the Tzoonie River between 2011 and 2016.

Waterbody	Season	Reach	Surveys (n)	Spawner Count				
				Totals	Average	SD	Min	Max
Chickwat Creek	Spring	Lower Diversion	25	393	15.7	17.8	0	86
		Downstream	25	371	7.0	8.2	0	42
	Fall	Lower Diversion	27	791	22.0	22.9	0	70
		Downstream	27	1,076	16.3	18.2	0	101
Tzoonie River	Spring	Chickwat Confluence	24	4	0.7	0.5	0	1
		AMP Control	7	14	3.5	1.7	1	5
		Tyson Confluence	7	8	2.7	3.8	0	7
	Fall	Chickwat Confluence	25	23	2.9	1.8	1	6
		AMP Control	9	274	39.1	52.7	2	126
		Tyson Confluence	7	31	7.8	9.7	0	22

Table 58. Summary by season, and reach of adult salmonids (Cutthroat Trout, Rainbow Trout, steelhead, Dolly Varden, and Coho Salmon combined) observed during snorkel surveys in Chickwat Creek and the Tzoonie River between 2011 and 2016.

Waterbody	Season	Reach	Surveys (n)	Spawner Count				
				Total	Average	SD	Min	Max
Chickwat Creek	Spring	Lower Diversion	25	435	10.1	15.1	0	86
		Downstream	25	402	4.5	7.0	0	42
	Fall	Lower Diversion	27	856	12.2	19.3	0	70
		Downstream	27	1,247	7.3	13.5	0	101
Tzoonie River	Spring	Chickwat Confluence	24	6	0.4	0.5	0	1
		AMP Control	7	34	2.1	2.6	0	7
		Tyson Confluence	7	22	2.4	3.1	0	8
	Fall	Chickwat Confluence	25	381	7.2	7.4	0	27
		AMP Control	9	551	21.2	30.4	0	126
		Tyson Confluence	7	242	11.5	13.9	0	45

4.5. Invertebrate Drift

The mean invertebrate drift density (#/m^3), biomass (mg/m^3), Simpson's family-level diversity index (1-λ), richness (# families), and CEFI index at each site on each sample date are provided in Table 59, along with the standard deviations and coefficients of variation. The means and standard deviations for each of these parameters are plotted in Figure 29, Figure 30, Figure 31, Figure 32, and

Figure 33, respectively. In all cases other than CEFI (where only aquatic taxa are considered), the results are for all taxa (aquatic, semi-aquatic, and terrestrial).

4.5.1. Density

Over the course of baseline monitoring, the invertebrate drift density was variable within all sites for both sampling periods (i.e., in September and November), with the coefficient of variation ranging from 15.11% to 45.49% (Table 59). Invertebrate drift density was generally higher in September than November (Figure 29). The highest mean density was observed at the downstream site (CHK-DSIV) on September 16, 2014 (3.27 ± 0.98 individuals/m³); the lowest mean density was observed at the downstream site on November 11, 2015 (0.55 ± 0.25 individuals/m³).

4.5.2. Biomass

Similar to density, the invertebrate drift biomass was also highly variable. Considering all data, the coefficient of variation ranged from 16.75% to 58.75% (Table 59). Over the course of monitoring, the highest mean biomass was observed at the upstream site (CHK-USIV) on September 16, 2014 (0.51 ± 0.27 mg/m³). The lowest mean biomass was observed at the downstream site on November 11, 2015 (0.046 ± 0.025 mg/m³). Visual inspection does not show consistent differences in biomass between sites, although biomass was typically lowest at the downstream site (Figure 30).

4.5.3.Simpson's Family Level Diversity (1- λ)

Compared to density and biomass, the Simson's diversity index (1- λ, family level data) showed relatively low variability, with the coefficient of variation ranging from 1.58% to 38.27% (Table 59). The diversity index was consistent across sites and sample dates with the exception of all samples on September 16, 2014 (Figure 31). The low diversity on this sample date is a result of high relative abundances of certain taxa (Baetidae (mayflies) in the upstream and diversion reach, Chironomidae (chironomids) in the downstream reach) coupled with a relatively low richness. Over the course of monitoring, the highest mean diversity was 0.92 ± 0.014 at the downstream site on September 28, 2015, while the lowest mean diversity was 0.20 ± 0.077 at the downstream site on September 16, 2014.

4.5.4.Richness (# of families)

Compared to density and biomass, richness (# of families) also showed relatively low variability, with the coefficient of variation ranging from 4.7% to 55.2% (Table 59). Similar to diversity results, richness was generally consistent across sites and sample dates with the exception of relatively low richness at the diversion and downstream sites on September 16, 2014 (Figure 32). Over the course of sampling, the highest mean richness was observed at the downstream site on November 2, 2014 (44.2 ± 2.1), while the lowest mean richness was observed at the downstream site on September 16, 2015 (18.8 ± 5.4).

4.5.5. Canadian Ecological Flow Index (CEFI)

Compared to all other parameters, CEFI showed the lowest variability, with the coefficient of variation ranging from 0.47% to 2.75% (Table 59). Generally, on a given sample date CEFI values were highest at the upstream site, and lowest at the downstream site (Figure 33). Over the course of sampling, the highest CEFI was observed at the upstream site on September 16, 2014 (0.42 ± 0.0069). The lowest CEFI was observed at the downstream site on September 16, 2014 (0.33 ± 0.0048).

Table 59. Mean density (#/m³), biomass (mg/ m³), Simpson's diversity index (1-λ, family level), richness (# families), and CEFI Index for invertebrate drift.

Year	Reach	Site	Date	# of Nets	Density (#/m³)			Biomass (mg/m³)			Simspon's Diversity Index (1-λ)			Richness (# of Families)			CEFI Index†		
					Mean	S.D.	C.V. (%)	Mean	S.D.	C.V. (%)	Mean	S.D.	C.V. (%)	Mean	S.D.	C.V. (%)	Mean	S.D.	C.V. (%)
2014	Upstream	CHK-USIV	16-Sep-2014	5	2.30	0.69	29.85	0.51	0.27	53.04	0.54	0.17	32.04	24.0	13.2	55.0	0.42	0.0069	1.65
			2-Nov-2014	5	1.41	0.33	23.40	0.12	0.073	58.75	0.86	0.023	2.69	41.8	3.3	7.8	0.36	0.0071	1.99
	Diversion	CHK-DVIV	16-Sep-2014	5	3.17	1.10	34.79	0.28	0.11	36.98	0.70	0.053	7.57	36.0	9.8	27.1	0.41	0.0045	1.09
			2-Nov-2014	5	1.38	0.43	30.91	0.079	0.030	37.56	0.87	0.023	2.68	36.4	5.5	15.1	0.37	0.0062	1.69
	Downstream	CHK-DSIV	16-Sep-2014	5	3.27	0.98	30.06	0.064	0.023	36.31	0.20	0.077	38.27	18.8	5.4	29.0	0.33	0.0048	1.46
			2-Nov-2014	5	1.27	0.32	25.50	0.076	0.017	22.84	0.88	0.018	2.06	44.2	2.3	5.2	0.35	0.0017	0.47
2015	Upstream	CHK-USIV	28-Sep-2015	5	1.61	0.71	44.45	0.18	0.031	16.75	0.82	0.034	4.11	38.4	3.6	9.5	0.38	0.0072	1.87
			11-Nov-2015	5	0.72	0.11	15.11	0.050	0.009	18.75	0.90	0.016	1.74	35.4	1.7	4.7	0.40	0.0062	1.55
	Diversion	CHK-DVIV	28-Sep-2015	5	1.49	0.41	27.85	0.20	0.060	29.28	0.80	0.081	10.10	33.4	4.9	14.6	0.39	0.0082	2.13
			11-Nov-2015	5	1.10	0.39	35.98	0.10	0.046	45.14	0.89	0.018	2.03	39.2	4.2	10.7	0.40	0.011	2.75
	Downstream	CHK-DSIV	28-Sep-2015	5	0.87	0.39	45.29	0.073	0.024	32.63	0.92	0.014	1.58	40.8	5.0	12.2	0.36	0.0048	1.32
			11-Nov-2015	5	0.55	0.25	45.49	0.046	0.025	54.95	0.89	0.015	1.72	35.8	5.2	14.4	0.38	0.0076	2.00

All Taxa (Aquatic, Semi-Aquatic, and Terrestrial)

† Calculation considers only aquatic taxa

Figure 29. Mean invertebrate drift density (#/m³) ± SD.

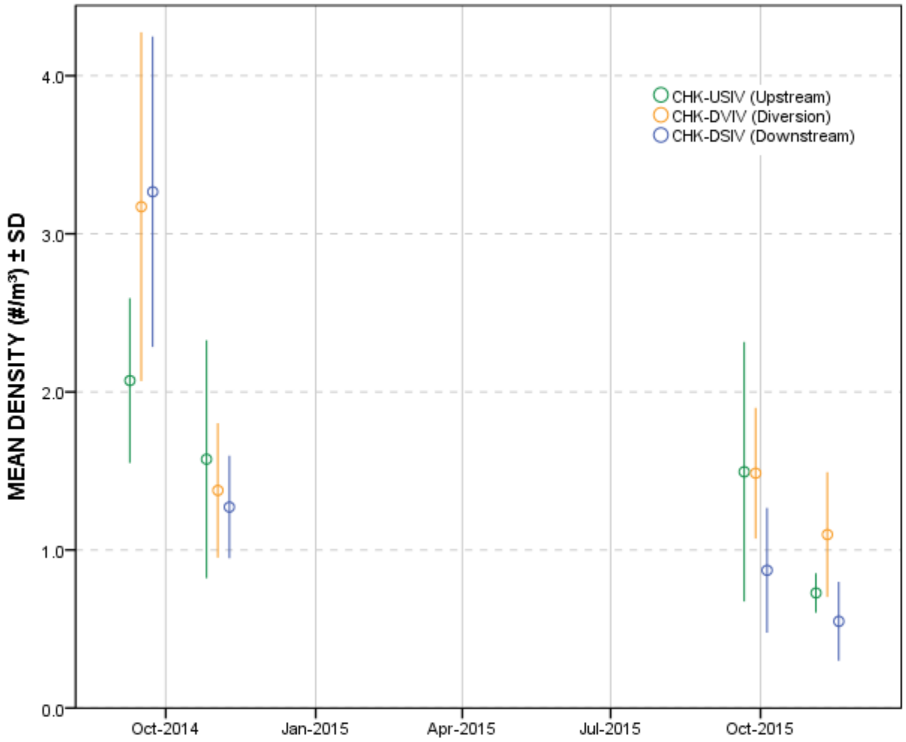


Figure 30. Mean invertebrate drift biomass (mg/m³) ± SD.

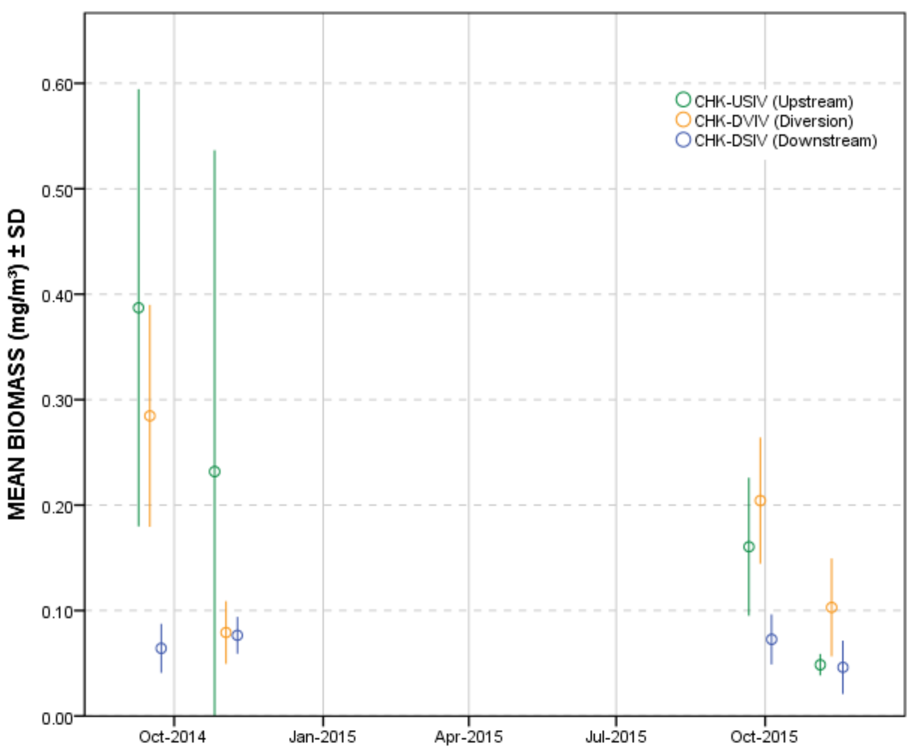


Figure 31. Mean family level Simpson's diversity index (1-λ) ± SD.

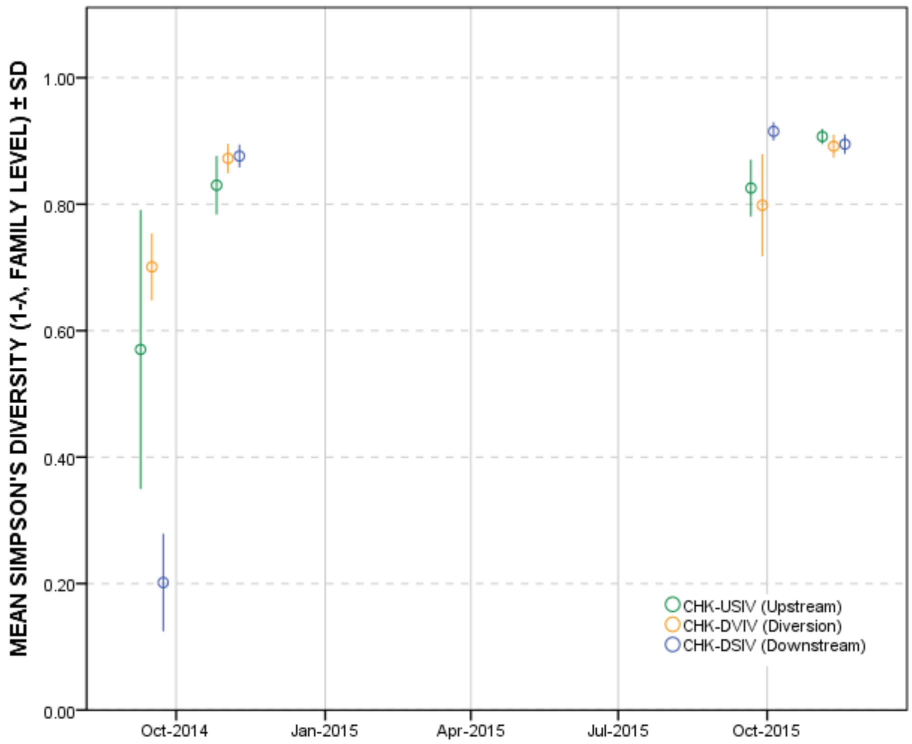


Figure 32. Mean family richness (# of families) ± SD.

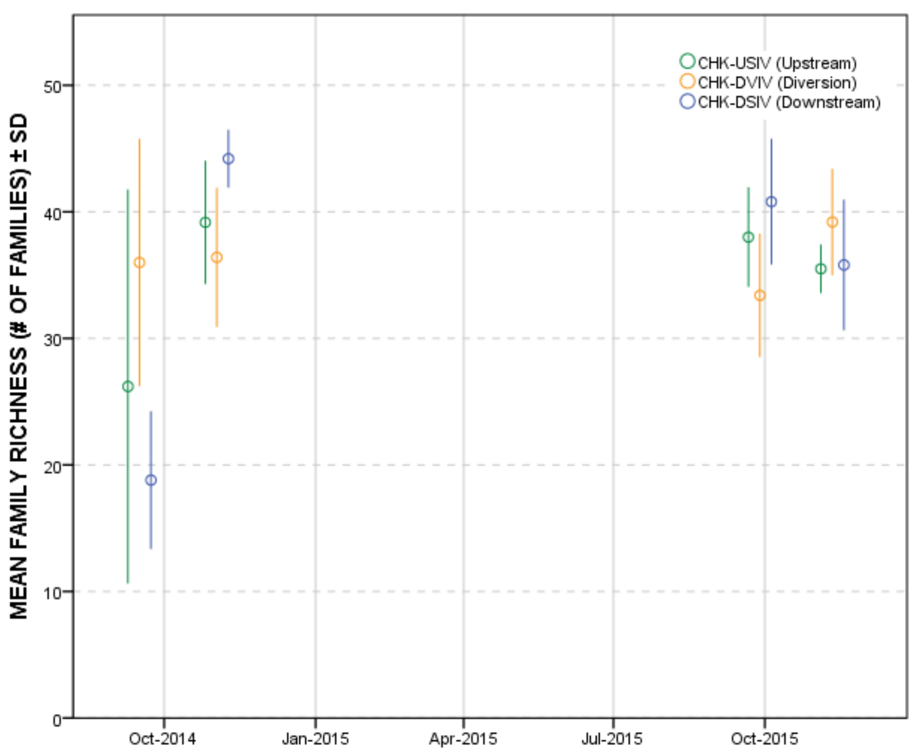
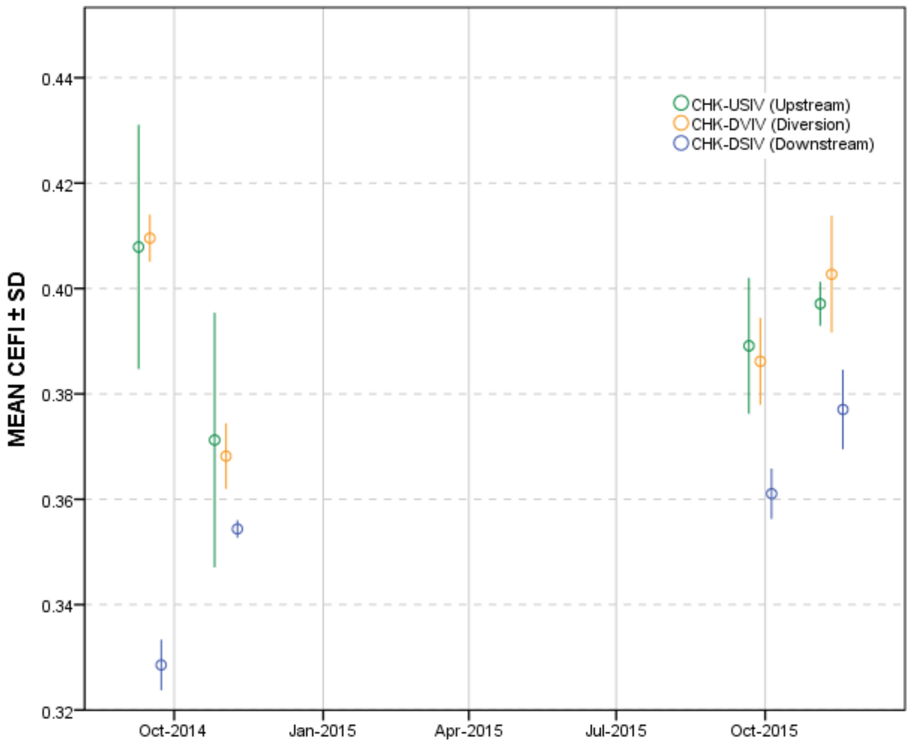


Figure 33. Mean Canadian Ecological Flow Index (CEFI) ± SD.



4.5.6. Top Five Families (% of Biomass)

A summary of the top five families in the invertebrate drift community at each sample site on each sample date is provided in Table 60. Generally, during the late summer, biomass was dominated by one or two families at a given site on a given date, while during the fall, biomass was more evenly distributed across a number of taxa. The dominant families contributing to biomass differed slightly between seasons; however, many of the dominant families were present in both late summer and fall.Changes in dominant taxa between seasons include the reduction of butterflies/moths (Lepidoptera) from late summer (5 instances) to fall (1 instance), the reduction of mites (Trombidiidae and Hydryphantidae) from late summer (2 instances) to fall (0 instances), the reduction of true files (notably Tachinidae, Tipulidae, and Muscidae) from late summer (6 instances) to fall (4 instances), the increase in Spiders (Araneae) from late summer (0 instances) to fall (5 instances), and the increase in Caddisflies (Rhyacophilidae, Limnephilidae and Lepidostomatidae) from late summer (1 instance) to fall (5 instances).

At the upstream site (CHK-USIV), mayflies (Baetidae and Heptageniidae) were consistently among the top five families contributing to biomass. Butterflies/moths (Lepidoptera, Geometridae, and Notodonidae) were frequently among the top five families contributing to biomass, while Beetles (Mycetophagidae and Curculionidae) and spiders (Dolomedes) were occasionally among the top five contributors to biomass.

At the diversion site (CHK-DVIV), mayflies (Baetidae, Heptageniidae, Ephemerellidae, and Ameletidae) were consistently among the top five contributors to biomass. True Flies (Chironomidae, Tachinidae, and Tipulidae) were frequently among the top five contributors to biomass, while Beetles (Dytiscidae and Cantharidae) were occasionally among the top five contributors to biomass.

At the downstream site (CHK-DSIV) True Flies (Chironomidae, Muscidae, and Mycetophilidae) were consistently among the top five contributors to biomass, Mayflies (Baetidae, Ephemeroptera, and Ameletidae) were frequently among the top five contributors to biomass. Caddisflies (Limnephilidae and Rhyacophilidae) and stoneflies (Plecoptera and Capniidae) were occasionally among the top five contributors to biomass.

Table 60. Top five families contributing to invertebrate drift biomass.

Year	Late Summer						Fall					
	Upstream		Diversion		Downstream		Upstream		Diversion		Downstream	
	Family	% of Total Biomass	Family	% of Total Biomass	Family	% of Total Biomass	Family	% of Total Biomass	Family	% of Total Biomass	Family	% of Total Biomass
2014	Mycetophagidae	50.0	Baetidae	39.5	Chironomidae	69.8	Notodontidae	22.9	Limnephilidae	13.6	Limnephilidae	17.0
	Baetidae	14.3	Geometridae	10.1	Baetidae	8.5	Limnephilidae	14.7	Dytiscidae	10.7	Chironomidae	9.7
	Lepidoptera	10.8	Psocoptera	9.7	Muscidae	4.9	Dolomedes	7.7	Heptageniidae	10.0	Rhyacophilidae	7.1
	Formicidae	6.9	Tachinidae	5.2	Plecoptera	2.7	Baetidae	6.5	Chironomidae	6.5	Mycetophilidae	5.7
	Geometridae	3.7	Tipulidae	2.9	Ephemeroptera	1.8	Heptageniidae	6.1	Baetidae	5.9	Lumbriculidae	5.1
2015	Baetidae	57.7	Baetidae	66.5	Baetidae	33.6	Ameletidae	14.7	Dolomedes	10.9	Chironomidae	14.5
	Geometridae	5.0	Trombidiidae	3.0	Staphylinidae	10.1	Heptageniidae	14.1	Ameletidae	9.6	Dolomedes	8.7
	Lepidoptera	3.8	Ephemerellidae	2.4	Hydryphantidae	7.3	Nemouridae	7.1	Cercopidae	7.5	Lepidostomatidae	6.8
	Curculionidae	3.0	Chironomidae	2.0	Chironomidae	6.5	Baetidae	6.3	Araneae	7.5	Ameletidae	6.5
	Heptageniidae	2.5	Heptageniidae	2.0	Rhyacophilidae	4.2	Dolomedes	6.0	Cantharidae	7.4	Capniidae	6.3

Legend

Mayflies	True Flies	Caddisflies	Butterfly/Moth	Spiders	Beetles	Mites	Aquatic Worms	Ants	Stoneflies	Barklice	True Bugs

4.5.7. Multivariate Analysis

The drift invertebrate community composition differed most strongly by sample collection date with the communities from individual reaches clustering together (Figure 34, Figure 35). The invertebrate community sampled in September 2014 diverged from the communities sampled in November 2014 and September and November 2015. Across reaches on a given sample date, the downstream site diverged the most from the other two sites and this was significant on two occasions (both days in 2014). Overall, the invertebrate drift communities at Chickwat Creek appear to be primarily driven by the date of sampling with relatively similar communities observed across reaches.

Figure 34. Hierarchical clustering dendrogram of invertebrate drift density, based on a Bray-Curtis (S17) matrix of similarity among sites. Black lines indicate dissimilar community composition at a 5% significance level, while pale red lines denote groups that are not significantly different in their community composition (SIMPROF tests).

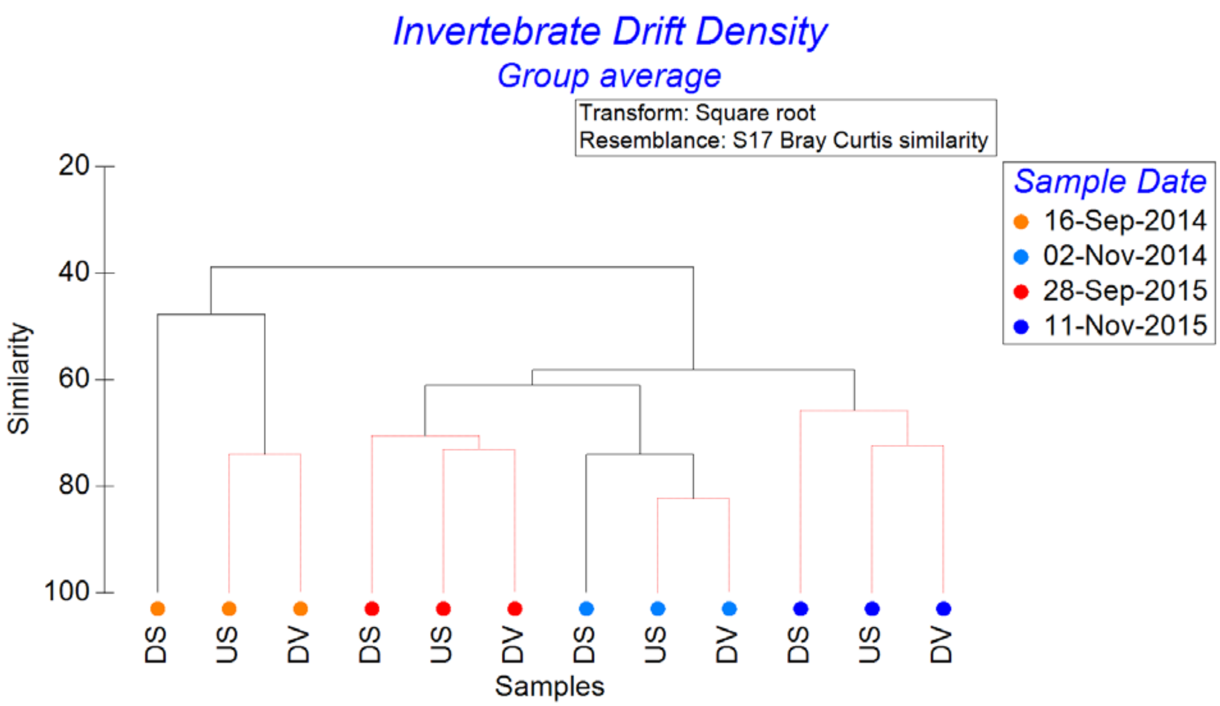
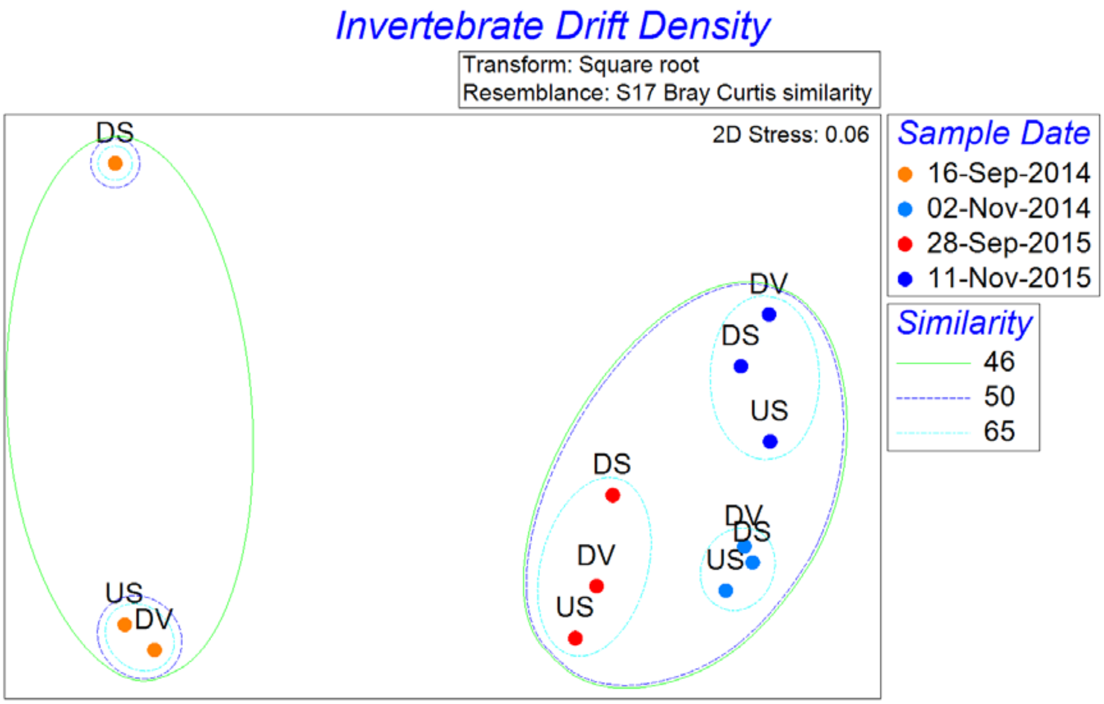


Figure 35. MDS ordination diagram showing the similarity among sites based on their invertebrate density and taxonomic composition (as computed by the Bray-Curtis Index). A stress value of 0.06 indicates that this is a strong representation of the data.



4.5.8. Power Analysis

The diversion reach power analysis predicts that a 50% reduction in invertebrate drift density would be detected with 1.00 power at a significance level (α) of 0.05 after five years of operational monitoring (Table 61). The minimum detectable effect size after five years of operational monitoring with 0.80 power is estimated to be 32% for α=0.05 (Figure 36a). The downstream reach power analysis predicts less power to detect a 50% reduction in density; 0.74 and 0.86 for α=0.05 and α=0.10, respectively (Table 61). The minimum detectable effect sizes after five years of operational monitoring with 0.80 power are estimated at 54% and 46% for the α=0.05 and α=0.10 significance levels respectively (Figure 36a). At a 0.05 significance level, 8 years of operational monitoring would be necessary to detect a 50% decrease in density with 0.80 power (Figure 36b).

The diversion reach analysis predicts that after five years of operational monitoring, a 50% reduction in invertebrate drift biomass would be detected with 0.41 power at α=0.05 and 0.57 power at α=0.10 (Table 61, Figure 37a). The minimum detectable effect sizes after five years of operational monitoring with 0.80 power are estimated at 86% and 73% for the α=0.05 and α=0.10 significance levels, respectively. At both significance levels, over 20 years of operational monitoring would be necessary to detect a 50% decrease in biomass with a power of 0.80 (Figure 37b). There is less power to detect a 50% reduction in biomass in the downstream reach after five years of monitoring:

0.12 and 0.23 for α=0.05 and α=0.10, respectively. The minimum detectable effect size after five years of operational monitoring with 0.80 power are estimated at >100% for both α=0.05 and α=0.10, and more than 20 years of operational monitoring would be necessary to detect a 50% decrease in biomass with a power of 0.80 (Figure 37).

The power to detect changes in richness, diversity, and CEFI is generally greater than the power to detect changes in invertebrate density and biomass. Effects on richness as low as 37% will be detectable in the diversion reach with 0.80 power at α=0.05 after five years of operational monitoring, while effects as low as 23% will be detectable downstream (Table 61, Figure 38). Effects on diversity as low as 18% will be detectable in the diversion reach with 0.80 power at α=0.05 after five years of operational monitoring and effects as low as 45% will be detectable downstream (Table 61, Figure 39). Effects on CEFI as low as 3% will be detectable in the diversion and 14% in the downstream reaches with 0.80 power at α=0.05 after five years of operational monitoring (Table 61, Figure 40).

With the exception of density in the downstream reach, where power to detect a 50% change was 0.74, slightly below the 0.80 power recommendation (Lewis *et al.* 2013), the results for the power analysis for invertebrate drift density, Simpson's diversity index, family richness, and CEFI show sufficient power for evaluating statistical significance in the impact reaches of Chickwat Creek. The results for biomass suggest that this metric may not be appropriate for evaluating statistically significant effects in the impact reaches.

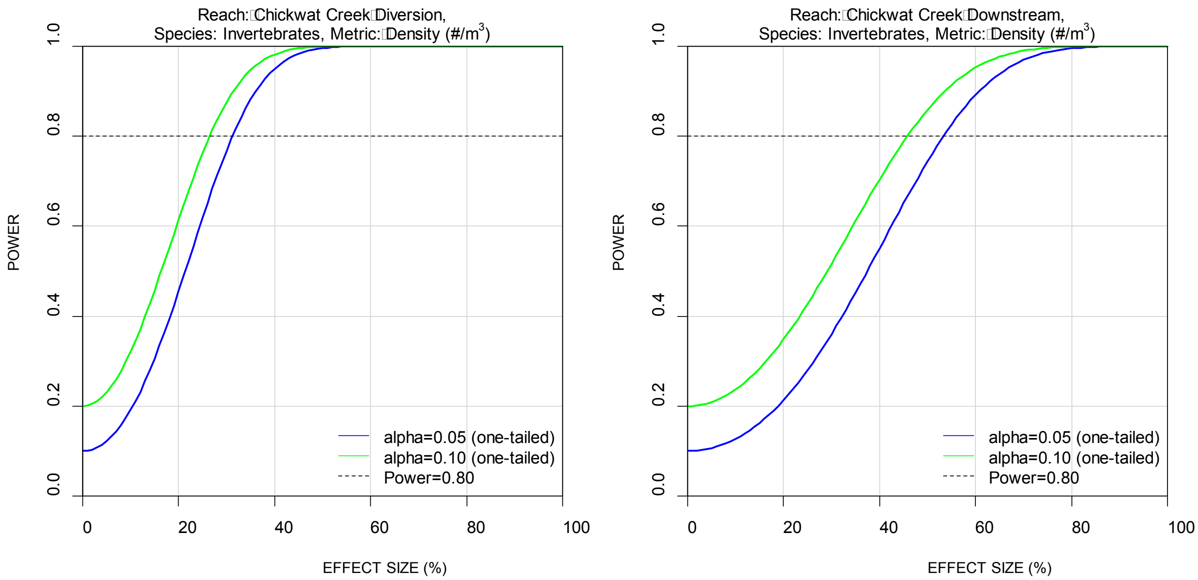
Table 61. Estimated power to detect negative effects on invertebrates in Chickwat Creek. Powers less than 0.80 for 50% effect size are highlighted in red.

Metric	Impact Reach	α (1-tailed)	Power[1]	Detectable Effect Size[1,2]
Density (#/m³)	Diversion	0.05	1.00	32%
		0.10	1.00	27%
	Downstream	0.05	0.74	54%
		0.10	0.86	46%
Biomass (mg/m³)	Diversion	0.05	0.41	86%
		0.10	0.57	73%
	Downstream	0.05	0.12	> 100%
		0.10	0.23	> 100%
Family Richness	Diversion	0.05	0.99	37%
		0.10	1.00	32%
	Downstream	0.05	1.00	23%
		0.10	1.00	20%
Simpson's Diversity (1-λ)	Diversion	0.05	1.00	18%
		0.10	1.00	15%
	Downstream	0.05	0.88	45%
		0.10	0.95	38%
CEFI Index	Diversion	0.05	1.00	3%
		0.10	1.00	3%
	Downstream	0.05	1.00	14%
		0.10	1.00	12%

[1]Based on 5 years (10 periods) of monitoring, with a 50% effect size
[2]Minimum detectable effect with 80% power

Figure 36. **Power to detect changes in density for diversion and downstream impact reaches a) as a function of effect size (assuming five years of operational monitoring) and b) as a function of years monitoring (50% effect size).**

Power vs. effect size.



Power vs. years monitoring.

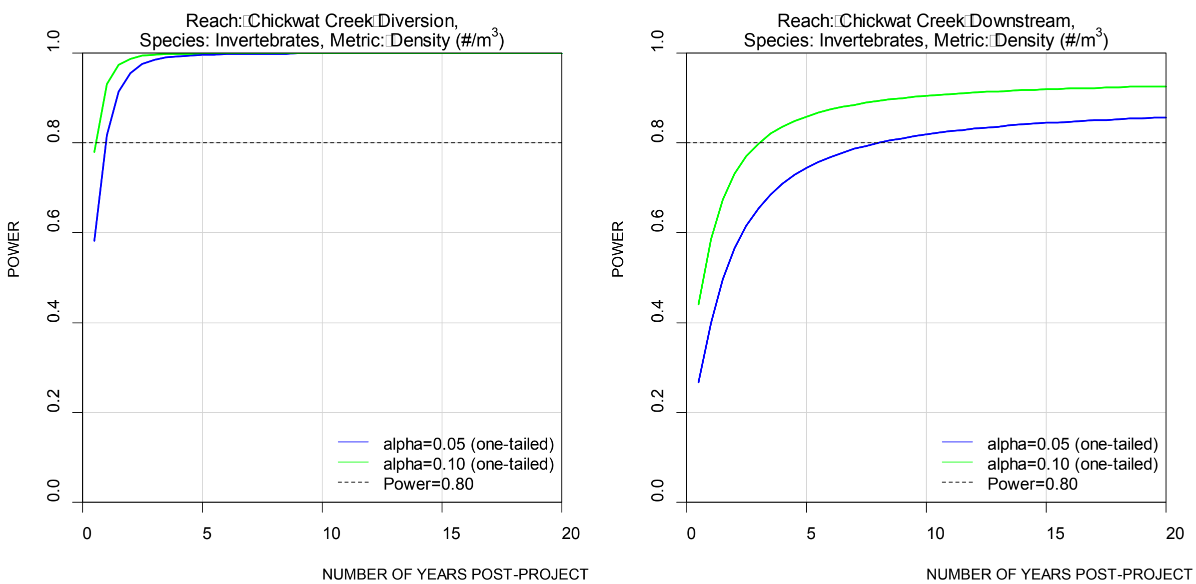
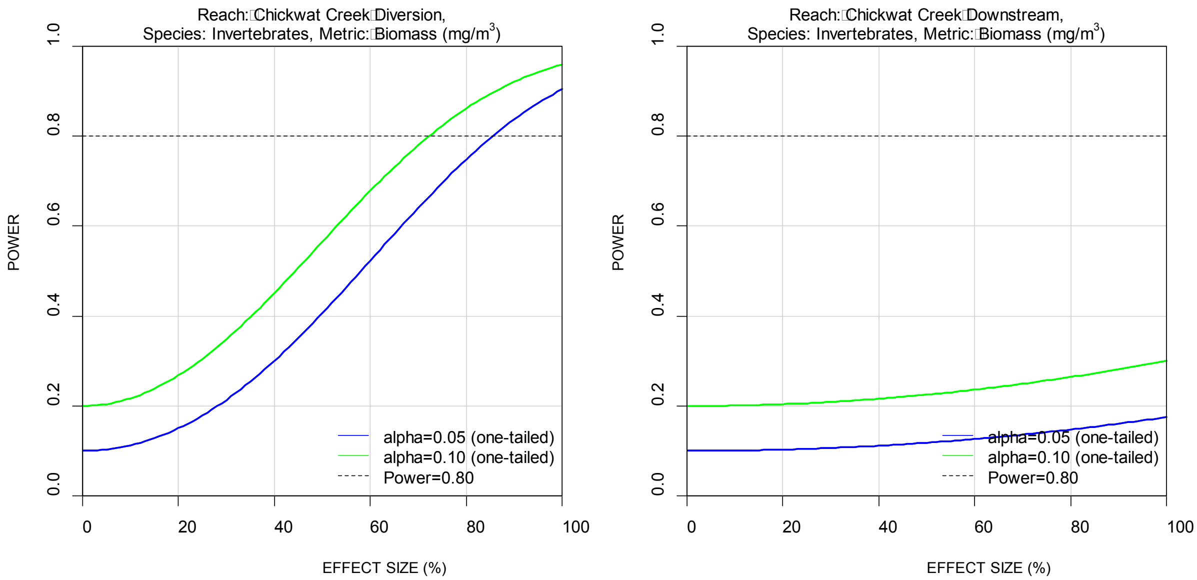


Figure 37. Power to detect changes in biomass for diversion and downstream impact reaches a) as a function of effect size (assuming five years of operational monitoring) and b) as a function of years monitoring (50% effect size).

Power vs. effect size.



Power vs. years monitoring.

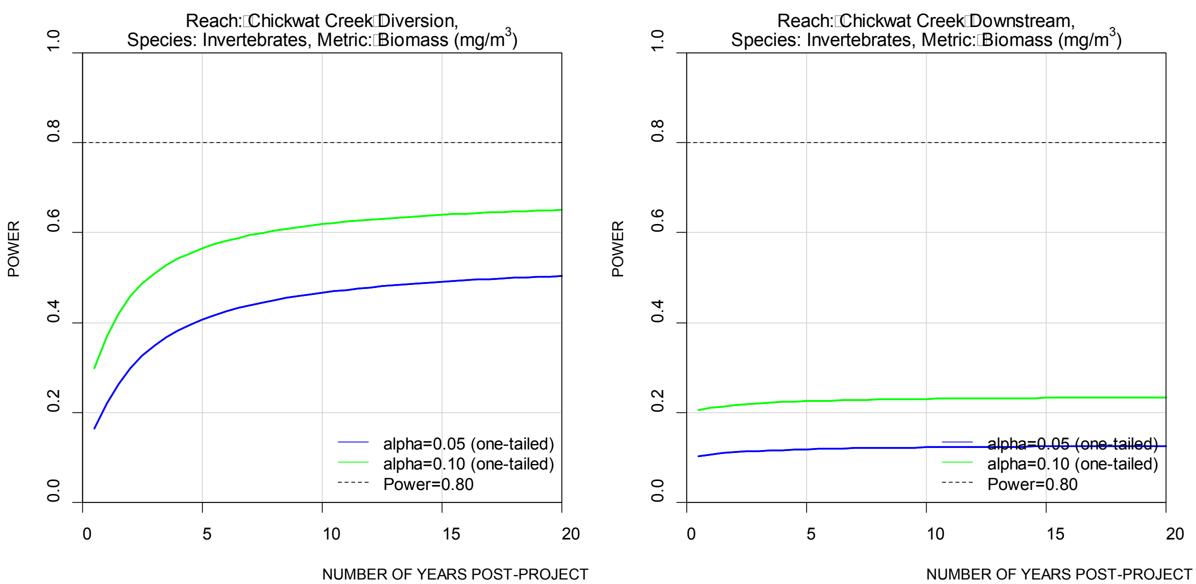


Figure 38. Power to detect changes in richness as a function of effect size (assuming five years of operational monitoring) for diversion and downstream impact reaches.

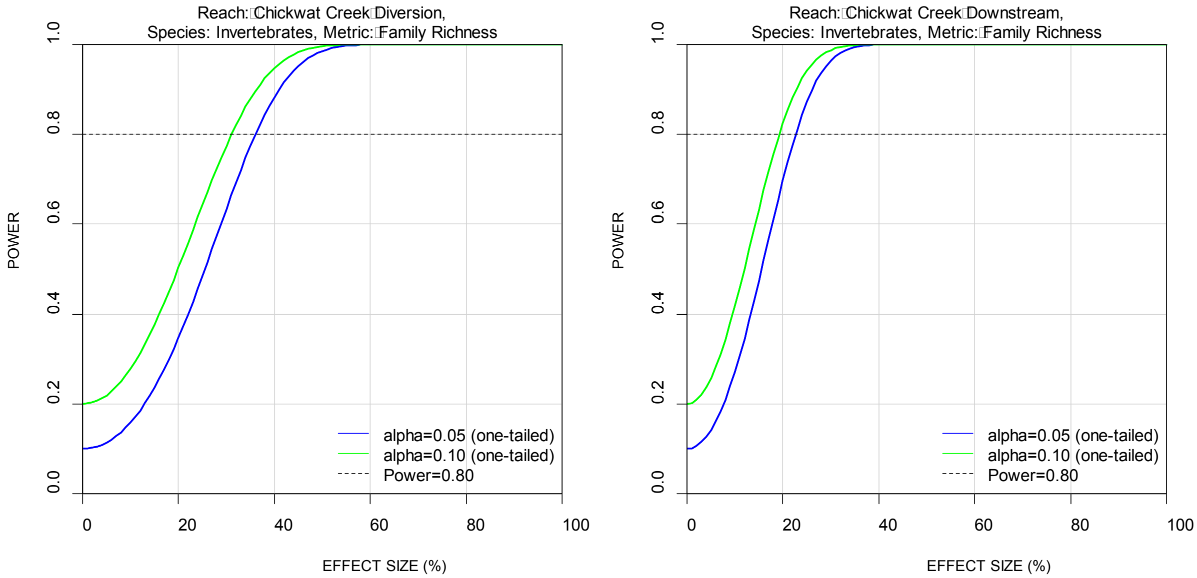


Figure 39. Power to detect changes in diversity as a function of effect size (assuming five years of operational monitoring) for diversion and downstream impact reaches.

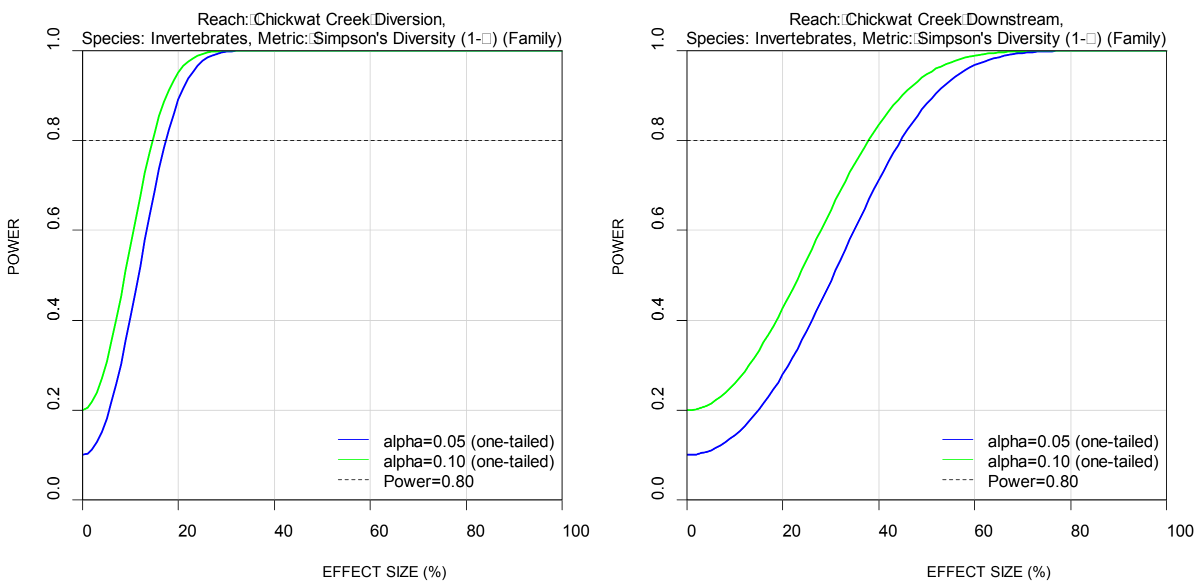
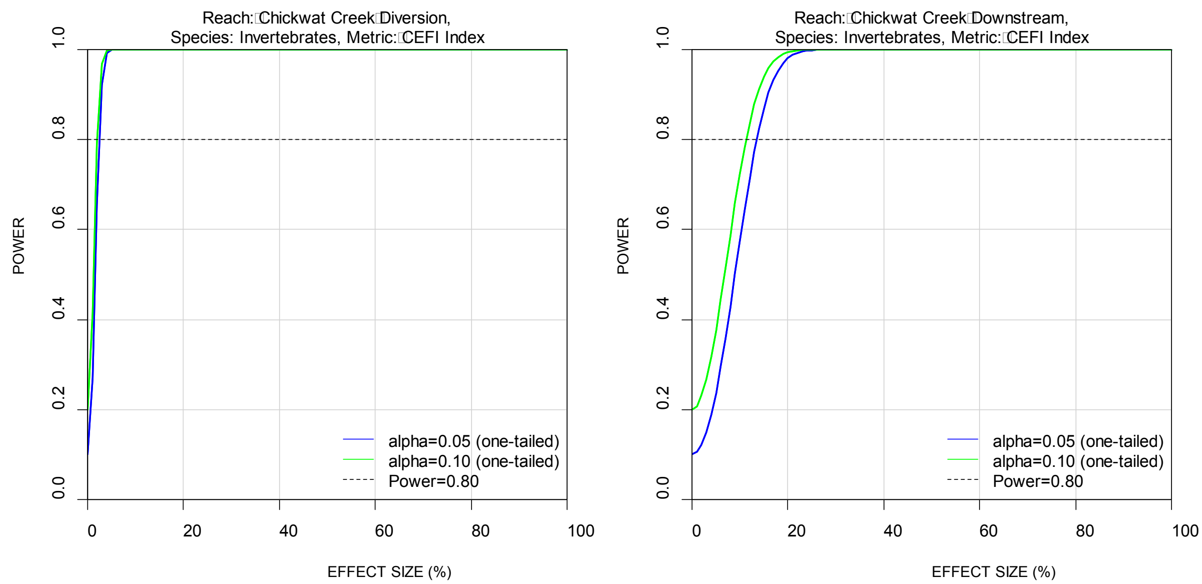


Figure 40. Power to detect changes in the CEFI as a function of effect size (assuming five years of operational monitoring) for diversion and downstream impact reaches.



4.6. Closure

The Chickwat Creek OEMP (Faulkner *et al.* 2016) outlines the operational monitoring frequency and duration for each monitoring component. The baseline data for this report have been collected according to the required methods stated in the Chickwat Creek OEMP (Faulkner *et al.* 2016). With the exception of fish community monitoring in the lower diversion, as part of the AMP, the data are adequate collected to effectively monitor the study components over the planned duration of the monitoring program. Each monitoring component is discussed below.

4.6.1. Water Quality

Two years of quarterly pre-construction baseline water quality samples were collected in Chickwat Creek as per the recommendations of the OEMP (Faulkner *et al.* 2016). The results of the baseline water quality monitoring will be adequate to effectively compare annual monitoring using a before-after-control-impact (BACI) design.

4.6.2. Water Temperature

Baseline temperature was collected in the upstream control reach and the upper and lower diversion reach of Chickwat Creek and in the Kid and Mountain Goat Tributaries from September 2014 to May 2016 (Table 5, Map 2). In addition, baseline data collected in the upstream reach from 2010 onwards was provided by Aquarius R&D and was included in the water temperature baseline data set for the Project. The water temperature data are adequate to monitor long-term water temperature over the duration of the long-term monitoring as described in the OEMP (Faulkner *et al.* 2016).

4.6.3.Stream Channel Morphology

This report documents the October 2015 and August 2016 survey efforts to establish baseline geomorphic conditions associated with the Chickwat Creek Hydroelectric Project. These surveys fulfil the baseline survey requirements identified in the OEMP (Faulkner *et al.* 2016). The reaches surveyed included the headpond and upstream reach, the lower diversion reach downstream of the canyon section, and the downstream reach from the tailrace to the debris fan apex just downstream of the existing bridge crossing. Furthermore, the geomorphic assessment generally confirms the observations from previous assessments (NHC 2011, MMA 2013).

4.6.4.Fish Community

4.6.4.1. Upper Diversion and Upstream

A mark-recapture sampling method was employed in the upstream and upper-diversion reaches of Chickwat Creek in 2014 and 2015 to determine Dolly Varden densities. The estimated power and detectable effect size for combined age classes (those that are typically used in examining project effects) are consistent with the minimum 0.8 power recommended by monitoring guidelines and suggests that the existing study design and baseline data collection will be adequate to detect a 50% reduction in Dolly Varden densities after 5 years of monitoring. Given these results, the fish community sampling plan outlined in the Chickwat Creek OEMP should achieve sufficient power to detect an effect size of 50% (Faulkner *et al.* 2016).

4.6.4.2. Lower Diversion

Only one year of sampling has been completed to establish the baseline metrics of the AMP. A second year of baseline sampling is scheduled for the fall of 2017, which together with 2016 will form the baseline for the AMP comparisons.

Adult snorkel surveys were conducted in Chickwat Creek in 2011, and 2013-2016 and in the Tzoonie River in 2016. The snorkel counts showed high variability during sampling from which limit statistical power to detect a Project related effect. Therefore, we propose to focus on the mark-recapture based adult abundance estimates for monitoring of the AMP.

4.6.5.Invertebrate Drift

Invertebrate drift was monitored in three reaches in 2014 and 2015 within Chickwat Creek. With the exception of density in the downstream reach, where power to detect a 50% change was 0.74, slightly below the 0.80 power recommendation (Lewis *et al.* 2013), the results for the power analysis for invertebrate drift density, Simpson's diversity index, family richness, and CEFI show sufficient power for evaluating statistical significance in the impact reaches of Chickwat Creek. The results for biomass suggest that this metric may not be appropriate for evaluating statistically significant effects in the impact reaches

However, monitoring of macroinvertebrate drift was not identified as a component of the OEMP (EAO 2014); and therefore, monitoring of macroinvertebrate drift is not proposed for this Project.

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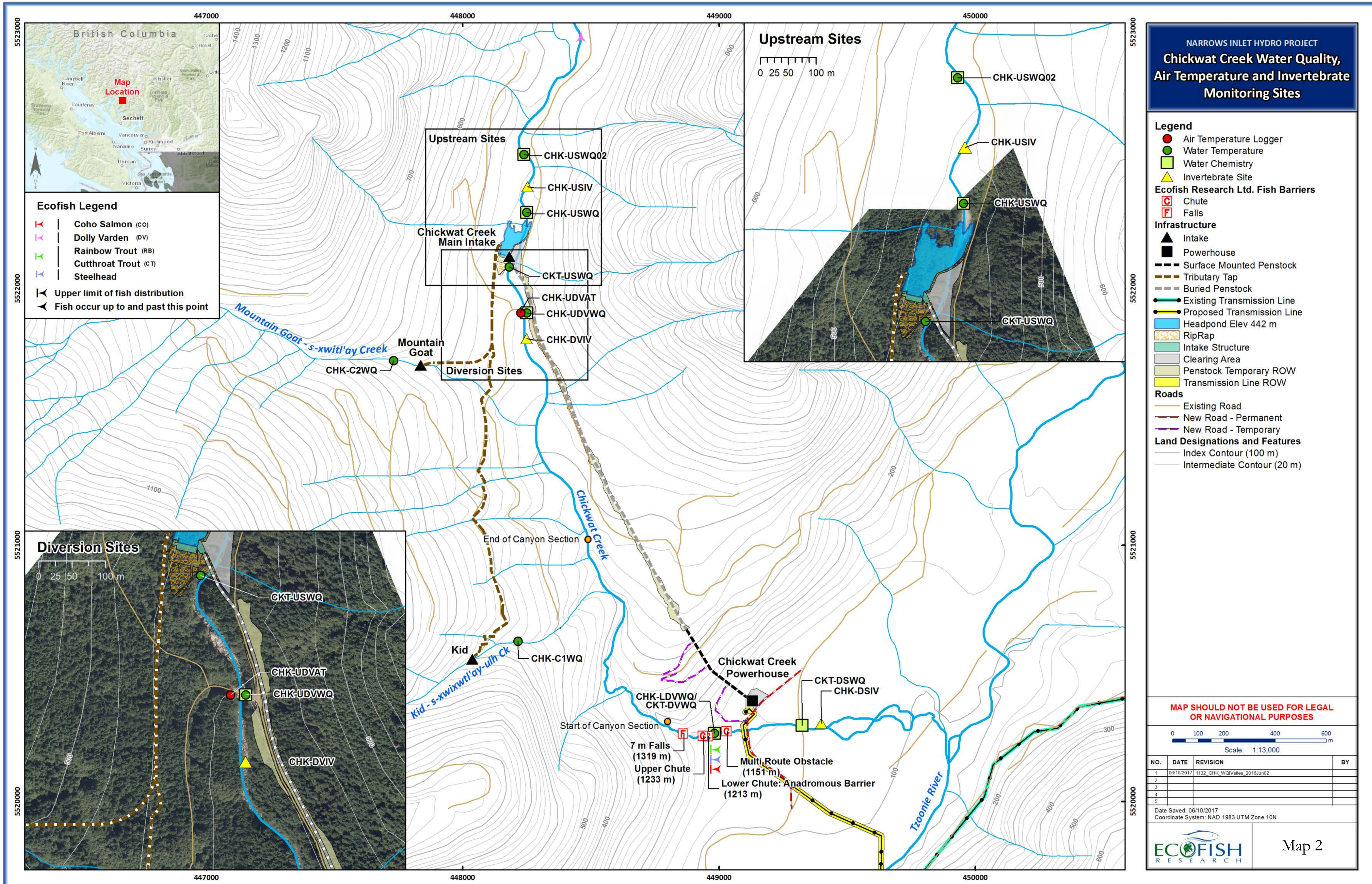
PROJECT MAPS



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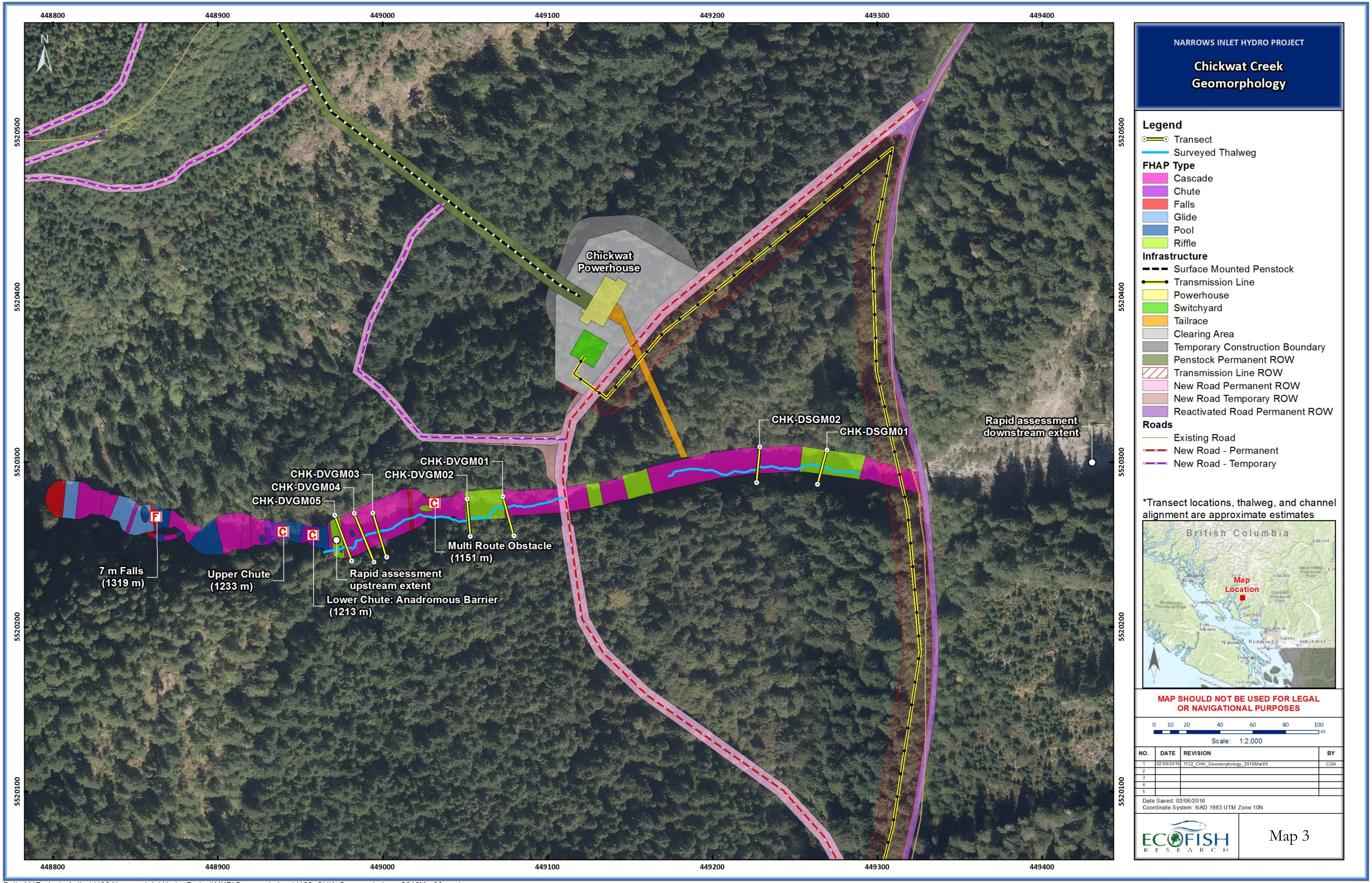

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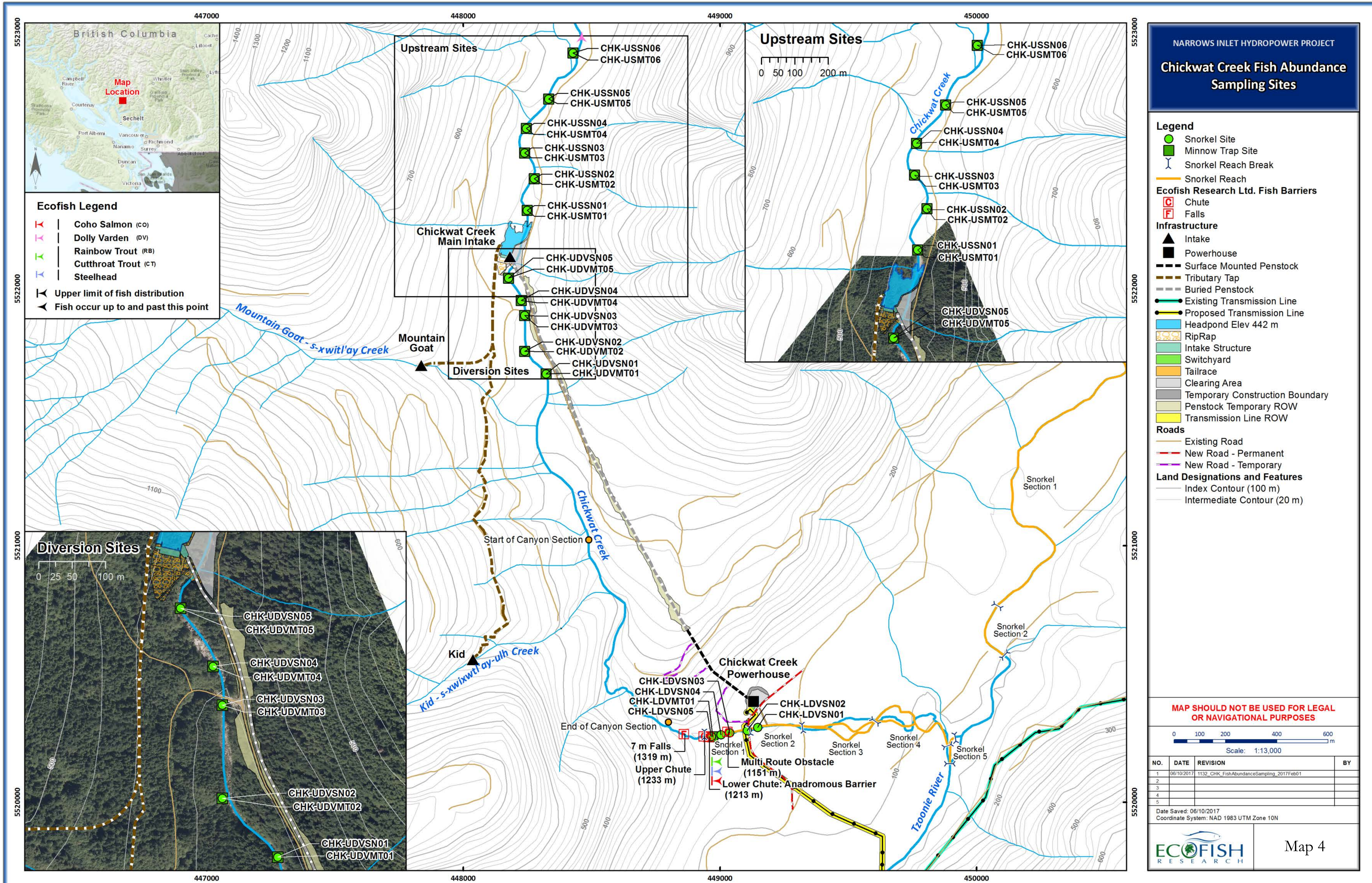

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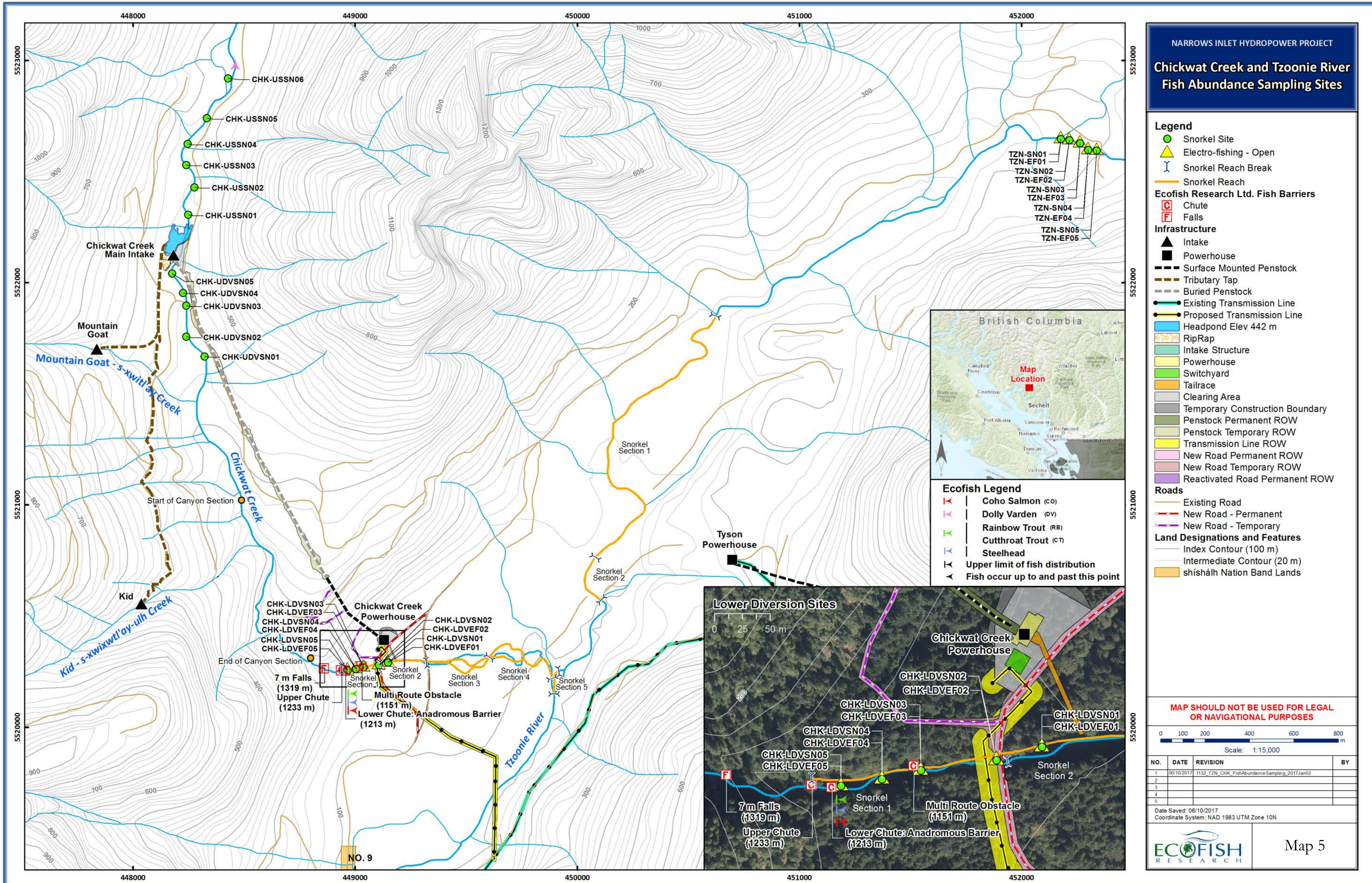

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1. GUIDELINES AND TYPICAL VALUES

Table 1. Water quality guidelines for the protection of aquatic life in British Columbia for parameters with less complex guidelines.

Parameter	Unit	BC Guideline for the Protection of Aquatic Life[1]	Guideline Reference
Specific Conductivity	µS/cm	No provincial or federal guidelines	n/a
pH	pH units	When baseline values are between 6.5 and 9 there is no restriction on changes within this range (lethal effects observed below 4.5 and above 9.5)	McKean and Nagpal (1991)
Alkalinity	mg/L	No provincial or federal guidelines. However, waterbodies with <10 mg/L are highly sensitive to acidic inputs, 10 to 20 mg/L are moderately sensitive to acidic inputs, > 20 mg/L have a low sensitivity to acidic inputs	n/a
Total Ammonia (N)	µg/L	Dependent on pH and temperature, too numerous to present, lowest maximum allowable concentration of 680 µg/L occurs at a pH of 9 and water temperature of 8ºC, lowest maximum average 30 day concentration of 102 µg/L occurs at a pH of 9 and water temperature of 20ºC	Nordin and Pommen (1986), MOE (2001)
Nitrite (N)	µg/L	The lowest maximum allowable concentration occurs when chloride is ≤ 2 mg/L; instantaneous maximum allowable concentration is 60 µg/L and a maximum 30 day average of 20 µg/L is allowed when chloride is ≤ 2 mg/L	Nordin and Pommen (1986), MOE (2001)
Nitrate (N)	µg/L	The 30 day average concentration to protect freshwater aquatic life is 2,900 µg/L[2] and the maximum concentration is 200 mg/L	Meays (2009), MOE (2001)
Orthophosphate	µg/L	No provincial or federal guidelines	n/a
Total Phosphorus (P)	µg/L	Trigger ranges that would signify a change in the trophic classification: <4: ultra-oligotrophic, 4-10 oligotrophic, 10 -20 mesotrophic, 20-35 meso-eutrophic, 35-100 eutrophic, > 100 hyper-eutrophic	CCME (2004)

[1] Guideline for total phosphorus is a federal guideline; provincial guidelines do not exist.

[2] The 30-d average (chronic) concentration is based on 5 weekly samples collected within a 30-day period.

Table 2. Total suspended solids and turbidity guidelines for the protection of aquatic life in British Columbia.

Period	British Columbia[1] Suspended Sediment and Turbidity Guidelines for the Protection of Aquatic Life	
	Total Suspended Sediments (mg/L)	**Turbidity (NTU)**
Clear Flow Period (< 25 mg/L or < 8 NTU)	"Induced suspended sediment concentrations should not exceed background levels by more than 25 mg/L during any 24-hour period (hourly sampling preferred). For sediment inputs that last between 24 hours and 30 days (daily sampling preferred), the average suspended sediment concentration should not exceed background by more than 5 mg/L."	"Induced turbidity should not exceed background levels by more than 8 NTU during any 24-hour period (hourly sampling preferred). For sediment inputs that last between 24 hours and 30 days (daily sampling preferred) the mean turbidity should not exceed background by more than 2 NTU."
Turbid Flow Period (≥ 25 mg/L or ≤ 8 NTU)	"Induced suspended sediment concentrations should not exceed background levels by more than 10 mg/L at any time when background levels are between 25 and 100 mg/L. When background exceeds 100 mg/L, suspended sediments should not be increased by more than 10% of the measured background level at any one time."	"Induced turbidity should not exceed background levels by more than 5 NTU at any time when background turbidity is between 8 and 50 NTU. When background exceeds 50 NTU, turbidity should not be increased by more than 10% of the measured background level at any one time."

[1] reproduced from Singleton (2001)

Table 3. Dissolved oxygen guidelines for the protection of aquatic life in British Columbia.

BC Guidelines for the Protection of Aquatic Life[1]			
	Life Stages Other Than Buried Embryo/Alevin	**Buried Embryo/Alevin[2]**	**Buried Embryo/Alevin[2]**
Dissolved Oxygen Concentration	Water column mg/L O_2	Water column mg/L O_2	Interstitial Water mg/L O_2
Instantaneous minimum[3]	5	9	6
30-day mean[4]	8	11	8

[1] MOE (1997a) and MOE (1997b)

[2] For the buried embryo / alevin life stages these are in-stream concentrations from spawning to the point of yolk sac absorption or 30 days post-hatch for fish; the water column concentrations recommended to achieve interstitial dissolved oxygen values when the latter are unavailable. Interstitial oxygen measurements would supersede water column measurements in comparing to criteria.

[3] The instantaneous minimum level is to be maintained at all times.

[4] The mean is based on at least five approximately evenly spaced samples. If a diurnal cycle exists in the water body, measurements should be taken when oxygen levels are lowest (usually early morning).

Table 4. Total gas pressure guidelines for the protection of aquatic life in British Columbia.

Water Depth	Maximum Allowable ΔP (Total Gas Pressure - Barometric Pressure) for the Protection of Aquatic Life in BC[1]
> 1 m	76 mm Hg regardless of pO_2 levels
< 1 m	$\Delta P_{\text{initiation of swim bladder overinflation}} = 73.89 * \text{water depth (m)} + 0.15 * pO_2$ where pO_2 = 157 mm Hg (i.e., sea level normoxic condition) In its most conservative form (assuming water column depth = 0 m), the BC guideline for waters less than 1 m deep is that the maximum allowable ΔP should not exceed 24 mm Hg

[1] Fidler and Miller (1994)

Table 5. Typical values for water quality parameters in British Columbia waters.

Parameter	Unit	Typical Range in BC	Reference
Specific Conductivity	µS/cm	The typical value in coastal British Columbia streams is 100 µS/cm	RISC (1998)
Total Dissolved Solids	mg/L	Generally, streams on the coast of BC have concentrations <75 mg/L, while those in the interior of the province can have up to 750 mg/L	RISC (1998)
pH	pH units	Natural fresh waters have a pH range from 4 to 10, lakes tend to have a pH ≥ 7.0 and coastal streams commonly have pH values of 5.5 to 6.5	RISC (1998)
Alkalinity	mg/L	Natural waters almost always have concentrations less than 500 mg/L, with waters in coastal BC typically ranging from 0 to 10 mg/L; waters in interior BC can have values greater than 100 mg/L	RISC (1998)
Total Suspended Solids	mg/L	In British Columbia natural concentrations of suspended solids vary extensively from waterbody to waterbody and can have large variation within a day and among seasons	Singleton (1985) in Caux *et al.* (1997)
Turbidity	NTU	In British Columbia natural concentrations of suspended solids vary extensively from waterbody to waterbody and can have large variation within a day and among seasons	Singleton (1985) in Caux *et al.* (1997)
Dissolved Oxygen	mg/L/ % sat.	In BC surface waters are generally well aerated and have DO concentrations greater than 10 mg/L and close to equilibrium with the atmosphere (i.e., close to 100% saturation)	MOE (1997a)
ΔP (Total Gas Pressure - Barometric Pressure)	mm Hg	In British Columbia, dissolved gas supersaturation is a natural feature of many waters with ΔP commonly being between 50 – 80 mm Hg. (We often see values between -10 and 60)	Fidler and Miller (1994)
Total Ammonia (N)	µg/L	<100 µg/L for waters not affected by waste discharges	Nordin and Pommen (1986)
Nitrite (N)	µg/L	Due to its unstable nature, nitrite concentrations are very low, typically present in surface waters at concentrations of <1 µg/L	RISC (1998)
Nitrate (N)	µg/L	In oligotrophic lakes and streams, nitrate concentrations are expected to be <100 µg/L	Nordin and Pommen (1986)
Orthophosphate	µg/L	Coastal BC streams have concentrations of <1 µg/L	Slaney and Ward (1993); Ashley and Slaney (1997)
Total Phosphorus (P)	µg/L	Oligotrophic water bodies have total phosphorus concentrations that are between 4 to 10 µg/L while concentrations are typically between 10 to 20 µg/L in mesotrophic water bodies.	CCME (2004)

2. WATER QUALITY MONITORING RESULTS

Table 6. Summary of general water quality parameters measured in situ from 2014 - 2016.

Year	Quarter	Site	pH pH units				Specific Conductivity µS/cm				Water Temperature °C				Air Temperature °C			
			Avg[1]	Min	Max	SD	Avg[1]	Min	Max	SD	Avg[1]	Min	Max	SD	Avg[1]	Min	Max	SD
2014	18-Sep	CHK-USWQ	-	-	-	-	14.0	14.0	14.0	0.0	11.0	11.0	11.0	0.0	13	-	-	-
		CHK-UDVWQ	3.82	3.79	3.85	0.03	13.3	13.0	14.0	0.6	11.2	11.2	11.2	0.0	13	-	-	-
		CHK-LDVWQ	4.10	4.00	4.21	0.11	13.3	13.0	14.0	0.6	12.2	12.2	12.2	0.0	14	-	-	-
	22-Sep	CHK-USWQ	4.65	4.65	4.66	0.01	12.0	12.0	12.0	0.0	11.6	11.5	11.6	0.1	18	18	18	0
		CHK-UDVWQ	3.55	3.55	3.55	0.00	12.0	12.0	12.0	0.0	11.8	11.8	11.8	0.0	-	-	-	-
		CHK-LDVWQ	3.87	3.87	3.87	0.00	12.0	12.0	12.0	0.0	12.3	12.3	12.3	0.0	17	17	17	0
	01-Dec	CHK-USWQ	5.49	5.49	5.49	0.00	9.4	9.4	9.4	0.0	1.8	1.7	1.8	0.1	-2	-2	-2	0
		CHK-UDVWQ	5.58	5.57	5.59	0.01	9.4	9.4	9.4	0.0	1.8	1.8	1.8	0.0	-	-	-	-
		CHK-LDVWQ	5.68	5.68	5.68	0.00	9.8	9.8	9.8	0.0	2.2	2.2	2.2	0.0	-1	-1	-1	0
		CHK-C2WQ	5.44	5.44	5.45	0.01	8.9	8.9	8.9	0.0	1.8	1.8	1.8	0.0	-1	-1	-1	0
	03-Dec	CHK-C1WQ	5.26	5.24	5.28	0.02	8.9	8.9	8.9	0.0	0.4	0.4	0.4	0.0	-	-	-	-
2015	08-Mar	CHK-USWQ	5.60	5.58	5.63	0.03	9.9	9.9	9.9	0.0	5.0	5.0	5.0	0.0	10	-	-	-
		CHK-UDVWQ	6.65	6.65	6.66	0.01	13.3	13.3	13.3	0.0	4.9	4.9	4.9	0.0	10	-	-	-
		CHK-LDVWQ	5.40	5.39	5.40	0.01	10.7	10.6	10.7	0.1	4.0	4.0	4.0	0.0	2	-	-	-
		CHK-C2WQ	5.52	5.51	5.52	0.01	9.3	9.3	9.3	0.0	3.8	3.8	3.8	0.0	7	-	-	-
		CHK-C1WQ	5.47	5.46	5.47	0.01	9.8	9.8	9.8	0.0	2.8	2.8	2.8	0.0	6	-	-	-
	28-May	CHK-USWQ	8.19	8.05	8.32	0.14	11.4	11.2	11.6	0.2	12.8	12.8	12.8	0.0	21	-	-	-
		CHK-UDVWQ	6.59	6.58	6.61	0.02	4.6	4.5	4.6	0.1	13.2	13.2	13.2	0.0	20	-	-	-
		CHK-LDVWQ	6.57	6.56	6.57	0.01	4.7	4.7	4.7	0.0	13.5	13.5	13.5	0.0	17	-	-	-
		CHK-C2WQ	8.48	8.41	8.53	0.06	4.4	4.4	4.4	0.0	11.7	11.7	11.7	0.0	19	-	-	-
		CHK-C1WQ	6.18	6.16	6.21	0.03	6.2	6.2	6.3	0.1	10.2	10.2	10.2	0.0	17	-	-	-
	23-Sep	CHK-USWQ	5.89	5.89	5.90	0.01	7.9	7.9	7.9	0.0	9.2	9.2	9.2	0.0	10	10	10	0
		CHK-UDVWQ	6.14	6.11	6.16	0.03	8.1	8.1	8.2	0.1	9.3	9.3	9.3	0.0	10	10	10	0
		CHK-LDVWQ	6.16	6.14	6.17	0.02	8.5	8.4	8.5	0.1	10.0	10.0	10.0	0.0	10	10	10	0
	18-Nov	CHK-USWQ02	5.72	5.66	5.77	0.06	6.8	6.8	6.8	0.0	3.8	3.8	3.8	0.0	2	-	-	-
		CHK-UDVWQ	6.37	6.35	6.41	0.03	7.0	7.0	7.0	0.0	4.1	4.1	4.1	0.0	3	-	-	-
		CHK-LDVWQ	6.52	6.51	6.53	0.01	7.3	7.3	7.3	0.0	4.8	4.8	4.8	0.0	4	-	-	-
2016	17-Mar	CHK-USWQ02	5.90	5.89	5.90	0.01	8.2	8.2	8.2	0.0	2.0	2.0	2.0	0.0	-	-	-	-
		CHK-UDVWQ	5.65	5.62	5.67	0.03	8.6	8.6	8.6	0.0	2.3	2.3	2.3	0.0	-	-	-	-
		CHK-LDVWQ	6.04	6.02	6.08	0.03	8.9	8.9	8.9	0.0	3.9	3.9	3.9	0.0	4	4	4	0
	03-May	CHK-USWQ02	5.64	5.61	5.68	0.04	7.5	7.5	7.5	0.0	6.6	6.6	6.7	0.1	10	10	10	0
		CHK-UDVWQ	5.97	5.88	6.13	0.14	8.7	8.5	9.1	0.3	6.6	6.6	6.7	0.1	9	9	9	0
		CHK-LDVWQ	5.69	5.66	5.73	0.04	9.3	9.3	9.3	0.0	7.4	7.4	7.4	0.0	9	9	9	0

[1] Average of three replicates (n=3) on each date unless otherwise indicated. A single data listed under Avg. indicates n=1.

Orange shaded parameters are erroneous data points, likely due to measurement/equipment error. pH values measured in the laboratory is available for these dates.

Table 7. General water quality parameters measured at ALS Laboratory from 2014 – 2016.

Year	Quarter	Site	pH (pH units)				Specific Conductivity (µS/cm)				Total Dissolved Solids (mg/L)				Alkalinity (as $CaCO_3$) (mg/L)				Total Suspended Solids (mg/L)				Turbidity (NTU)			
			Avg[1]	Min	Max	SD	Avg[1]	Min	Max	SD	Avg[1]	Min	Max	SD	Avg[1]	Min	Max	SD	Avg[1]	Min	Max	SD	Avg[1]	Min	Max	SD
2014	22-Sep	CHK-USWQ	6.87	6.86	6.87	0.01	11.7	11.4	12.3	0.5	<11	<10	12	1	3.7	3.6	3.8	0.1	<1.0	<1.0	<1.0	0.0	0.11	0.11	0.11	0.00
		CHK-UDVWQ	6.58	5.68	7.37	0.85	16.8	13.1	22.8	5.2	<11	<10	12	1	3.7	3.6	3.8	0.1	<1.0	<1.0	<1.0	0.0	0.20	0.16	0.24	0.04
		CHK-LDVWQ	6.72	6.65	6.76	0.06	11.8	11.7	11.9	0.1	<11	<10	12	1	3.2	2.8	3.5	0.4	<1.0	<1.0	<1.0	0.0	0.21	0.11	0.28	0.09
	01-Dec	CHK-USWQ	6.41	6.41	6.42	0.01	7.5	7.3	7.7	0.2	<10	<10	<10	0	2.1	1.9	2.5	0.3	<1.0	<1.0	<1.0	0.0	0.19	0.11	0.31	0.11
		CHK-UDVWQ	6.39	6.37	6.41	0.02	7.6	7.4	8.0	0.3	<10	<10	<10	0	2.1	1.9	2.3	0.2	<1.0	<1.0	<1.0	0.0	0.30	0.24	0.38	0.07
		CHK-LDVWQ	6.35	6.31	6.41	0.06	7.9	7.8	7.9	0.1	<10	<10	<10	0	1.9	1.8	2.0	0.1	<1.0	<1.0	<1.0	0.0	0.23	0.21	0.25	0.02
2015	08-Mar	CHK-USWQ	6.69	6.67	6.70	0.02	9.1	9.1	9.2	0.1	15	13	17	2	2.7	2.5	2.9	0.2	<1.0	<1.0	<1.0	0.0	<0.10	<0.10	<0.10	0.00
		CHK-UDVWQ	6.69	6.68	6.70	0.01	9.4	9.4	9.4	0.0	15	14	16	1	2.7	2.6	2.8	0.1	<1.0	<1.0	<1.0	0.0	<0.10	<0.10	<0.10	0.00
		CHK-LDVWQ	6.66	6.59	6.73	0.07	10.7	9.6	12.8	1.8	16	15	18	2	2.7	2.5	2.9	0.2	<1.0	<1.0	<1.0	0.0	<0.10	<0.10	<0.10	0.00
	28-May	CHK-USWQ	6.44	6.44	6.45	0.01	4.3	4.3	4.4	0.1	<10	<10	<10	0	<2.0	<2.0	<2.0	0.0	<1.0	<1.0	<1.0	0.0	0.18	0.12	0.22	0.05
		CHK-UDVWQ	6.45	6.44	6.45	0.01	4.4	4.4	4.4	0.0	<10	<10	<10	0	<2.0	<2.0	<2.0	0.0	<1.0	<1.0	<1.0	0.0	0.44	0.23	0.56	0.18
		CHK-LDVWQ	6.48	6.43	6.57	0.08	5.1	4.5	5.8	0.7	<10	<10	<10	0	<2.1	<2.0	2.3	0.2	<1.0	<1.0	<1.0	0.0	0.30	0.22	0.34	0.07
	23-Sep	CHK-USWQ	6.71	6.65	6.78	0.07	7.6	7.5	7.7	0.1	<11	<10	11	1	2.5	2.5	2.6	0.1	<1.0	<1.0	<1.0	0.0	0.14	0.12	0.18	0.03
		CHK-UDVWQ	6.66	6.64	6.68	0.02	8.0	7.9	8.1	0.1	<10	<10	11	1	2.3	2.2	2.4	0.1	<1.2	<1.0	1.7	0.4	0.18	0.13	0.25	0.06
		CHK-LDVWQ	6.80	6.71	6.91	0.10	9.5	9.2	9.8	0.3	<11	<10	12	1	2.4	2.3	2.5	0.1	<1.0	<1.0	<1.0	0.0	0.22	0.17	0.27	0.05
	18-Nov	CHK-USWQ02	6.71	6.58	6.96	0.22	7.1	7.0	7.1	0.1	<11	<10	13	2	2.9	2.5	3.3	0.4	<1.0	<1.0	<1.0	0.0	0.17	0.15	0.18	0.02
		CHK-UDVWQ	6.61	6.61	6.61	0.00	7.3	7.3	7.4	0.1	<13	<10	15	3	2.7	2.6	2.8	0.1	<1.0	<1.0	<1.0	0.0	0.22	0.15	0.35	0.11
		CHK-LDVWQ	6.64	6.63	6.64	0.01	8.0	7.7	8.5	0.5	17	15	19	2	2.6	2.3	3.2	0.5	<1.0	<1.0	<1.0	0.0	0.35	0.33	0.37	0.02
2016	17-Mar	CHK-USWQ02	6.65	6.64	6.65	0.01	7.8	7.7	7.8	0.1	<10	<10	<10	0	2.9	2.8	3.1	0.2	<1.0	<1.0	<1.0	0.0	<0.10	<0.10	0.11	0.01
		CHK-UDVWQ	6.67	6.67	6.68	0.01	8.9	8.8	8.9	0.1	<10	<10	<10	0	3.2	2.7	3.4	0.4	<1.0	<1.0	<1.0	0.0	0.13	0.12	0.14	0.01
		CHK-LDVWQ	6.87	6.74	7.04	0.16	9.2	9.1	9.4	0.2	<10	<10	<10	0	3.1	2.8	3.3	0.3	<1.0	<1.0	<1.0	0.0	0.14	0.13	0.14	0.01
	03-May	CHK-USWQ02	6.44	6.39	6.52	0.07	4.4	4.0	5.1	0.6	<10	<10	<10	0	<2.0	<2.0	<2.0	0.0	<1.0	<1.0	<1.0	0.0	0.15	0.15	0.16	0.01
		CHK-UDVWQ	6.41	6.40	6.42	0.01	4.1	4.0	4.1	0.1	<10	<10	<10	0	<2.0	<2.0	<2.0	0.0	<1.4	<1.0	2.3	0.8	0.21	0.16	0.29	0.07
		CHK-LDVWQ	6.42	6.40	6.45	0.03	4.4	4.1	4.6	0.3	<10	<10	<10	0	<2.0	<2.0	<2.0	0.0	<1.0	<1.0	1.1	0.1	0.29	0.24	0.32	0.04

[1] Average of three replicates (n=3) on each date unless otherwise indicated. A single data listed under Avg. indicates n=1.

Parameters that have a concentration below the detection limit are assumed to have a concentration equal to the detection limit for calculation purposes.

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Table 8. Summary of dissolved gases measured in situ from 2014-2016.

Year	Quarter	Site	Dissolved Oxygen %				Dissolved Oxygen mg/L				Barometric Pressure mm Hg				TGP %				TGP mm Hg				ΔP mm Hg			
			Avg[1]	Min	Max	SD	Avg[1]	Min	Max	SD	Avg[1]	Min	Max	SD	Avg[1]	Min	Max	SD	Avg[1]	Min	Max	SD	Avg[1]	Min	Max	SD
2014	18-Sep	CHK-USWQ	86.3	86.2	86.3	0.1	9.48	9.48	9.48	0.00	722	722	722	0	104	104	105	1	754	754	754	0	32	32	32	0
		CHK-UDVWQ	98.5	98.0	98.8	0.4	10.81	10.75	10.84	0.05	723	723	723	0	105	105	105	0	759	759	759	0	36	36	36	0
		CHK-LDVWQ	101.9	101.7	102.3	0.3	10.93	10.91	10.97	0.03	749	748	749	1	113	113	114	1	852	849	854	3	103	100	106	3
	22-Sep	CHK-USWQ	96.2	95.8	96.4	0.3	10.41	10.39	10.44	0.03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		CHK-UDVWQ	104.0	103.9	104.1	0.1	11.29	11.28	11.30	0.01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		CHK-LDVWQ	108.6	108.5	108.7	0.1	11.61	11.61	11.61	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	01-Dec	CHK-USWQ	103.7	103.2	103.9	0.4	13.80	13.76	13.86	0.05	725	724	726	1	104	104	104	0	755	755	755	0	30	29	31	1
		CHK-UDVWQ	105.4	105.3	105.5	0.1	14.01	14.00	14.03	0.02	724	724	724	0	104	104	104	0	755	755	755	0	31	31	31	0
		CHK-LDVWQ	108.2	108.1	108.3	0.1	14.87	14.86	14.88	0.01	753	753	753	0	105	105	105	0	788	788	788	0	35	35	35	0
		CHK-C2WQ	106.9	106.8	107.0	0.1	14.08	14.08	14.09	0.01	716	716	716	0	103	103	103	0	739	739	739	0	23	23	23	0
	03-Dec	CHK-C1WQ	102.2	102.2	102.3	0.1	14.03	14.03	14.04	0.01	716	716	717	1	103	103	103	0	735	735	736	1	19	18	20	1
2015	08-Mar	CHK-USWQ	90.3	90.3	90.4	0.1	11.09	11.06	11.10	0.02	727	726	727	1	101	101	101	0	732	732	732	0	5	5	6	1
		CHK-UDVWQ	91.5	91.4	91.7	0.2	11.72	11.72	11.73	0.01	729	729	729	0	105	105	105	0	767	767	767	0	38	38	38	0
		CHK-LDVWQ	86.0	86.0	86.1	0.1	11.31	11.31	11.32	0.01	756	755	756	1	102	102	102	0	771	770	772	1	15	14	17	2
		CHK-C2WQ	84.2	84.2	84.3	0.1	10.55	10.53	10.56	0.02	718	718	718	0	102	102	102	0	730	730	730	0	12	12	12	0
		CHK-C1WQ	83.3	83.1	83.5	0.2	10.81	10.77	10.87	0.05	727	727	727	0	102	101	102	1	738	738	738	0	11	11	11	0
	28-May	CHK-USWQ	88.9	88.6	89.1	0.3	9.40	9.38	9.43	0.03	724	724	724	0	102	102	102	0	741	740	741	1	17	16	17	1
		CHK-UDVWQ	88.1	87.9	88.2	0.2	9.23	9.18	9.26	0.04	726	726	726	0	102	102	102	0	743	743	744	1	17	17	18	1
		CHK-LDVWQ	92.6	92.1	93.0	0.5	9.58	9.51	9.69	0.10	748	747	748	1	105	105	105	0	782	782	782	0	34	34	35	1
		CHK-C2WQ	90.1	89.9	90.4	0.3	9.77	9.73	9.82	0.05	717	717	717	0	102	102	102	0	735	735	735	0	18	18	18	0
		CHK-C1WQ	97.1	96.2	98.6	1.3	10.90	10.80	11.05	0.13	723	723	724	1	103	102	103	1	741	741	741	0	18	17	18	1
	23-Sep	CHK-USWQ	98.2	97.4	99.2	0.9	11.33	11.27	11.38	0.06	720	720	720	0	102	102	103	1	737	736	737	1	17	16	17	1
		CHK-UDVWQ	93.7	93.3	94.2	0.5	10.72	10.66	10.79	0.07	723	722	723	1	102	102	103	1	740	740	740	0	17	17	18	1
		CHK-LDVWQ	99.8	99.4	100.1	0.4	11.22	11.21	11.23	0.01	748	748	748	0	105	105	105	0	783	783	784	1	35	35	36	1
	18-Nov	CHK-USWQ02	95.4	95.4	95.5	0.1	12.58	12.57	12.58	0.01	723	723	723	0	102	102	102	0	737	737	737	0	14	14	14	0
		CHK-UDVWQ	95.7	95.5	95.9	0.2	12.51	12.50	12.52	0.01	724	724	725	1	103	103	103	0	744	743	746	2	20	19	21	1
		CHK-LDVWQ	103.1	102.9	103.2	0.2	13.25	13.23	13.27	0.02	752	752	753	1	105	105	105	0	789	789	789	0	37	36	37	1
2016	17-Mar	CHK-USWQ02	100.2	100.1	100.2	0.1	13.85	13.84	13.85	0.01	718	718	719	1	104	103	104	1	744	742	745	2	26	24	27	2
		CHK-UDVWQ	99.6	98.8	100.0	0.7	13.69	13.59	13.76	0.09	720	720	721	1	105	105	105	0	759	759	759	0	39	38	39	1
		CHK-LDVWQ	100.5	100.0	101.2	0.6	13.20	13.17	13.22	0.03	751	750	751	1	105	105	105	0	785	785	785	0	34	34	35	1
	03-May	CHK-USWQ02	96.9	96.7	97.2	0.3	11.90	11.88	11.92	0.02	721	721	721	0	104	103	104	1	747	745	749	2	26	24	28	2
		CHK-UDVWQ	93.0	92.3	94.2	1.1	11.40	11.25	11.49	0.13	724	723	724	1	103	103	104	1	749	748	750	1	25	24	27	2
		CHK-LDVWQ	103.8	103.3	104.3	0.5	12.46	12.39	12.53	0.07	751	750	751	1	107	107	107	0	803	802	804	1	53	52	53	1

[1] Average of three replicates (n=3) on each date unless otherwise indicated. A single data listed under Avg. indicates n=1.

Grey shading indicates exceedance of the shallow (water depth <1 m) water quality guideline for ΔP of 24 mm Hg.

Blue shading indicate exceedance of the deep (>1m) water quality guidelines for ΔP of 76 mm Hg.

Table 9. Summary of low level nutrients analysed by ALS Laboratory from 2014-2016.

Year	Quarter	Site	Total Ammonia (as N) µg/L				Nitrate (as N) µg/L				Nitrite (as N) µg/L				Total Nitrogen µg/L				Dissolved Orthophosphate (as P) µg/L				Total Phosphorus (P) µg/L			
			Avg[1]	Min	Max	SD	Avg[1]	Min	Max	SD	Avg[1]	Min	Max	SD	Avg[1]	Min	Max	SD	Avg[1]	Min	Max	SD	Avg[1]	Min	Max	SD
2014	22-Sep	CHK-USWQ	<5.0	<5.0	<5.0	0.0	139.3	139.0	140.0	0.6	<1.0	<1.0	<1.0	0.0	159.0	154.0	169.0	8.7	<1.0	<1.0	<1.0	0.0	<2.0	<2.0	<2.0	0.0
		CHK-UDVWQ	<5.0	<5.0	<5.0	0.0	136.0	135.0	137.0	1.0	<1.0	<1.0	<1.0	0.0	182.0	173.0	200.0	15.6	<1.0	<1.0	<1.0	0.0	<2.0	<2.0	<2.0	0.0
		CHK-LDVWQ	<5.0	<5.0	<5.0	0.0	153.3	153.0	154.0	0.6	<1.0	<1.0	<1.0	0.0	171.7	171.0	172.0	0.6	<1.0	<1.0	<1.0	0.0	<2.0	<2.0	<2.0	0.0
	01-Dec	CHK-USWQ	<5.0	<5.0	<5.0	0.0	101.3	100.0	103.0	1.5	<1.0	<1.0	<1.0	0.0	146.0	144.0	149.0	2.6	<1.0	<1.0	<1.0	0.0	<2.0	<2.0	<2.0	0.0
		CHK-UDVWQ	<5.0	<5.0	<5.0	0.0	102.0	101.0	103.0	1.0	<1.0	<1.0	<1.0	0.0	149.7	136.0	164.0	14.0	<1.0	<1.0	<1.0	0.0	<2.0	<2.0	<2.0	0.0
		CHK-LDVWQ	<5.0	<5.0	<5.0	0.0	116.3	116.0	117.0	0.6	<1.0	<1.0	<1.0	0.0	159.7	143.0	189.0	25.5	<1.0	<1.0	<1.0	0.0	<2.0	<2.0	<2.0	0.0
2015	08-Mar	CHK-USWQ	<5.0	<5.0	<5.0	0.0	74.2	73.8	74.5	0.4	<1.0	<1.0	<1.0	0.0	82.3	79.0	89.0	5.8	<1.0	<1.0	<1.0	0.0	<3.5	<2.0	6.6	2.7
		CHK-UDVWQ	<5.0	<5.0	<5.0	0.0	75.9	75.9	75.9	0.0	<1.0	<1.0	<1.0	0.0	92.3	87.0	96.0	4.7	<1.0	<1.0	<1.0	0.0	<2.0	<2.0	<2.0	0.0
		CHK-LDVWQ	<5.0	<5.0	<5.0	0.0	88.0	87.4	88.7	0.7	<1.0	<1.0	<1.0	0.0	98.0	92.0	109.0	9.5	<1.0	<1.0	<1.0	0.0	<2.0	<2.0	<2.0	0.0
	28-May	CHK-USWQ	<5.0	<5.0	<5.0	0.0	15.5	15.3	15.7	0.2	<1.0	<1.0	<1.0	0.0	<30.0	<30.0	<30.0	0.0	<1.0	<1.0	<1.0	0.0	<2.0	<2.0	<2.0	0.0
		CHK-UDVWQ	<5.0	<5.0	<5.0	0.0	14.9	14.9	14.9	0.0	<1.0	<1.0	<1.0	0.0	<30.0	<30.0	<30.0	0.0	<1.0	<1.0	<1.0	0.0	<2.0	<2.0	<2.0	0.0
		CHK-LDVWQ	<5.0	<5.0	<5.0	0.0	14.4	14.2	14.6	0.2	<1.0	<1.0	<1.0	0.0	<30.0	<30.0	<30.0	0.0	<1.0	<1.0	<1.0	0.0	<2.0	<2.0	<2.0	0.0
	23-Sep	CHK-USWQ	<5.0	<5.0	<5.0	0.0	81.5	81.1	81.9	0.4	<1.0	<1.0	<1.0	0.0	104.0	103.0	105.0	1.0	<1.0	<1.0	<1.0	0.0	<2.0	<2.0	<2.0	0.0
		CHK-UDVWQ	<5.0	<5.0	<5.0	0.0	83.3	83.1	83.6	0.3	<1.0	<1.0	<1.0	0.0	110.7	110.0	111.0	0.6	<1.0	<1.0	<1.0	0.0	<2.0	<2.0	<2.0	0.0
		CHK-LDVWQ	<5.0	<5.0	<5.0	0.0	101.0	101.0	101.0	0.0	<1.0	<1.0	<1.0	0.0	123.3	122.0	125.0	1.5	<1.0	<1.0	<1.0	0.0	<2.0	<2.0	<2.0	0.0
	18-Nov	CHK-USWQ02	<5.0	<5.0	<5.0	0.0	89.9	89.2	90.6	0.7	<1.0	<1.0	<1.0	0.0	127.7	122.0	135.0	6.7	<1.0	<1.0	<1.0	0.0	<2.0	<2.0	<2.0	0.0
		CHK-UDVWQ	<5.0	<5.0	<5.0	0.0	93.0	92.6	93.2	0.3	<1.0	<1.0	<1.0	0.0	133.0	129.0	139.0	5.3	<1.0	<1.0	<1.0	0.0	<2.0	<2.0	<2.0	0.0
		CHK-LDVWQ	<5.0	<5.0	<5.0	0.0	99.2	98.9	99.5	0.3	<1.0	<1.0	<1.0	0.0	134.7	131.0	139.0	4.0	<1.0	<1.0	<1.0	0.0	<2.0	<2.0	<2.0	0.0
2016	17-Mar	CHK-USWQ02	<5.0	<5.0	<5.0	0.0	76.0	72.1	82.9	6.0	<1.0	<1.0	<1.0	0.0	96.7	95.0	98.0	1.5	<1.0	<1.0	<1.0	0.0	<2.0	<2.0	<2.0	0.0
		CHK-UDVWQ	<5.0	<5.0	<5.0	0.0	73.2	73.1	73.4	0.2	<1.0	<1.0	<1.0	0.0	98.7	98.0	100.0	1.2	<1.0	<1.0	<1.0	0.0	<2.0	<2.0	<2.0	0.0
		CHK-LDVWQ	<5.0	<5.0	<5.0	0.0	76.7	75.8	77.1	0.8	<1.0	<1.0	<1.0	0.0	100.3	96.0	103.0	3.8	<1.0	<1.0	<1.0	0.0	<2.0	<2.0	<2.0	0.0
	03-May	CHK-USWQ02	<5.0	<5.0	<5.0	0.0	13.4	12.7	14.4	0.9	<1.0	<1.0	<1.0	0.0	<42.7	<30.0	67.0	21.1	<1.0	<1.0	<1.0	0.0	<2.2	<2.0	2.6	0.3
		CHK-UDVWQ	<5.0	<5.0	<5.0	0.0	12.8	12.5	13.0	0.3	<1.0	<1.0	<1.0	0.0	<30.3	<30.0	31.0	0.6	<1.0	<1.0	<1.0	0.0	<2.0	<2.0	<2.0	0.0
		CHK-LDVWQ	<5.0	<5.0	<5.0	0.0	12.6	12.4	12.9	0.3	<1.0	<1.0	<1.0	0.0	<30.0	<30.0	<30.0	0.0	<1.0	<1.0	<1.0	0.0	<2.4	<2.0	3.2	0.7

[1] Average of three replicates (n=3) on each date unless otherwise indicated.

Parameters that have a concentration below the detection limit are assumed to have a concentration equal to the detection limit for calculation purposes.

3. HOLD TIME EXCEEDANCE REPORT

Year	Date	Site	Hold Time Exceedances[1,2]		
			Parameter	Recommended Hold Time	Actual Hold Time
2015	28-May	CHK-LDVWQ	Turbidity	3 days	4 days
		CHK-UDVWQ	Turbidity	3 days	4 days
		CHK-USWQ	Turbidity	3 days	4 days

[1] Exceedances refer to all replicates for the site, unless otherwise indicated.

[2] The hold time for pH is only 15 min. and is therefore exceeded for all samples on all dates.

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Appendix D. Water temperature guidelines, baseline data plots and summary statistics

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1. WATER TEMPERATURE GUIDELINES

Table 1. Water temperature guidelines for the protection of freshwater aquatic life (Oliver and Fidler 2001).

Category	Guideline
All Streams	the rate of temperature change in natural water bodies not to exceed 1°C/hr
	temperature metrics to be described by the mean weekly maximum temperature (MWMxT)
Streams with Known Fish Presence	mean weekly maximum water temperatures should not exceed ±1°C beyond the optimum temperature range for each life history phase of the most sensitive salmonid species present[1]
Streams with Bull Trout or Dolly Varden	maximum daily temperatures should not exceed 15°C
	maximum spawning temperature should not exceed 10°C
	preferred incubation temperatures should range from 2- 6°C
	±1°C change from natural condition[2]
Streams with Unknown Fish Presence	salmonid rearing temperatures not to exceed MWMxT of 18°C
	maximum daily temperature not to exceed 19°C
	maximum temperature for salmonid incubation from June until August not to exceed 12°C

[1] since the criterion is ±1°C beyond optimum ranges, we also calculated mean weekly minimum water temperatures (MWMnT) as this metic is more applicable for comparison to the lower end of temperature optima than MWMxT

[2] provided natural conditions are within these guidelines, if they are not, natural conditions should not be altered (Deniseger, pers. comm. 2009)

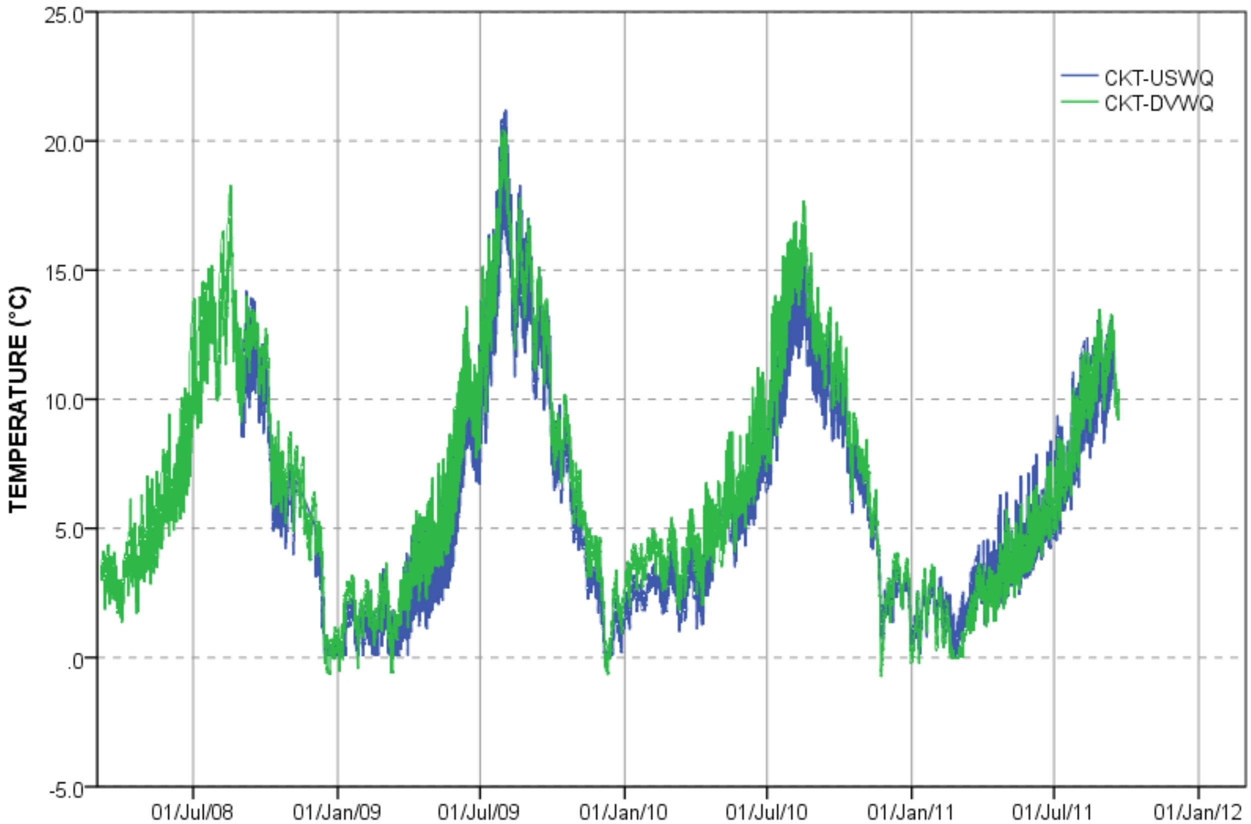
Table 2. Site Name Change Key

Previous Site Name (2008-2011)	UTM Coordinates (Zone 9U)		Baseline Site Name (2014-2016)	UTM Coordinates (Zone 9U)		Comments
	Easting	Northing		Easting	Northing	
CKT-DVWQ/ CK-WQ-2/ ChickwatFalls	448,986	5,520,263	CHK-LDVWQ	448,982	5,520,267	Temperature data was collected at a hydrometric station at this location from 2011 to 2016, however data was deemed unreliable.
CKT-USWQ/ CK-WQ-3/ ChickwatIntake	448,181	5,522,085	CHK-USWQ	448,250	5,522,297	Temperature data was collected at a hydrometric station at this location from 2011 to 2016. data was deemed reliable and used to supplement data gaps.
			CHK-USWQ02	448,239	5,522,523	Site moved upstream due to design change.

2. WATER TEMPERATURE PLOTS

2.1. Baseline: 2008 to 2011

Figure 1. Summary plot of water temperature data at the Chickwat upstream (CKT-USWQ) and diversion (CKT-DVWQ) sites from March 2008 to September 2011.



2.2. CHK-C1WQ and CHK-C2WQ (2014 to 2016)

Figure 2. Baseline water temperature at CHK-C1WQ from December 2014 to May 2016.

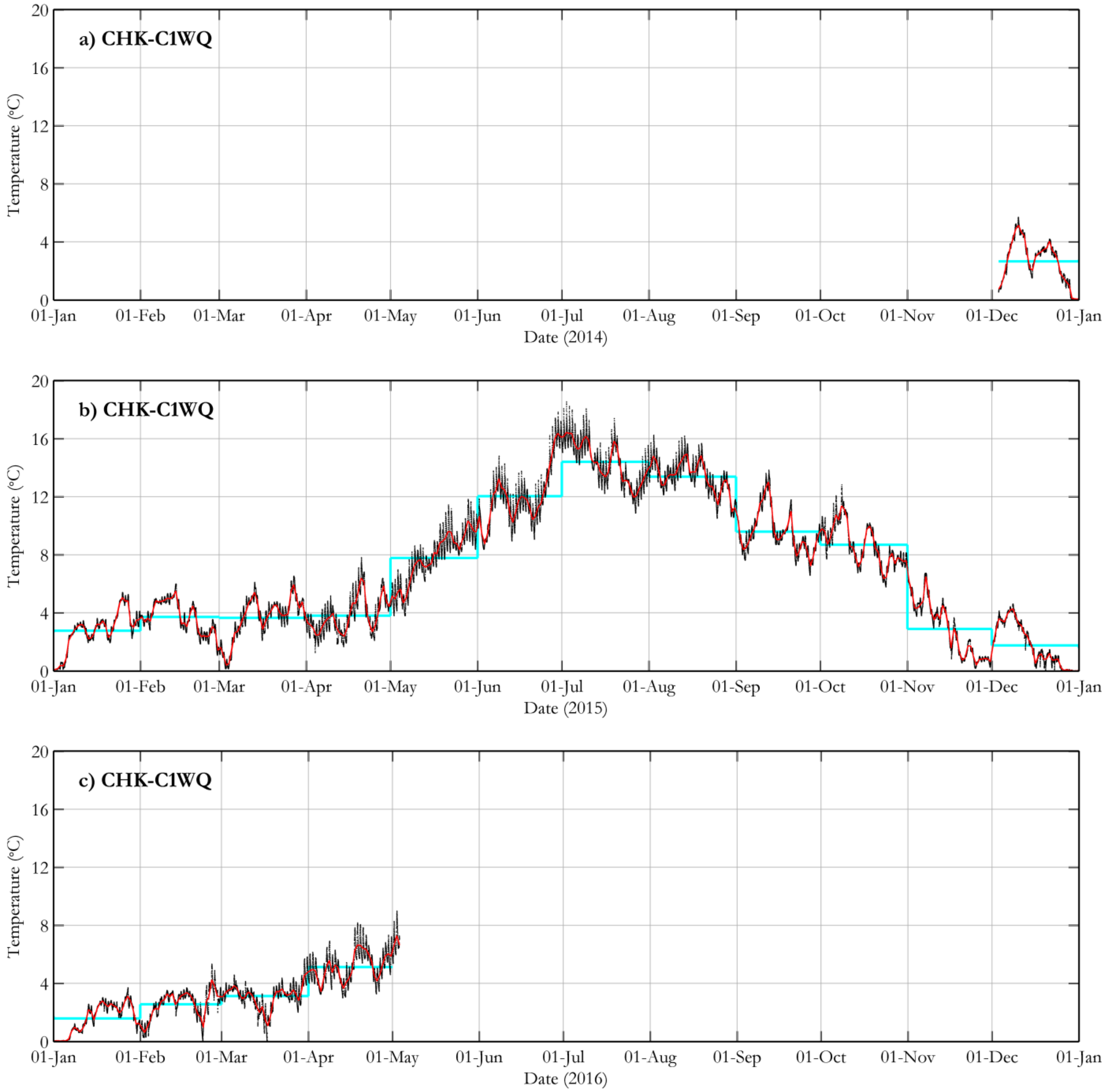
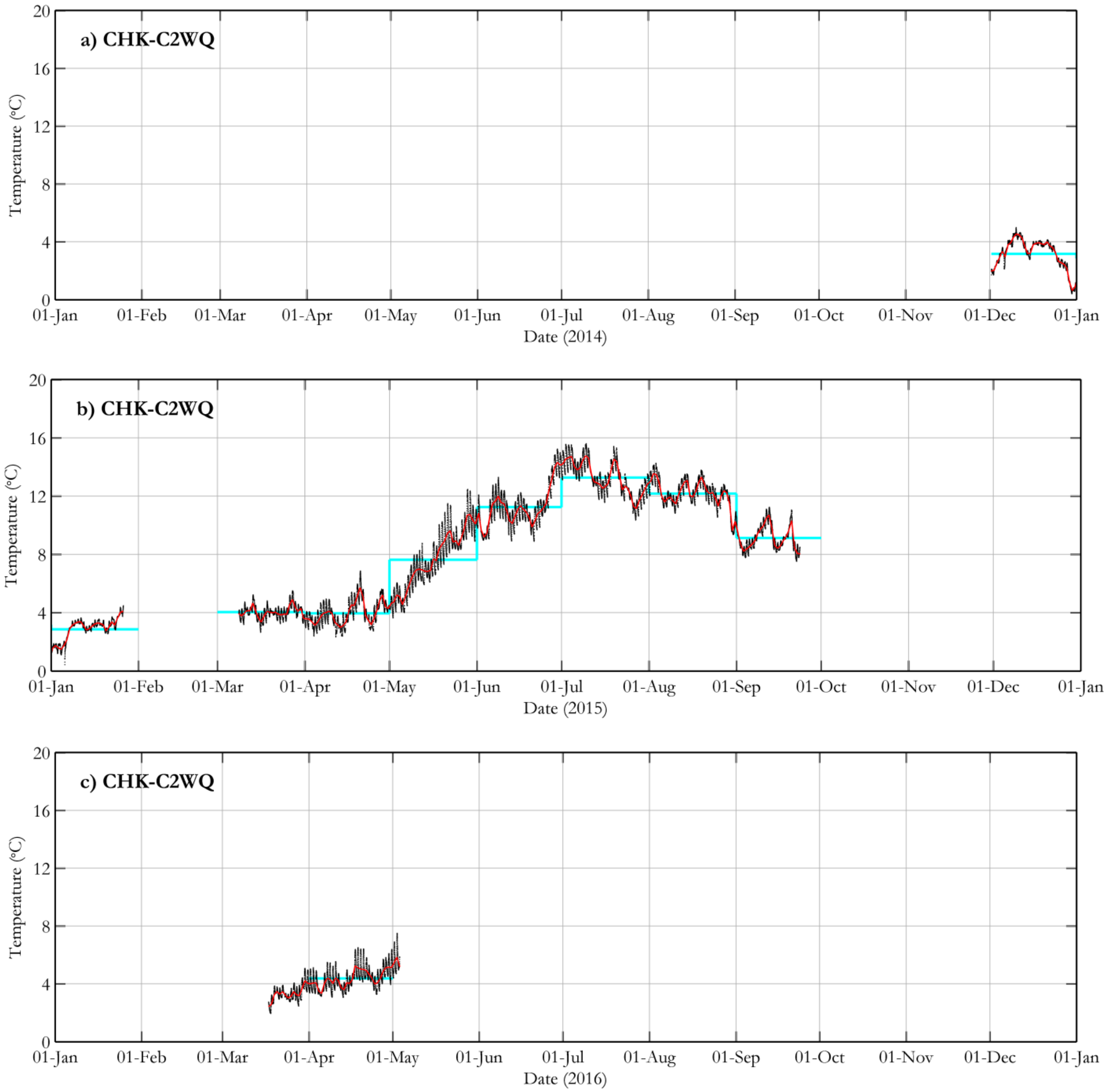


Figure 3. Baseline water temperature at CHK-C2WQ from December 2014 to May 2016.



2.3. CHK-USWQ02/CHK-USWQ (2010-2016)

Figure 4. Baseline water temperature at CHK-USWQ02 from November 2015 to May 2016.

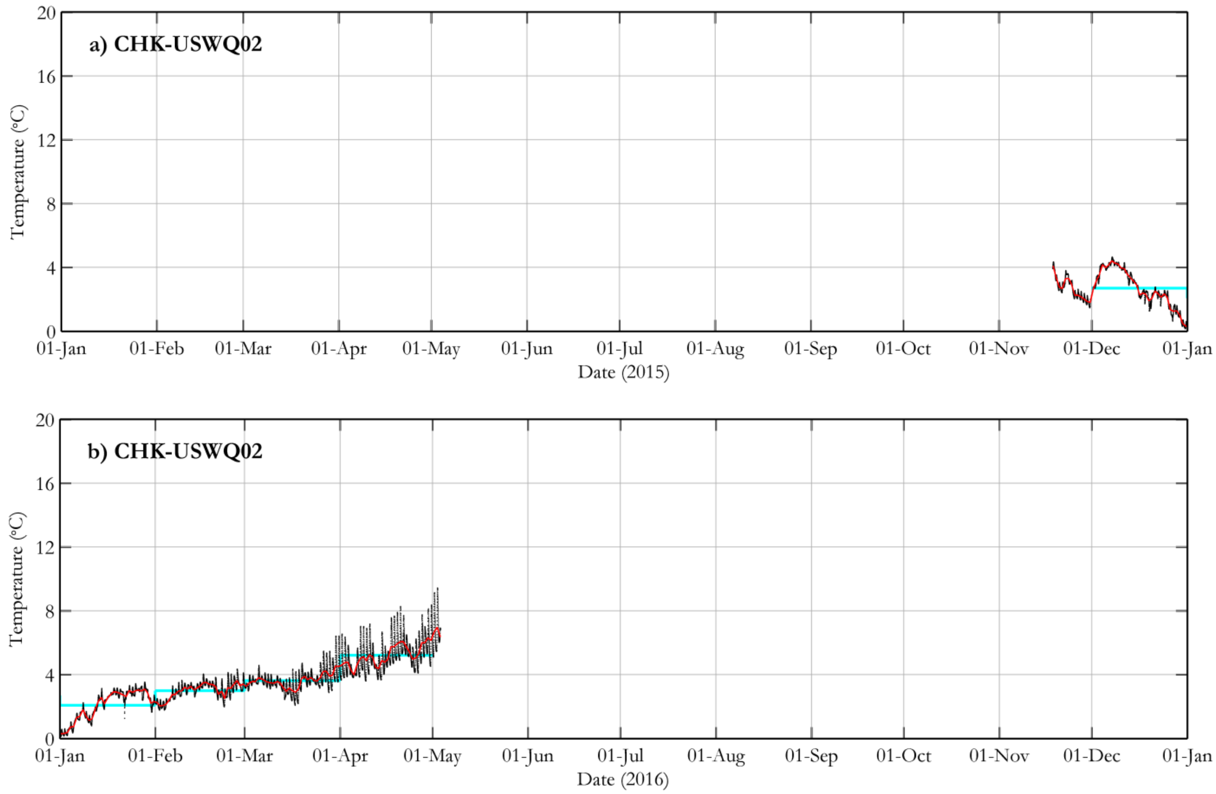


Figure 5. Baseline water temperature at CHK-USWQ from July 2010 to May 2016 Purple shading indicates data was collected at the hydrometric gauge; data provided by Aquarius R&D. Grey shading indicates data was collected by Ecofish.

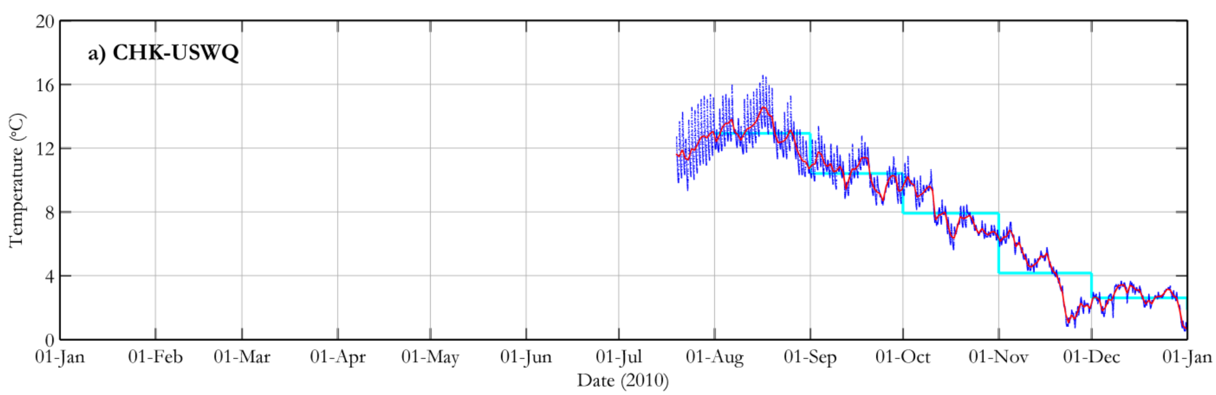


Figure 5. (Continued).

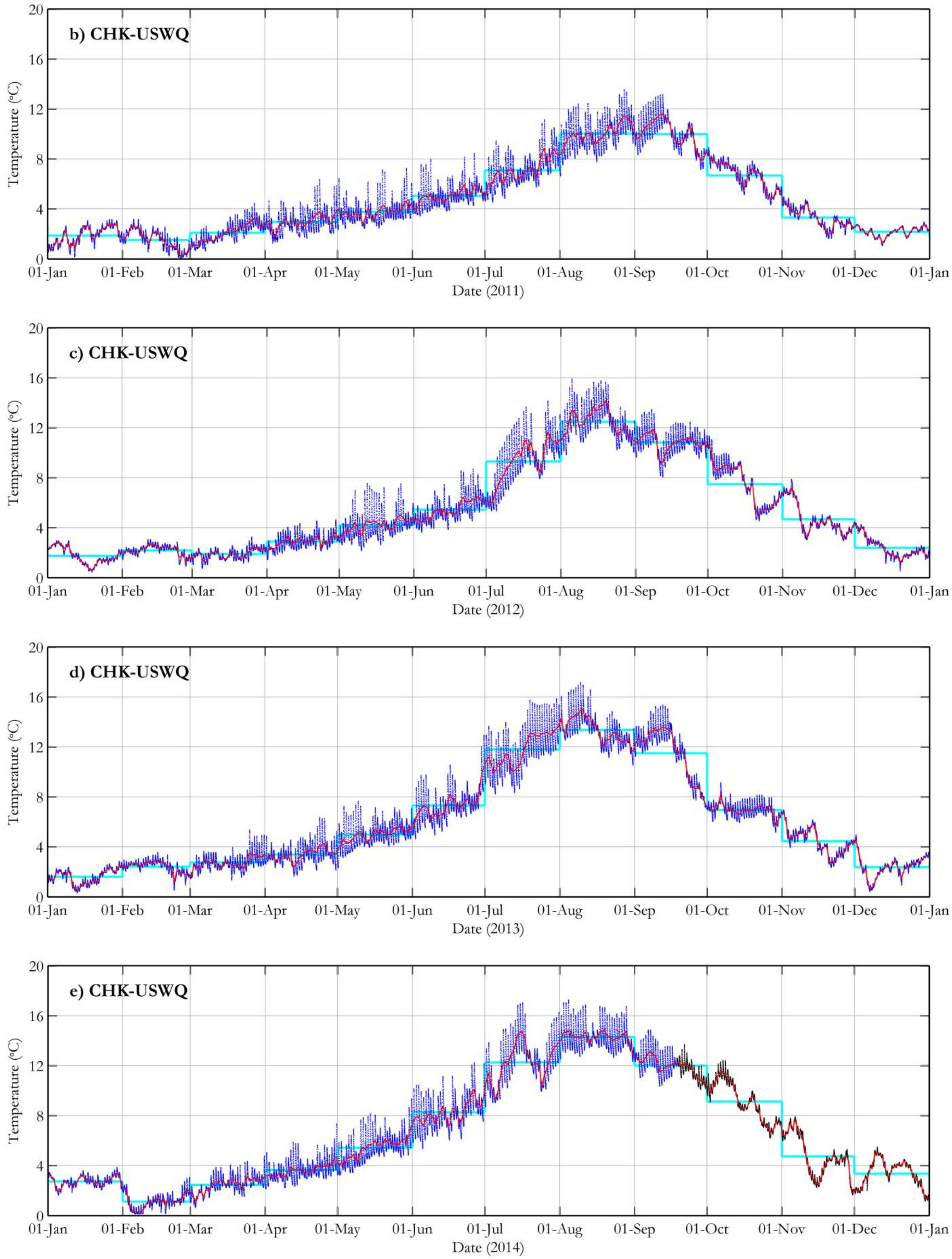
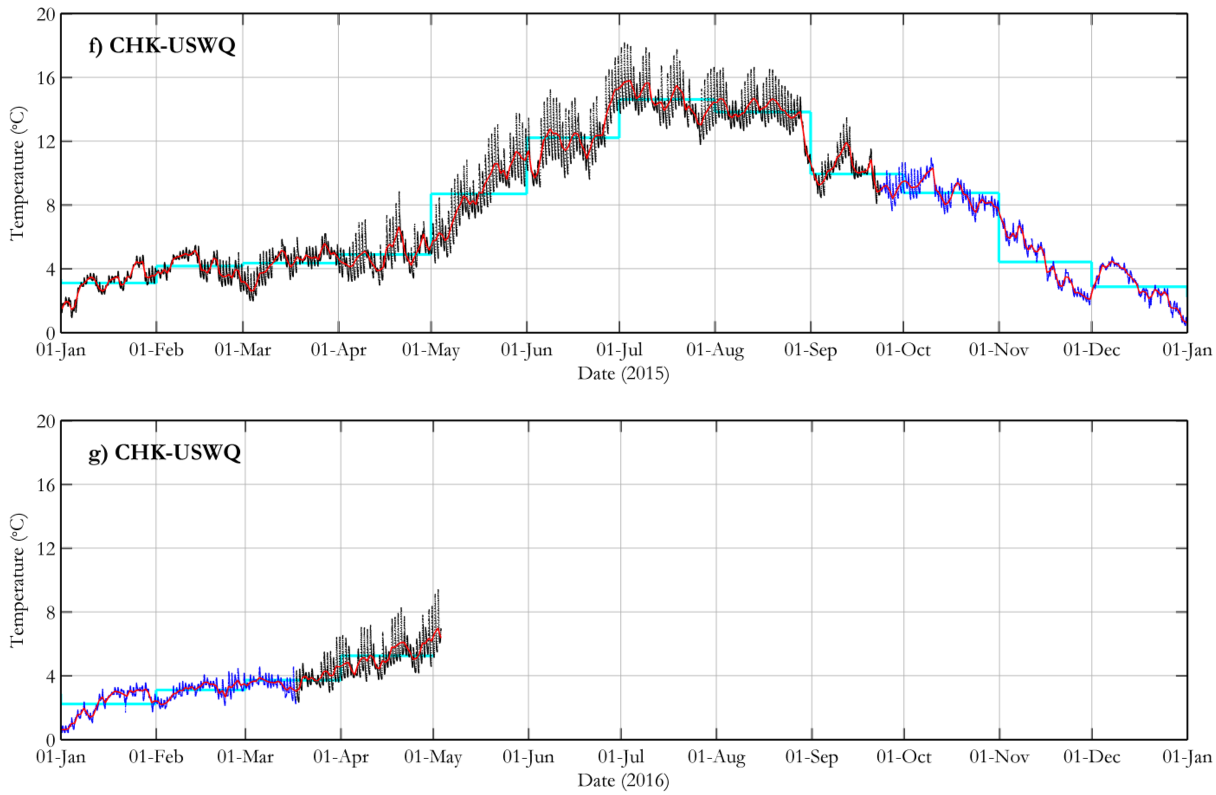


Figure 5. (Continued).



2.4. CHK-UDVWQ and CHK-LDVWQ (2014 to 2016)

Figure 6. Baseline water temperature at CHK-UDVWQ from October 2014 to May 2016.

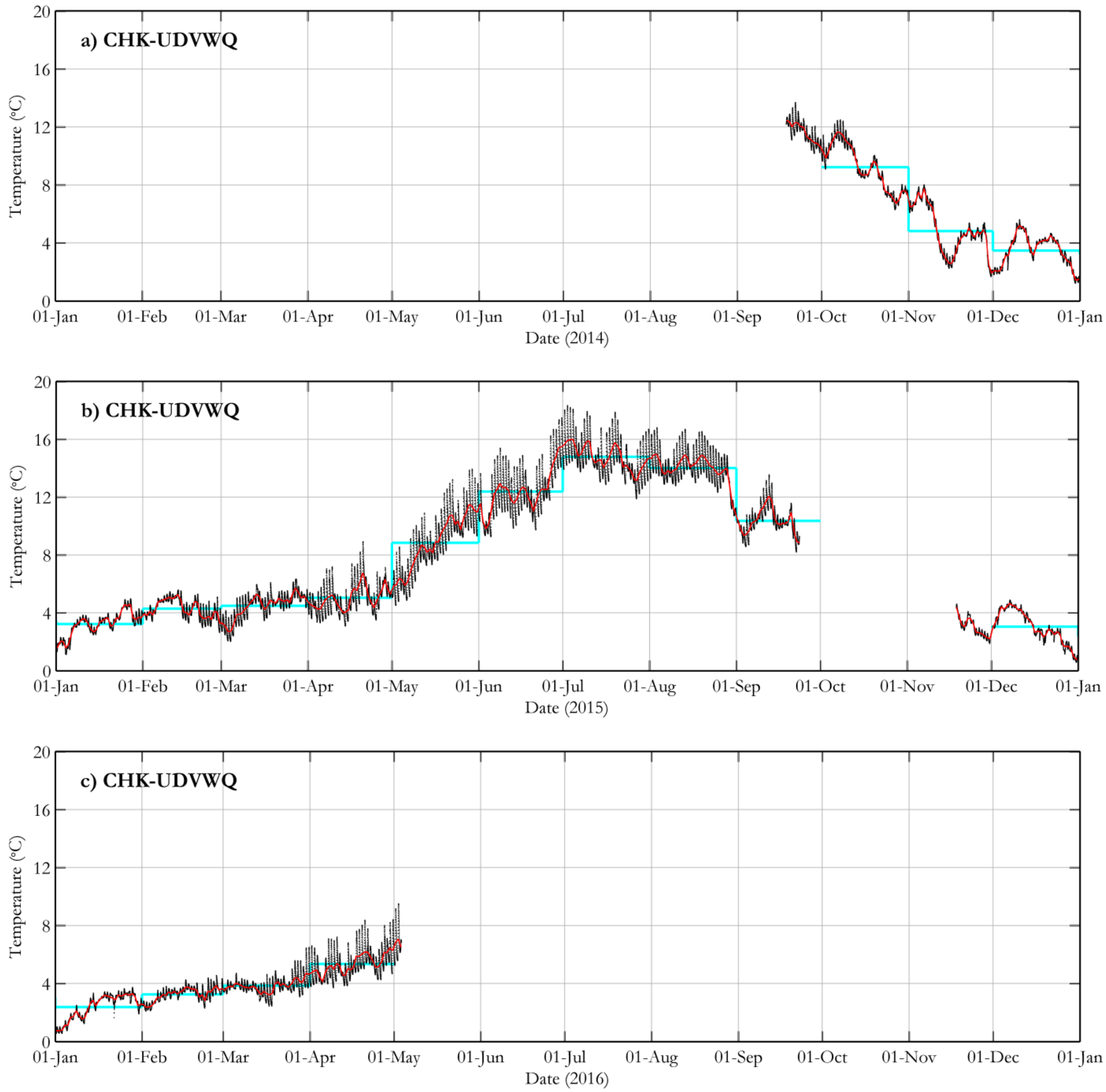
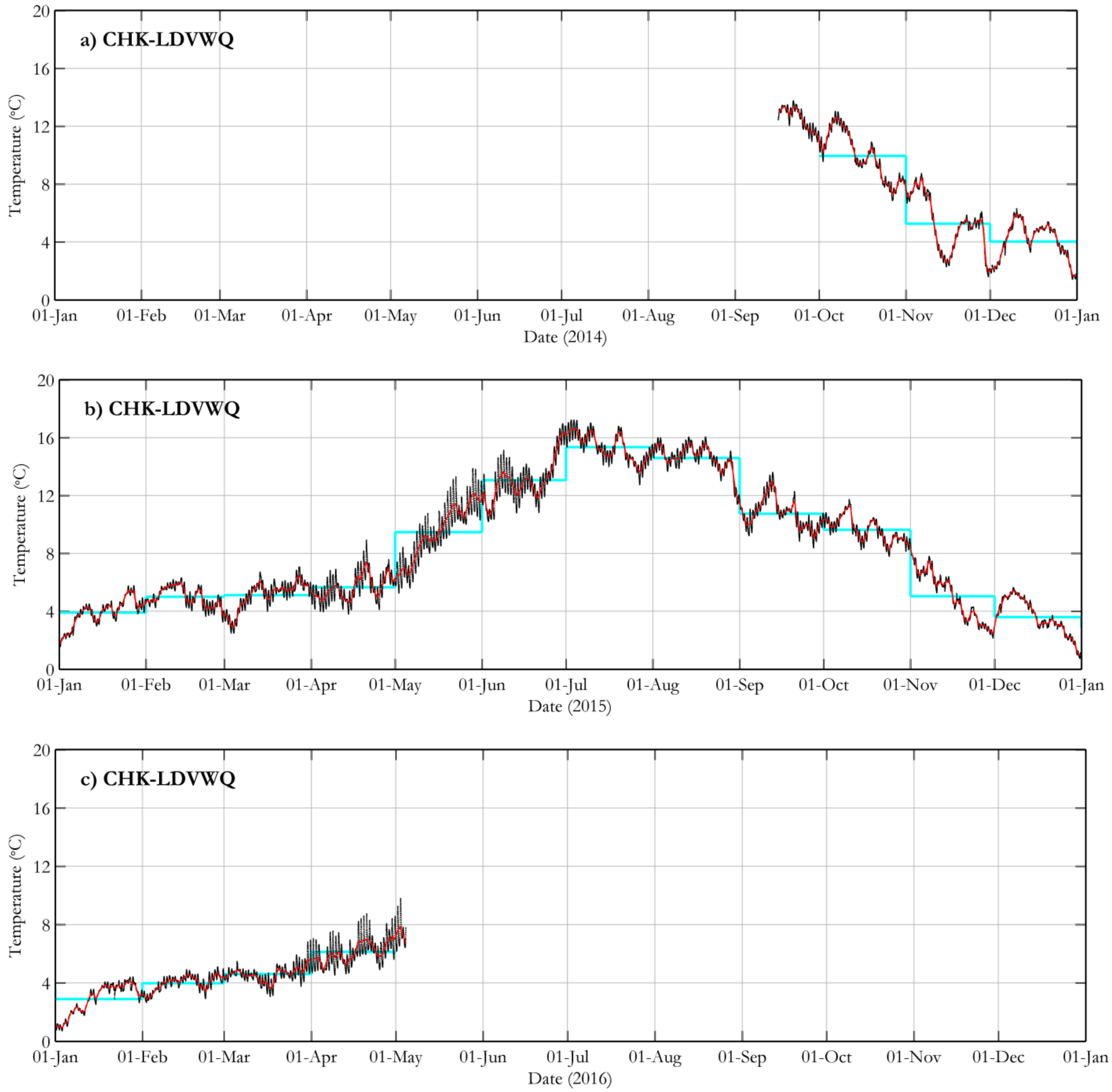


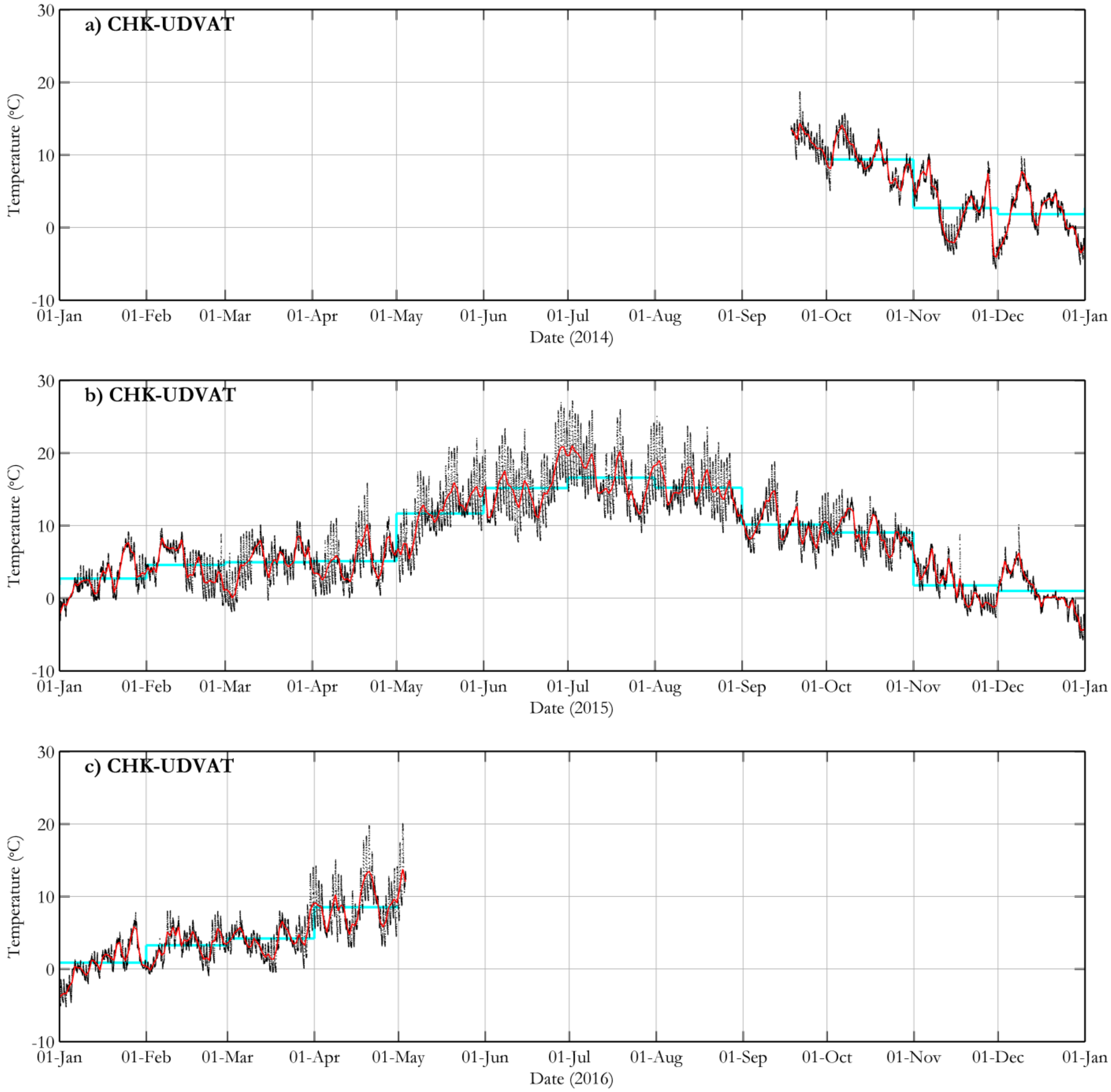
Figure 7. Baseline water temperature at CHK-LDVWQ from October 2014 to May 2016.



3. AIR TEMPERATURE PLOT

3.1. CHK-UDVAT: Air temperature plots (2014 to 2016).

Figure 8. Baseline air temperature at CHK-UDVAT from September 2014 to May 2016.



4. WATER TEMPERATURE DIFFERENCES RELATIVE TO CONTROL SITE

Table 3. Summary statistics for the difference between CHK-UDVWQ, CHK-LDVWQ, CHK-C2WQ, CHK-C1WQ relative to the control CHK-USWQ from October 2014 to April 2016.

Year	Month	<CHK-UDVWQ>-<CHK-USWQ>			<CHK-LDVWQ>-<CHK-USWQ>			<CHK-C2WQ>-<CHK-USWQ>			<CHK-C1WQ>-<CHK-USWQ>		
		Avg	Lower bound	Upper bound	Avg	Lower bound	Upper bound	Avg	Lower bound	Upper bound	Avg	Lower bound	Upper bound
2014	Sep	-	-	-	-	-	-	-	-	-	-	-	-
	Oct	0.1	-0.1	0.3	0.8	-0.4	1.4	-	-	-	-	-	-
	Nov	0.1	-0.1	0.2	0.5	-0.4	1.0	-	-	-	-	-	-
	Dec	0.1	0.0	0.3	0.7	-0.1	1.4	-0.2	-0.9	0.7	-0.8	-2.0	0.4
2015	Jan	0.1	0.0	0.3	0.8	0.1	1.4	-0.1	-1.0	0.5	-0.3	-2.0	0.7
	Feb	0.1	0.0	0.3	0.8	-0.4	1.1	-	-	-	-0.4	-2.6	0.6
	Mar	0.1	0.0	0.4	0.8	-0.6	1.3	-0.7	-1.7	0.3	-0.7	-3.0	0.7
	Apr	0.1	-0.2	0.5	0.8	-1.0	1.3	-0.9	-2.5	0.6	-1.1	-2.7	0.8
	May	0.1	-0.2	0.5	0.8	-0.5	1.4	-1.1	-2.5	0.8	-0.9	-2.5	0.7
	Jun	0.2	-0.2	0.6	0.9	-1.3	1.9	-1.0	-3.1	1.0	-0.2	-2.4	2.5
	Jul	0.2	-0.5	0.7	0.7	-1.6	1.9	-1.3	-3.6	0.9	-0.2	-2.4	2.2
	Aug	0.2	-0.4	0.6	0.8	-1.4	1.8	-1.7	-3.7	0.5	-0.4	-3.3	1.1
	Sep	0.1	-0.1	0.4	0.8	-0.3	1.4	-1.1	-3.0	0.0	-0.3	-1.7	1.6
	Oct	-	-	-	0.9	-0.3	1.3	-	-	-	-0.1	-1.9	2.4
	Nov	-	-	-	0.6	0.1	1.7	-	-	-	-1.5	-2.5	0.2
	Dec	0.2	0.0	0.5	0.7	0.0	1.5	-	-	-	-1.1	-2.4	0.4
2016	Jan	0.2	-0.4	0.9	0.7	0.0	1.8	-	-	-	-0.6	-1.7	0.5
	Feb	0.2	-0.1	0.3	0.9	0.1	1.2	-	-	-	-0.5	-2.1	1.6
	Mar	0.1	-0.2	0.4	0.9	-0.3	1.3	-	-	-	-0.6	-2.5	1.1
	Apr	0.1	-0.2	0.3	0.9	-0.4	1.3	-0.9	-2.2	0.5	-0.1	-1.6	2.2

5. BASELINE MONTHLY SUMMARY STATISTICS

5.1. Water Temperature

Table 4. Water temperature summary statistics for CKT-USWQ (CHK-USWQ) and CKT-DVWQ sites 2008 to 2011 (reproduced from O'Toole *et al.* 2012).

Year	Month	CKT-USWQ[1,2]					CKT-DVWQ[1,3]					USWQ - DVWQ		
		n	Avg	Min	Max	SD	n	Avg	Min	Max	SD	Avg	Min	Max
2008	Mar	-	-	-	-	-	609	2.9	1.5	4.4	0.6	-	-	-
	Apr	-	-	-	-	-	720	3.6	1.4	6.3	0.9	-	-	-
	May	-	-	-	-	-	744	5.1	2.8	9.4	1.2	-	-	-
	Jun	-	-	-	-	-	720	7.3	4.9	13.2	1.6	-	-	-
	Jul	-	-	-	-	-	744	11.9	8.9	15.2	1.5	-	-	-
	Aug	9	10.3	9.4	11.3	0.7	744	13.3	9.1	18.3	2.1	-	-	-
	Sep	720	10.9	8.5	14.2	1.2	720	12.0	9.8	14.0	0.9	-1.1	-1.2	0.2
	Oct	744	6.9	4.2	12.2	1.7	744	7.9	5.2	12.7	1.8	-1.1	-1.0	-0.5
	Nov	185	6.0	4.0	7.5	1.0	719	6.2	3.8	8.7	1.2	-0.3	0.2	-1.2
	Dec	708	1.5	0.1	5.2	1.7	744	2.1	-0.6	6.4	2.3	-0.6	0.7	-1.2
2009	Jan	744	1.0	0.1	2.3	0.7	744	1.6	-0.5	3.2	0.9	-0.6	0.6	-0.9
	Feb	672	1.1	0.1	3.5	0.6	672	1.9	0.5	3.2	0.6	-0.8	-0.3	0.2
	Mar	744	1.1	0.1	4.0	0.8	744	1.8	-0.6	3.7	1.0	-0.7	0.7	0.3
	Apr	720	2.6	0.7	6.1	1.1	720	3.8	1.9	6.6	0.9	-1.1	-1.1	-0.6
	May	744	4.1	1.8	9.1	1.6	744	5.4	3.3	9.7	1.4	-1.3	-1.5	-0.5
	Jun	720	8.6	4.8	13.2	1.6	720	9.6	6.1	13.6	1.4	-1.0	-1.3	-0.4
	Jul	744	13.6	7.6	20.9	3.0	744	14.7	9.0	20.4	2.9	-1.0	-1.4	0.4
	Aug	744	14.8	10.9	21.2	2.0	744	15.8	11.9	20.4	1.8	-0.9	-1.0	0.8
	Sep	720	11.8	7.4	16.2	1.6	720	12.9	8.2	16.7	1.7	-1.1	-0.7	-0.5
	Oct	744	7.2	4.4	9.8	1.2	744	8.1	5.2	10.2	1.2	-0.9	-0.7	-0.4
	Nov	720	3.7	1.7	6.1	1.0	720	4.7	2.9	7.3	1.0	-1.0	-1.2	-1.1
	Dec	744	0.9	0.1	2.9	0.7	744	1.6	-0.7	4.1	1.1	-0.7	0.8	-1.2
2010	Jan	744	2.3	1.1	3.2	0.5	744	3.6	1.9	4.6	0.6	-1.2	-0.8	-1.4
	Feb	672	2.8	1.7	4.1	0.4	672	4.0	2.6	5.3	0.6	-1.2	-0.9	-1.2
	Mar	744	2.8	1.0	4.4	0.7	744	3.9	1.8	5.8	0.9	-1.1	-0.8	-1.4
	Apr	517	3.0	1.1	6.1	0.9	720	4.4	2.0	6.8	1.0	-1.4	-0.9	-0.7
	May	420	5.3	3.5	7.6	0.8	744	5.9	3.5	8.8	1.1	-0.7	0.0	-1.2
	Jun	720	6.7	4.3	9.9	1.1	720	7.8	5.0	11.2	1.2	-1.1	-0.7	-1.4
	Jul	744	10.4	6.6	15.3	2.0	744	11.9	7.5	16.2	2.2	-1.5	-0.9	-0.9
	Aug	744	12.9	10.2	16.5	1.3	744	14.7	11.8	17.7	1.2	-1.8	-1.6	-1.2
	Sep	720	10.4	8.4	13.3	1.0	720	11.9	9.6	14.3	1.0	-1.5	-1.2	-1.1
	Oct	744	7.9	5.6	11.4	1.3	744	9.0	6.1	12.4	1.5	-1.1	-0.5	-1.0
	Nov	720	4.1	0.7	7.3	1.8	720	4.3	-0.8	8.5	2.5	-0.2	1.5	-1.2
	Dec	744	2.6	0.5	3.6	0.7	744	2.8	-0.2	4.0	0.9	-0.2	0.7	-0.4
2011	Jan	744	1.8	0.2	3.1	0.7	744	1.9	-0.2	3.6	1.0	0.0	0.4	-0.5
	Feb	672	1.5	0.0	3.1	0.8	672	0.9	0.0	2.7	0.8	0.5	0.0	0.4
	Mar	744	2.0	0.6	4.4	0.8	744	1.6	0.0	3.7	1.0	0.4	0.6	0.7
	Apr	720	2.9	1.3	6.3	0.9	720	2.6	1.2	5.1	0.7	0.3	0.1	1.2
	May	744	3.7	2.3	7.2	0.9	744	3.8	2.3	6.3	0.7	-0.1	0.0	0.9
	Jun	720	5.0	3.4	8.4	0.9	720	5.1	3.5	7.6	0.8	-0.1	-0.1	0.8
	Jul	744	7.0	4.5	11.1	1.3	744	7.2	4.8	10.5	1.1	-0.2	-0.3	0.6
	Aug	744	10.0	6.6	13.5	1.2	744	10.6	7.4	13.5	1.2	-0.6	-0.8	0.0
	Sep	348	10.7	8.3	13.1	1.1	491	11.2	9.2	13.3	1.0	-	-	-

[1]Coldest months on average are denoted in blue, warmest months on average are denoted in red.

[2]Shading indicates period when Solinst Sensor was installed at the USWQ site (Corrected WL-16 Sensor prior to May 14, 2010).

[3]Shading indicates period when new WL-16 Sensor was installed at the DVWQ site (new correction equation).

ECOFISH RESEARCH

Table 5. Monthly water temperature summary statistics from August 2010 to December 2014 at CHK-USWQ (data provided by Aquarius R&D).

Year	Month	Water Temperature[1] (°C) CHK-USWQ				Year	Month	Water Temperature[1] (°C) CHK-USWQ			
		Avg	Min	Max	SD			Avg	Min	Max	SD
2010	Jul	-	-	-	-	2012	Jan	1.7	0.5	3.0	0.7
	Aug	12.9	10.3	16.6	1.3		Feb	2.2	1.0	3.1	0.4
	Sep	10.4	8.5	13.4	1.0		Mar	1.9	0.8	3.3	0.4
	Oct	7.9	5.7	11.5	1.3		Apr	2.9	1.5	4.7	0.6
	Nov	4.2	0.8	7.4	1.8		May	4.2	2.2	7.6	1.1
	Dec	2.6	0.6	3.7	0.7		Jun	5.4	3.7	8.7	1.0
2011	Jan	1.9	0.2	3.2	0.7		Jul	9.3	5.4	14.2	2.0
	Feb	1.5	0.1	3.2	0.8		Aug	12.5	9.9	15.9	1.3
	Mar	2.1	0.7	4.5	0.8		Sep	10.8	8.1	13.5	1.0
	Apr	3.0	1.3	6.4	0.9		Oct	7.5	4.6	11.4	1.7
	May	3.8	2.4	7.3	0.9		Nov	4.7	3.0	7.9	1.2
	Jun	5.0	3.5	8.5	0.9		Dec	2.4	0.6	4.4	0.8
	Jul	7.1	4.6	11.2	1.3	2013	Jan	1.6	0.4	2.9	0.6
	Aug	10.0	6.7	13.6	1.2		Feb	2.4	0.6	3.6	0.5
	Sep	10.0	7.2	13.2	1.3		Mar	2.7	1.4	5.4	0.7
	Oct	6.7	4.4	9.0	1.1		Apr	3.4	1.7	6.4	0.8
	Nov	3.3	1.7	5.0	0.8		May	5.0	2.4	7.7	0.9
	Dec	2.2	1.1	3.0	0.4		Jun	7.3	4.7	13.0	1.4
	-	-	-	-	-		Jul	11.8	8.3	15.9	1.8
	-	-	-	-	-		Aug	13.4	10.6	17.2	1.3
	-	-	-	-	-		Sep	11.5	7.1	15.4	2.1
	-	-	-	-	-		Oct	7.0	5.2	9.2	0.6
	-	-	-	-	-		Nov	4.4	2.4	7.0	1.0
	-	-	-	-	-		Dec	2.4	0.5	5.0	0.8

[1]Summary statistics were only generated for months with at least three weeks of data.

Red shading highlights annual maximum values.

Blue shading highlights annual minimum values.

Table 6. Monthly water temperature summary statistics from January 2015 to May 2016 at all sites.

Year	Month	Water Temperature[1] (°C)																							
		CHK-USWQ02				CHK-USWQ[2]				CHK-UDVWQ[3]				CHK-LDVWQ				CHK-C2WQ[3]				CHK-C1WQ			
		Avg.	Min	Max	SD	Avg.	Min	Max	SD	Avg.	Min	Max	SD	Avg.	Min	Max	SD	Avg.	Min	Max	SD	Avg.	Min	Max	SD
2014	Jan	-	-	-	-	2.7	1.7	3.9	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Feb	-	-	-	-	1.1	0.2	3.1	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Mar	-	-	-	-	2.5	0.7	4.8	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Apr	-	-	-	-	3.7	2.2	7.4	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	May	-	-	-	-	5.4	3.3	9.4	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Jun	-	-	-	-	8.3	5.4	12.3	1.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Jul	-	-	-	-	12.3	8.7	17.1	1.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Aug	-	-	-	-	14.3	12.4	17.3	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Sep	-	-	-	-	12.0	10.1	14.9	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Oct	-	-	-	-	9.1	6.2	12.4	1.6	9.2	6.3	12.5	1.6	10.0	6.9	13.0	1.6	-	-	-	-	-	-	-	-
	Nov	-	-	-	-	4.7	1.6	7.9	1.6	4.8	1.7	8.0	1.6	5.3	1.6	8.7	1.9	-	-	-	-	-	-	-	-
	Dec	-	-	-	-	3.4	1.2	5.5	1.0	3.5	1.2	5.6	1.1	4.0	1.4	6.3	1.3	3.2	0.4	5.0	1.0	2.7	0.1	5.7	1.5
2015	Jan	-	-	-	-	3.1	0.9	4.8	0.8	3.2	1.1	5.0	0.8	3.9	1.6	5.8	0.9	2.9	0.4	4.5	0.7	2.8	0.1	5.4	1.3
	Feb	-	-	-	-	4.2	2.6	5.5	0.6	4.3	2.7	5.6	0.7	5.0	3.2	6.3	0.7	-	-	-	-	3.7	1.1	6.0	1.1
	Mar	-	-	-	-	4.4	2.0	6.2	0.9	4.5	2.0	6.3	0.9	5.1	2.5	7.1	1.0	4.0	2.7	5.5	0.5	3.7	0.1	6.5	1.5
	Apr	-	-	-	-	4.9	3.0	8.8	1.0	5.0	3.1	8.9	1.0	5.7	3.8	8.9	0.9	4.0	2.3	6.9	0.8	3.8	1.3	7.8	1.3
	May	-	-	-	-	8.7	4.4	13.7	2.1	8.8	4.5	13.9	2.1	9.5	5.3	13.9	2.0	7.6	3.6	12.5	2.0	7.8	3.8	11.8	1.8
	Jun	-	-	-	-	12.2	9.1	17.3	1.7	12.4	9.3	17.5	1.8	13.1	10.2	17.0	1.5	11.2	8.9	15.2	1.4	12.0	8.4	17.8	2.0
	Jul	-	-	-	-	14.6	11.8	18.2	1.3	14.8	11.9	18.3	1.3	15.3	12.8	17.2	1.0	13.3	10.4	15.6	1.2	14.4	10.9	18.5	1.5
	Aug	-	-	-	-	13.8	10.6	16.6	1.2	14.0	10.7	16.8	1.2	14.6	11.4	16.1	1.0	12.2	9.4	14.3	0.9	13.4	10.5	16.2	1.2
	Sep	-	-	-	-	9.9	7.7	13.5	1.0	10.4	8.2	13.6	1.0	10.7	8.4	13.6	1.0	9.1	7.5	11.2	0.8	9.6	6.6	13.8	1.5
	Oct	-	-	-	-	8.8	7.0	11.0	0.8	-	-	-	-	9.6	7.8	11.7	0.8	-	-	-	-	8.7	5.8	12.8	1.4
	Nov	-	-	-	-	4.4	1.8	7.6	1.6	-	-	-	-	5.0	2.2	8.5	1.7	-	-	-	-	2.9	0.2	7.1	1.9
	Dec	2.7	0.2	4.7	1.2	2.9	0.5	4.8	1.1	3.0	0.6	4.9	1.1	3.6	0.7	5.6	1.2	-	-	-	-	1.8	0.0	4.6	1.5
2016	Jan	2.1	0.1	3.5	0.9	2.2	0.5	3.6	0.9	2.4	0.6	3.7	0.9	2.9	0.7	4.4	1.0	-	-	-	-	1.6	0.0	3.7	1.0
	Feb	3.0	1.8	4.4	0.5	3.1	2.0	4.5	0.5	3.3	2.1	4.6	0.5	4.0	2.7	5.1	0.5	-	-	-	-	2.6	0.1	5.3	1.0
	Mar	3.6	2.1	6.4	0.6	3.7	2.3	6.4	0.6	3.9	2.5	6.5	0.6	4.6	3.1	6.9	0.6	-	-	-	-	3.1	0.0	5.8	0.9
	Apr	5.2	3.6	8.4	1.0	5.3	3.7	8.3	1.0	5.3	3.7	8.4	1.0	6.1	4.5	8.7	0.9	4.4	3.1	6.5	0.8	5.1	3.0	8.2	1.1
	May	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

[1]Summary statistics were only generated for months with at least three weeks of data.

[2]The data prior to 18 Sept 2014 and gaps in data at CHK-USWQ from 23 Sept 2015 to 17 Mar 2016 are supplemented by data collected at a nearby hydrometric gauge (ChickwatIntake site) installed by Aquarius R&D.

[3]Data collection gaps at sites CHK-UDVWQ and CHK-C2WQ are due to Tidbit malfunctioning.

Red shading highlights annual maximum values.

Blue shading highlights annual minimum values.

5.2. Air Temperature

Table 7. Monthly air temperature summary statistics from October 2014 to April 2016 at CHK-UDVAT.

Year	Month	Air Temperature			
		CHK-UDVAT			
		Avg	Min	Max	SD
2014	Sep	-	-	-	-
	Oct	9.4	3.1	15.7	2.5
	Nov	2.7	-5.7	10.1	3.7
	Dec	1.8	-5.1	9.7	3.1
2015	Jan	2.7	-3.2	9.1	2.5
	Feb	4.6	-1.0	9.6	2.4
	Mar	4.9	-1.8	10.6	2.7
	Apr	5.1	0.1	15.8	3.0
	May	11.7	2.2	22.0	3.9
	Jun	15.1	7.7	26.9	4.0
	Jul	16.6	9.0	27.1	3.8
	Aug	15.2	9.0	25.0	3.1
	Sep	10.1	4.1	18.8	2.6
	Oct	9.0	3.8	15.0	2.3
	Nov	1.8	-2.7	8.7	2.6
	Dec	1.0	-5.7	10.1	2.7
2016	Jan	0.9	-5.2	7.8	2.4
	Feb	3.3	-0.9	8.0	2.0
	Mar	4.2	-0.4	14.0	2.2
	Apr	8.5	3.0	19.8	3.2

Red shading highlights annual maximum values.

Blue shading highlights annual minimum values.

6. HOURLY RATE OF CHANGE

6.1. Baseline: 2008 to 2011

Table 8. Rate of change in water temperature in the upstream and lower diversion reach from 2008 to 2011 (O'Toole *et al.* 2012).

Site	Start of record	End of record	Datapoints		Maximum Exceedance of + 1 °C/hr		Maximum Exceedance of - 1 °C/hr	
			Total No.	Exceedance (%)	Rate (°C/hr)	Date and Time	Rate (°C/hr)	Date and Time
CKT-DVWQ	6-Mar-08	21-Sep-11	31051	0.003	-	-	-1.02	15-May-08 17:00
CKT-USWQ	31-Aug-08	15-Sep-11	25539	0.282	1.18	09-Jul-09 11:00	-1.02	May/June 2009

6.2. CHK-C1WQ and CHK-C2WQ (2014 to 2016)

Figure 9. Hourly rate of change in baseline water temperature at CHK-C1WQ and CHK-C2WQ from 2014 to 2016. Red circles indicate rates that exceed the ±1.0°C/hr provincial guideline.

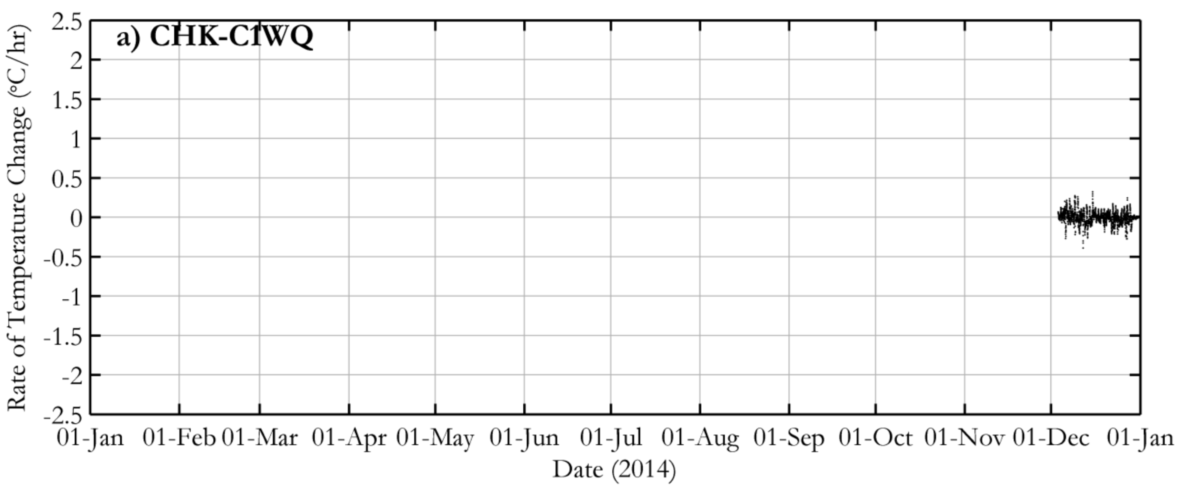
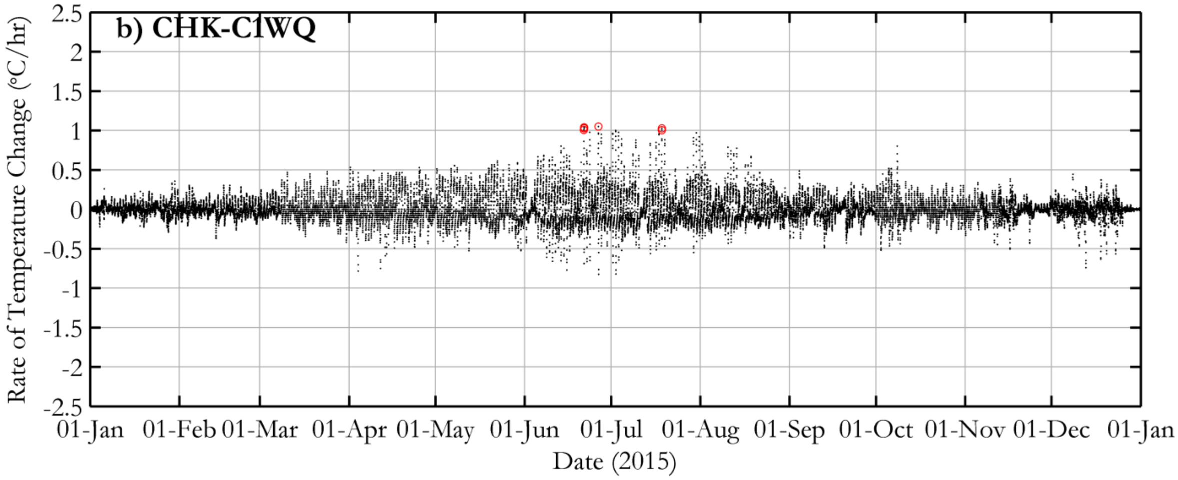
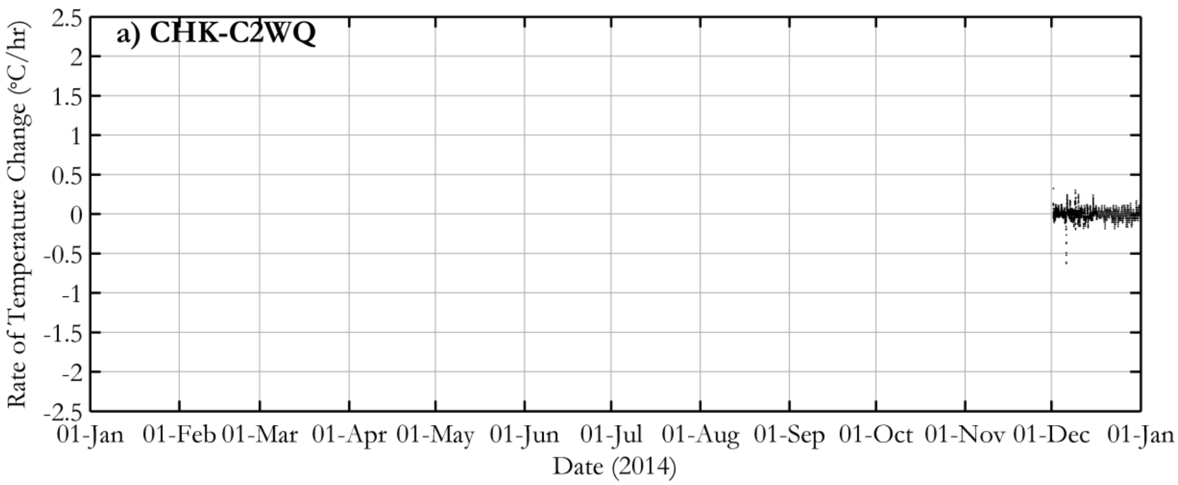
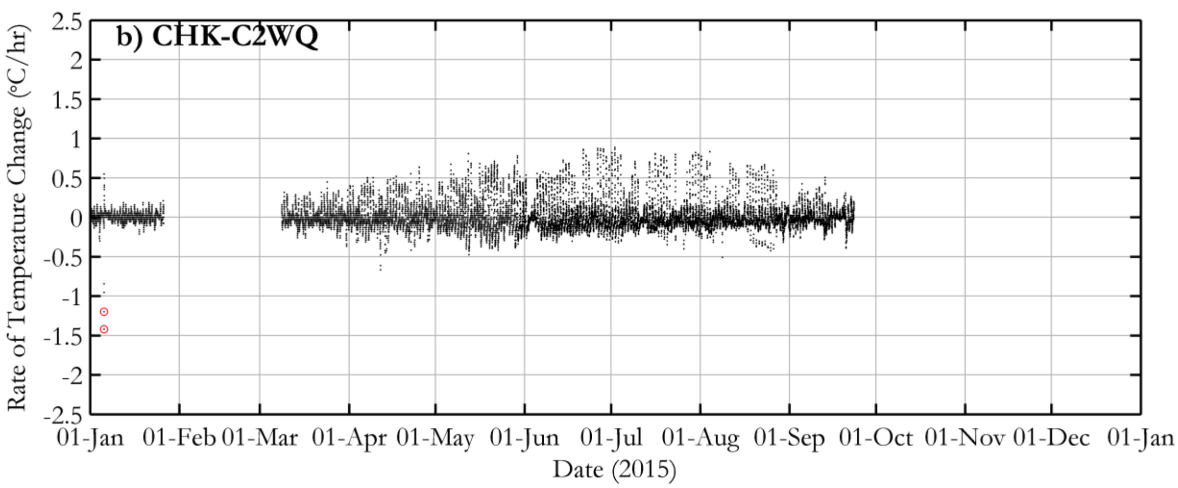


Figure 9. (Continued).







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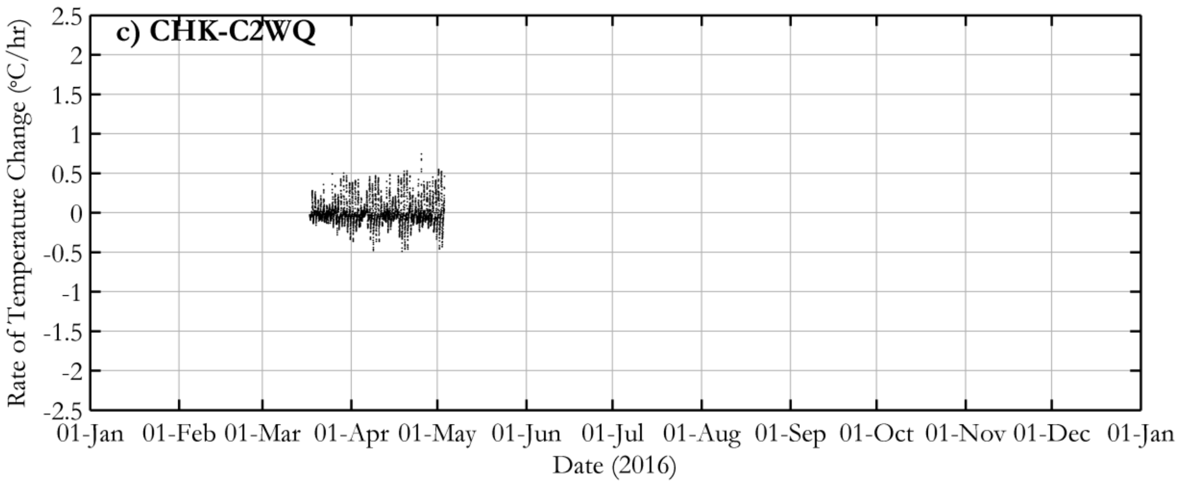
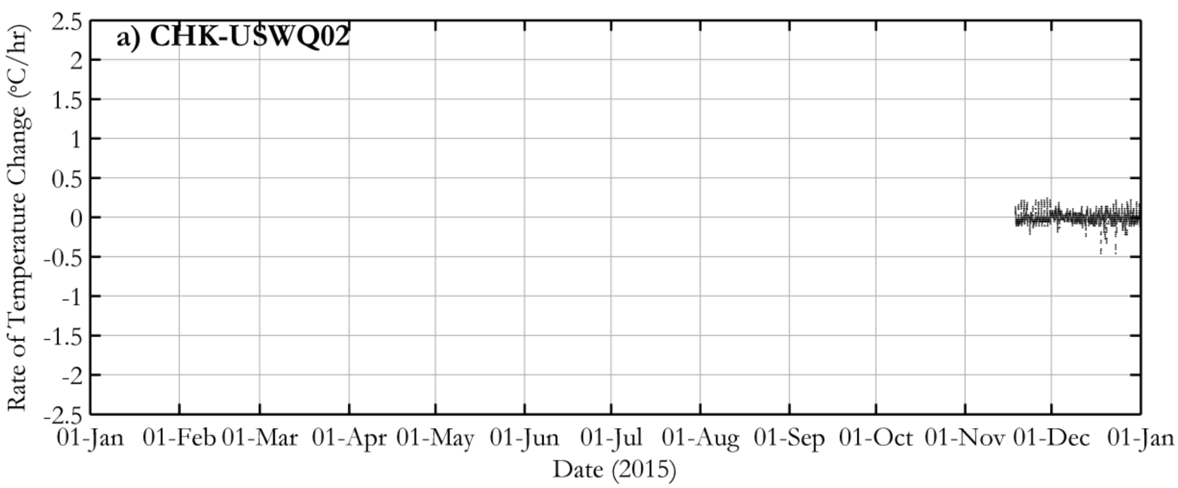


6.3. CHK-USWQ02/CHK-USWQ (2010 to 2016)

Figure 10. Hourly rate of change in baseline water temperature at CHK-USWQ02 and CHK-USWQ from 2014 to 2016. Red circles indicate rates that exceed the ±1.0°C/hr provincial guideline.



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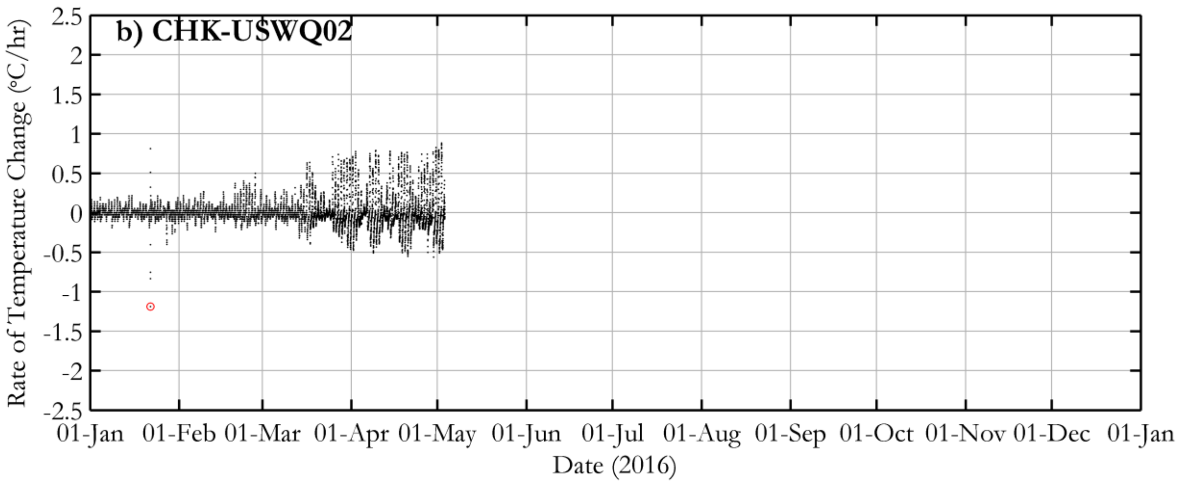

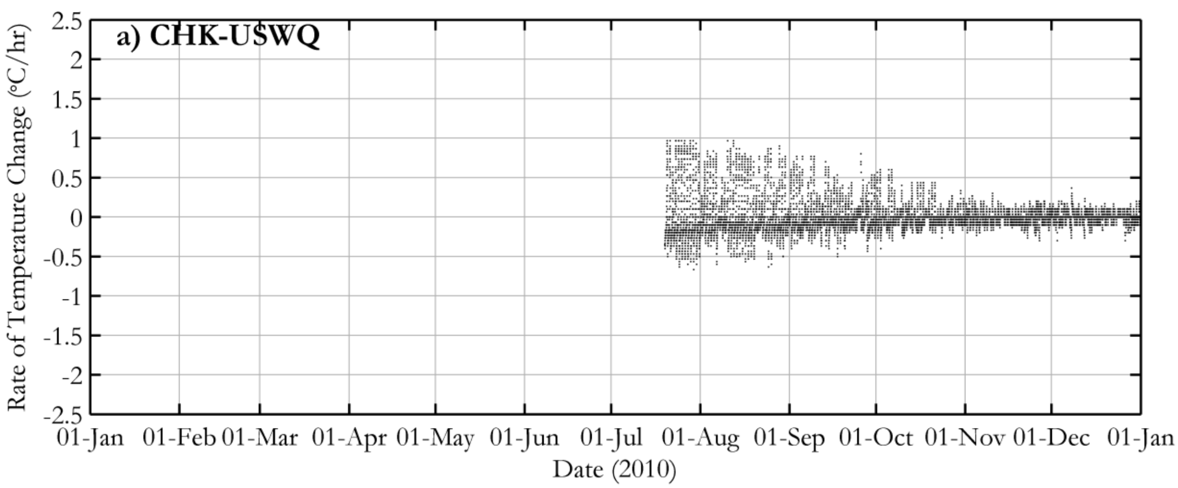

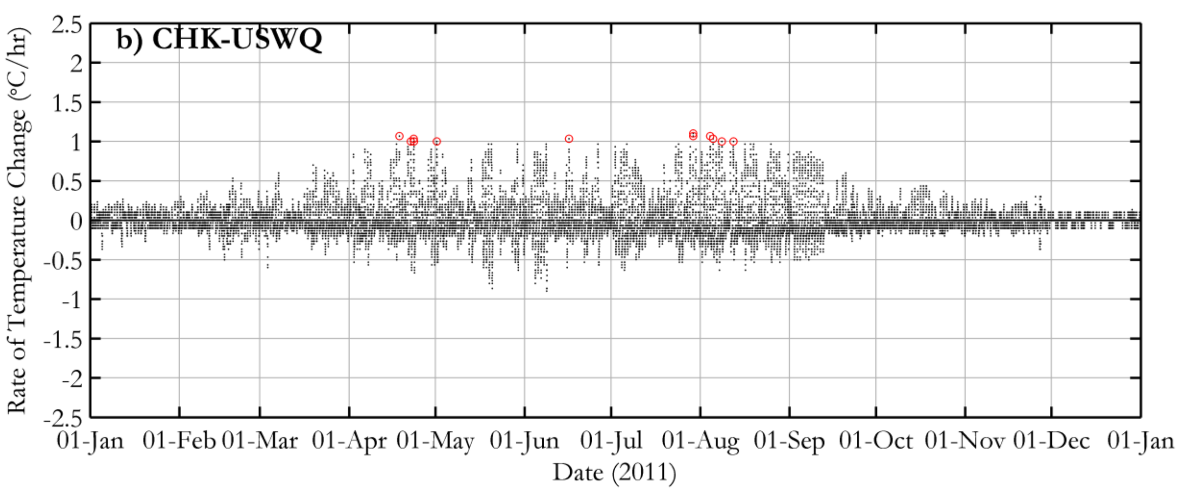

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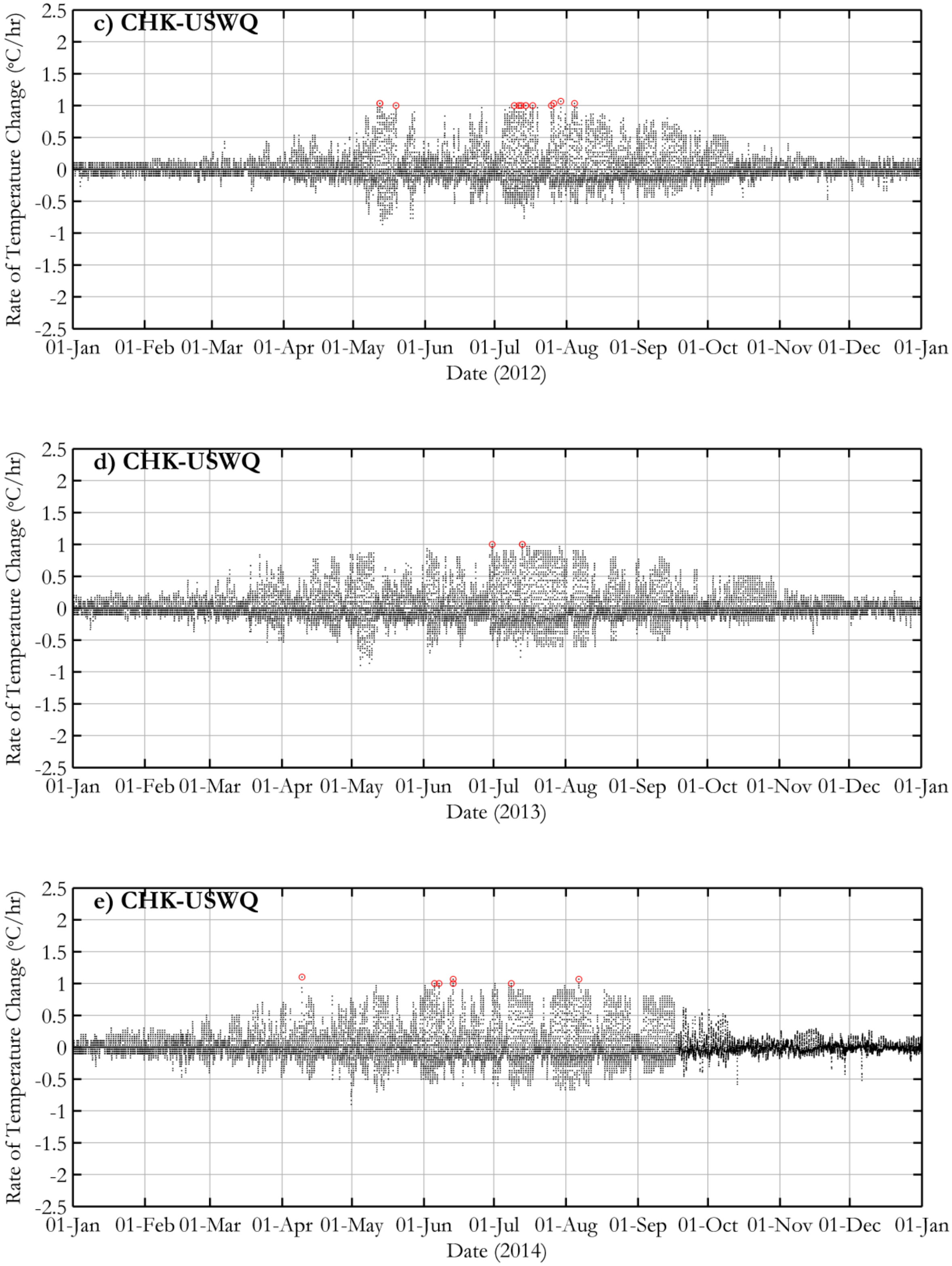

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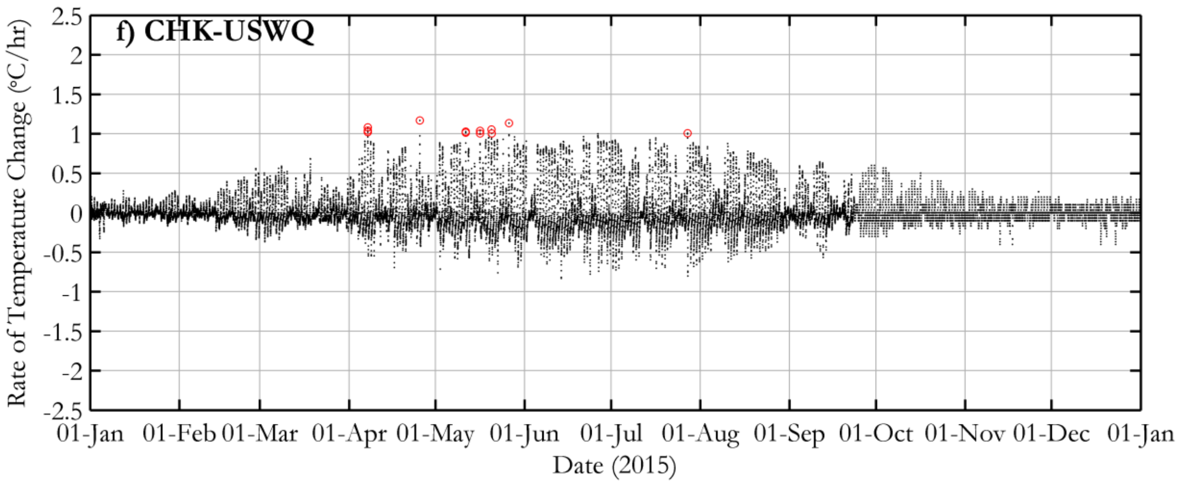
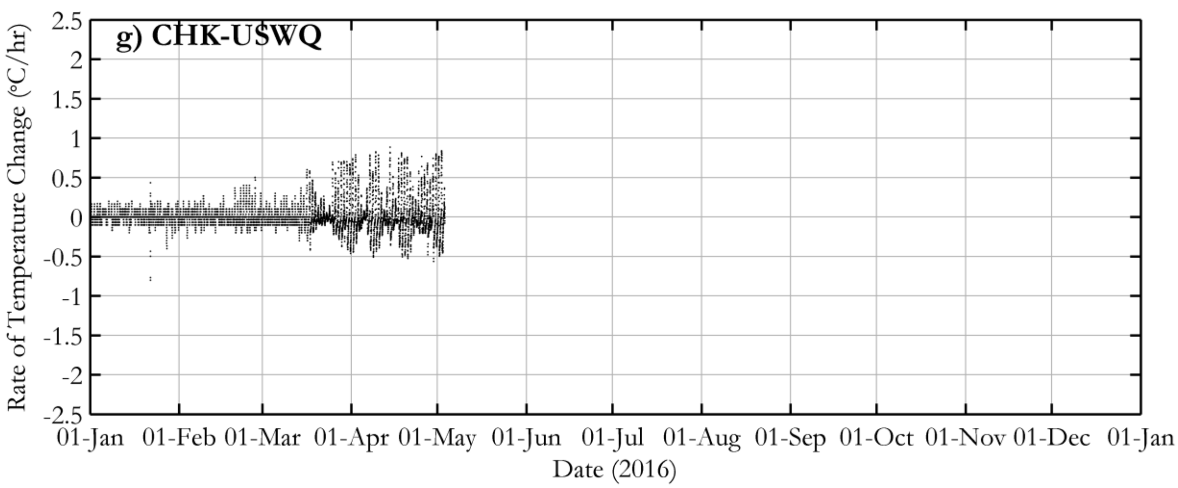




7. GROWING SEASON AND DEGREE DAYS

7.1. Baseline: 2008 to 2010

Table 9. Baseline summary of the growing season and growing degree days in Chickwat Creek (2008 to 2010)).

Site[1]	Year	Definition of Growing Season[2]	Analysis of Growing Season	
			Calendar days (n)	Degree Days (˚C)[3]
CKT-DVWQ	2008	May 20 to December 15	210	1926
	2009	May 14 to November 26	196	2101
	2010	May 7 to November 25	203	1969
CKT-USWQ	2009	May 28 to November 18	175	1817
	2010	May 14 to November 25	195	1688
Optimal Recruitment Degree Days (˚C) Range:[4]			-	900-1200

[1]CKT-USWQ data gap from April 22 to May 14, 2010.

[2]Start of the growing season - first week where average stream temperatures exceeded and remained above 5°C; the end of growing season - last day of the first week where average stream temperature dropped below 4°C (Coleman and Fausch 2007).

[3]Degree days correspond to accumulate thermal units defined as the sum of daily average temperature in the growing season.

[4] Estimate for cutthroat trout in high elevation streams, defined as "best opportunity for recruitment" (Coleman and Fausch 2007).

7.2. Baseline: 2011 to 2016

Table 10. Baseline summary of the growing season and growing degree days in Chickwat Creek and Tributary C1 and C2 (2011 to 2016).

Reach	Site	Year	Number of days with valid data	Growing Season Data Summary[1]				
				Start Date	End Date	Length (days)	Gap (days)	Degree Days
Tributary	CHK-C1WQ	2015	365	27-Apr	15-Nov	203	0	2,106
Upstream	CHK-USWQ[2]	2011	365	14-Jun	08-Nov	148	0	1,160
		2012	366	05-Jun	15-Nov	164	0	1,455
		2013	365	13-May	21-Nov	193	0	1,759
		2014	365	07-May	15-Nov	193	0	1,939
		2015	365	14-Apr	21-Nov	222	0	2,285
Diversion	CHK-UDVWQ	2015	310	13-Apr	21-Nov	223	55	2,249
	CHK-LDVWQ	2015	365	07-Mar	24-Nov	263	0	2,674

[1] Growing season metrics were only calculated for those years with sufficient temperature data over the entire growing season.

[2] At site CHK-USWQ, the data prior to 18 Sept 2014 was provided by Aquarius R &D and was collected at the nearby historical ChickwatIntake site.

Appendix E. Graphical presentation of water temperature in-situ spot measurements and corresponding logged temperature data

LIST OF FIGURES

Figure 1. Comparison of water temperature spot measurements and data logged at CHK-USWQ02 during the period of record.

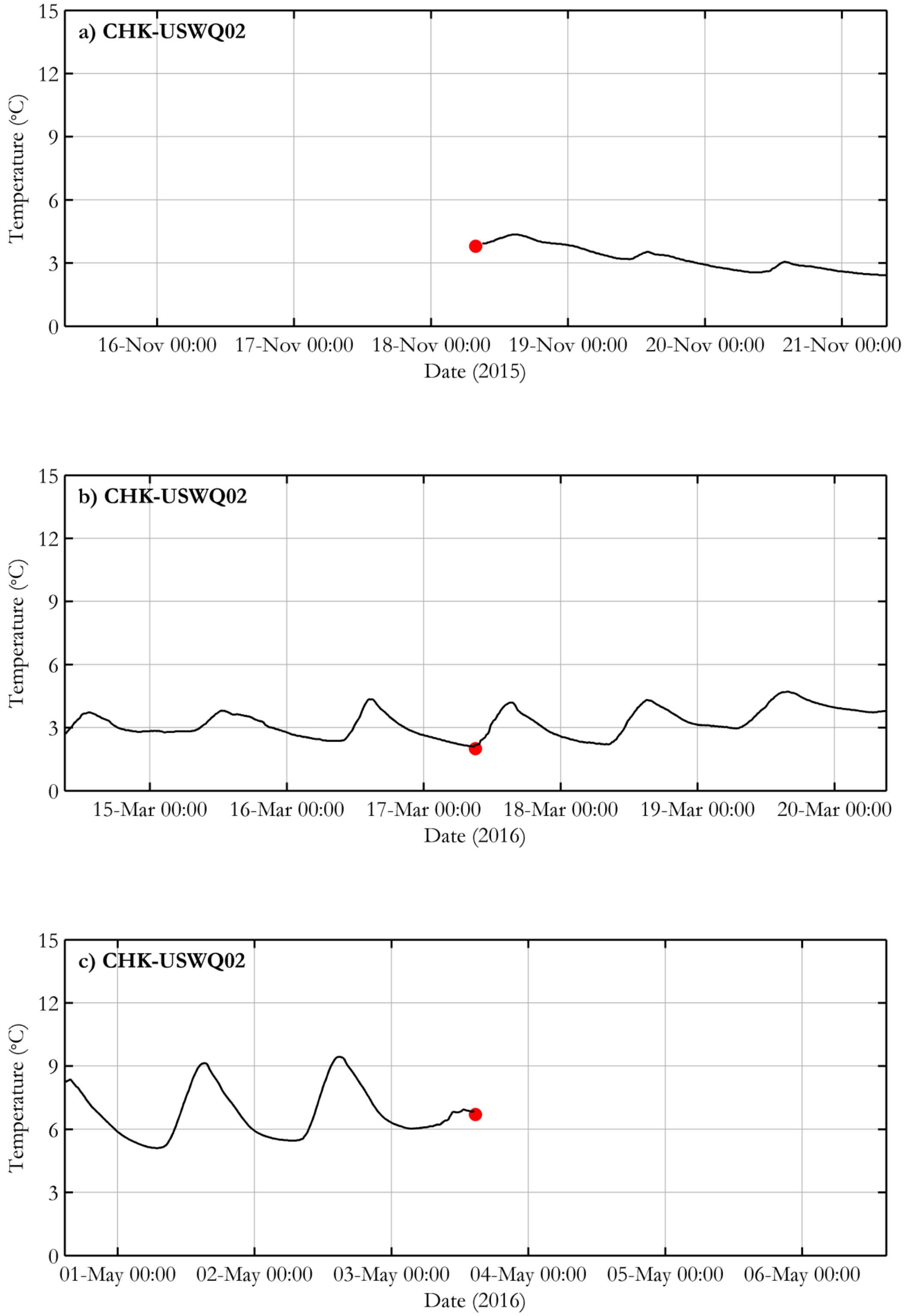
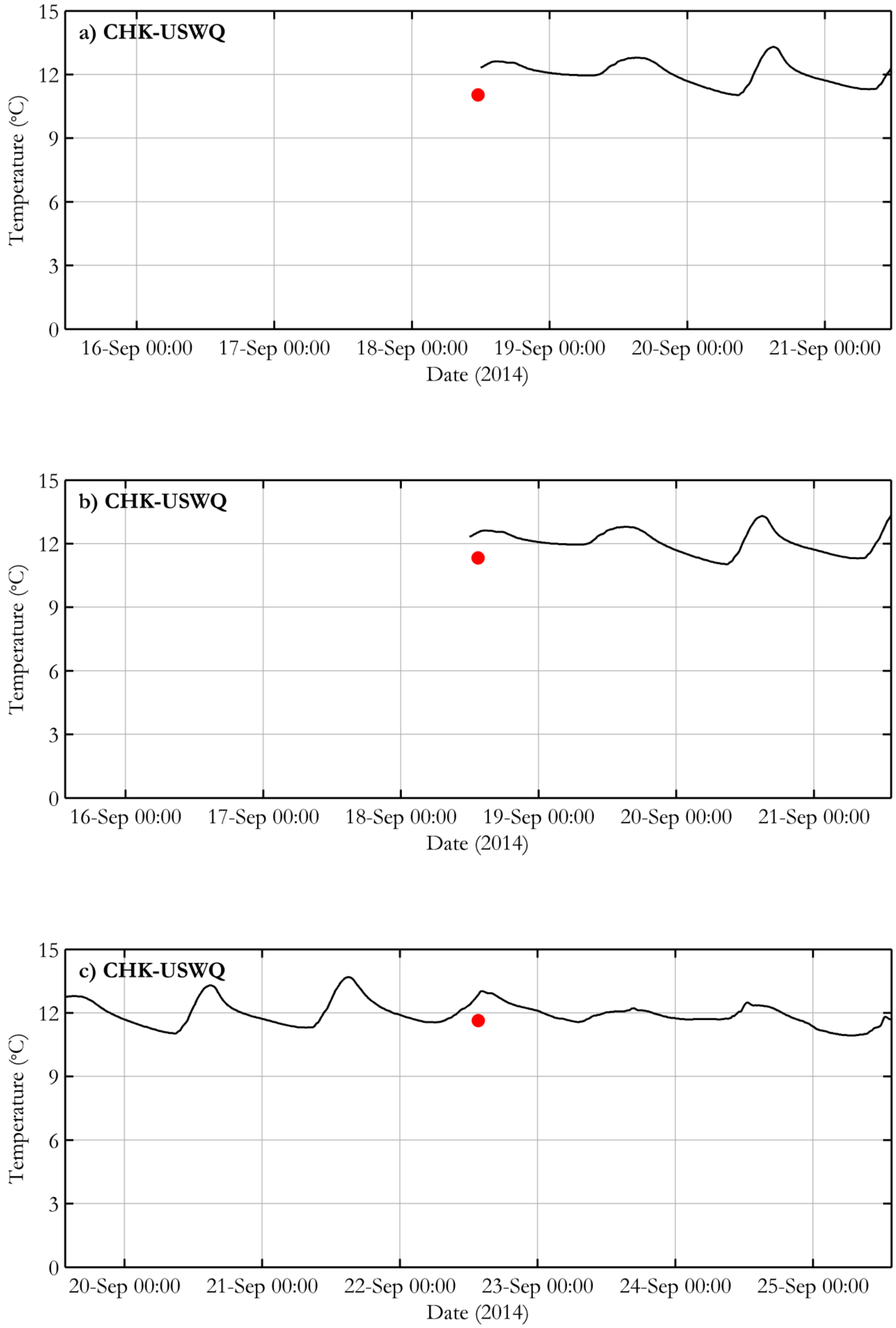


Figure 2. Comparison of water temperature spot measurements and data logged at CHK-USWQ during the period of record.



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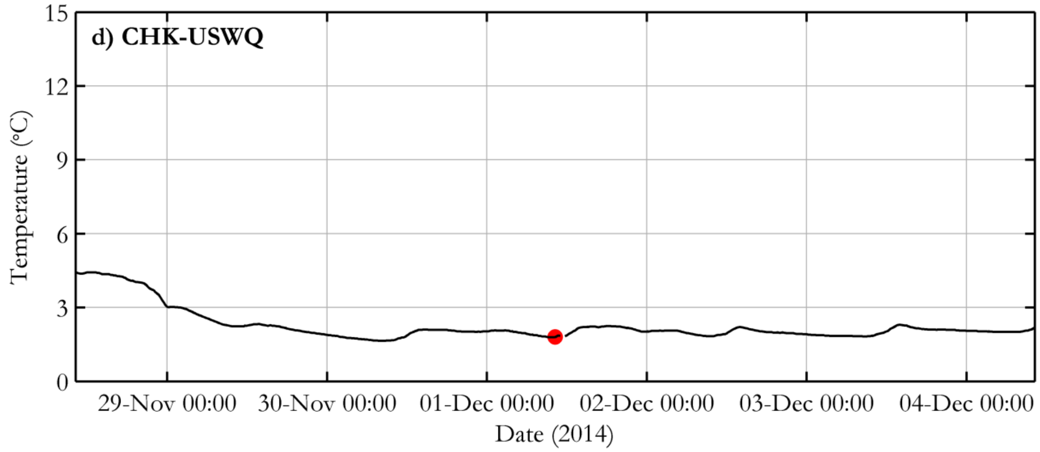

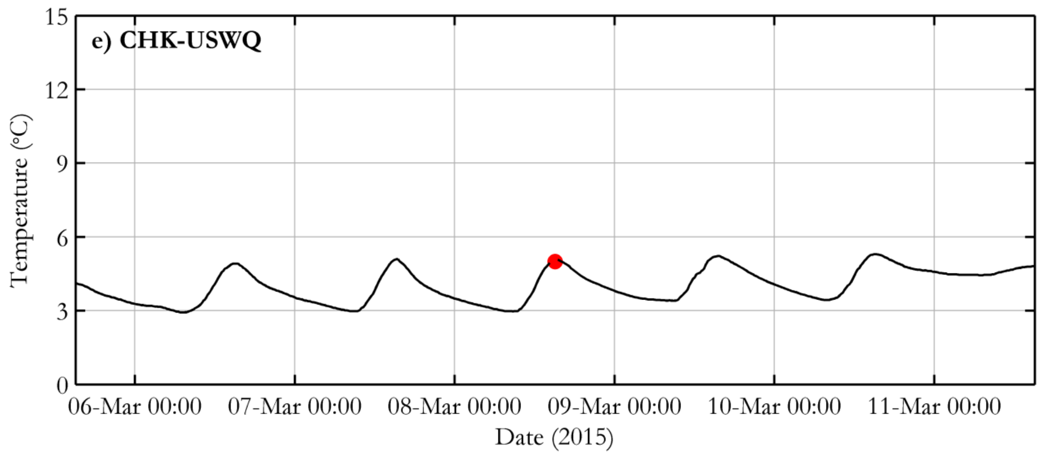

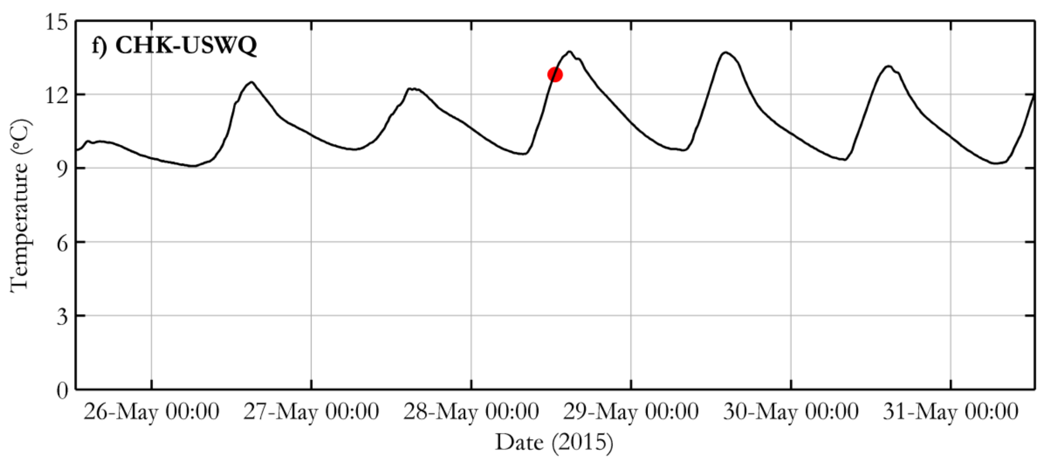

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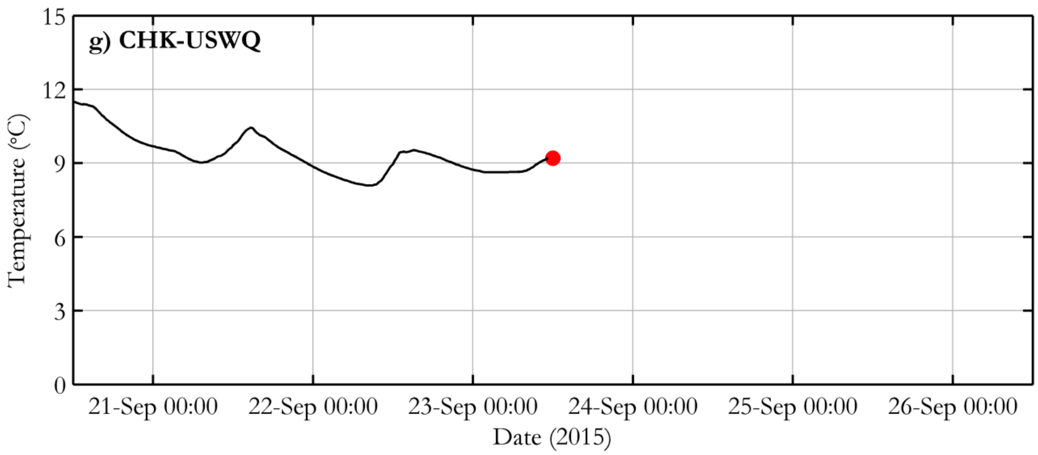
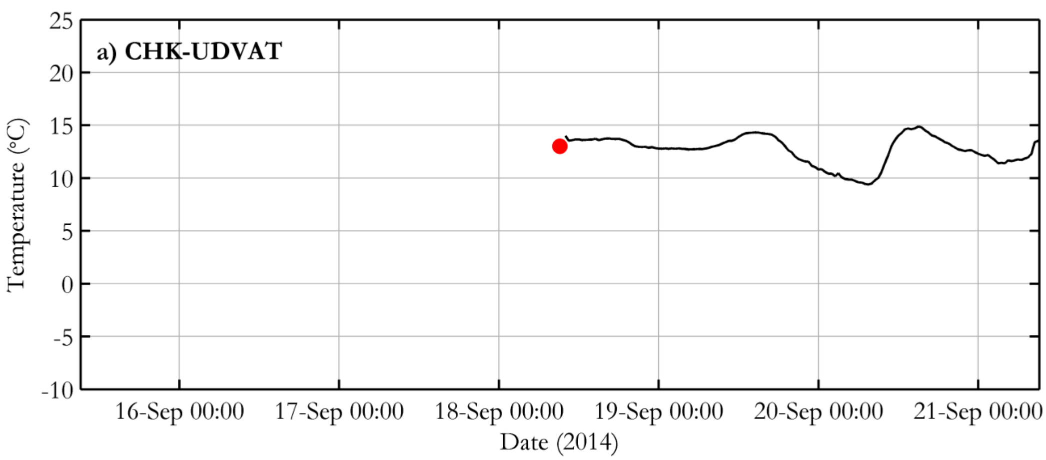
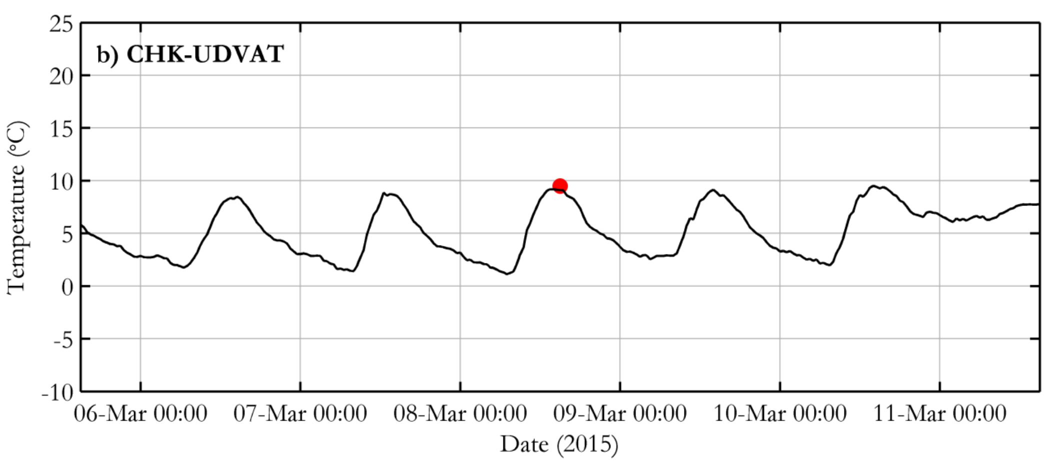


Figure 3. Comparison of water temperature spot measurements and data logged at CHK-UDVAT during the period of record.





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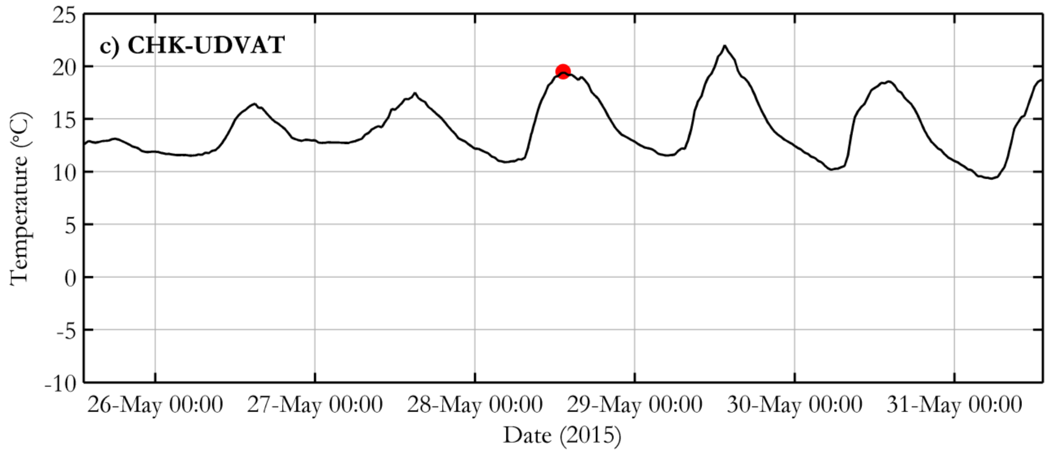

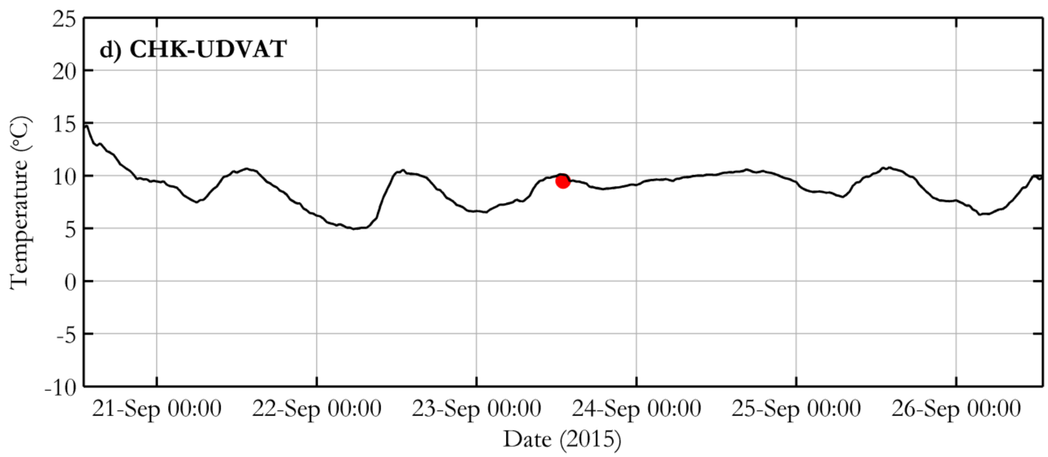

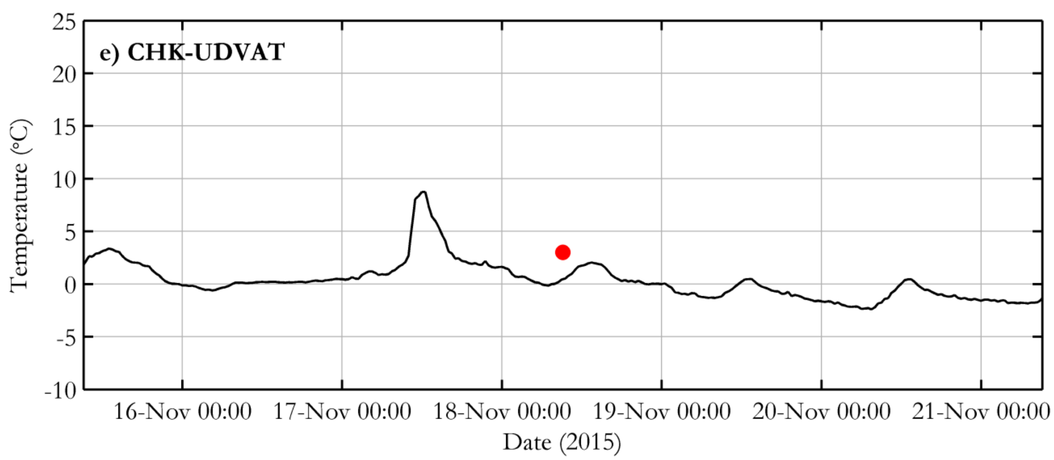

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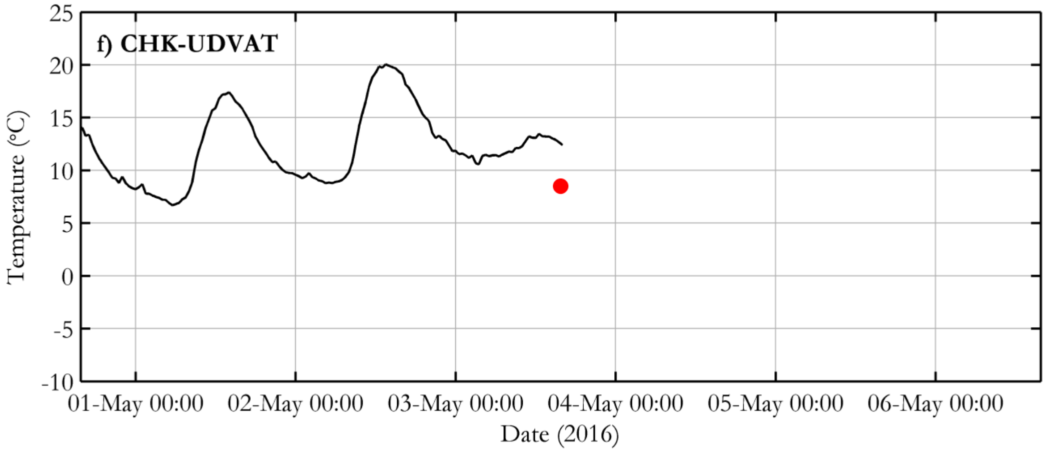
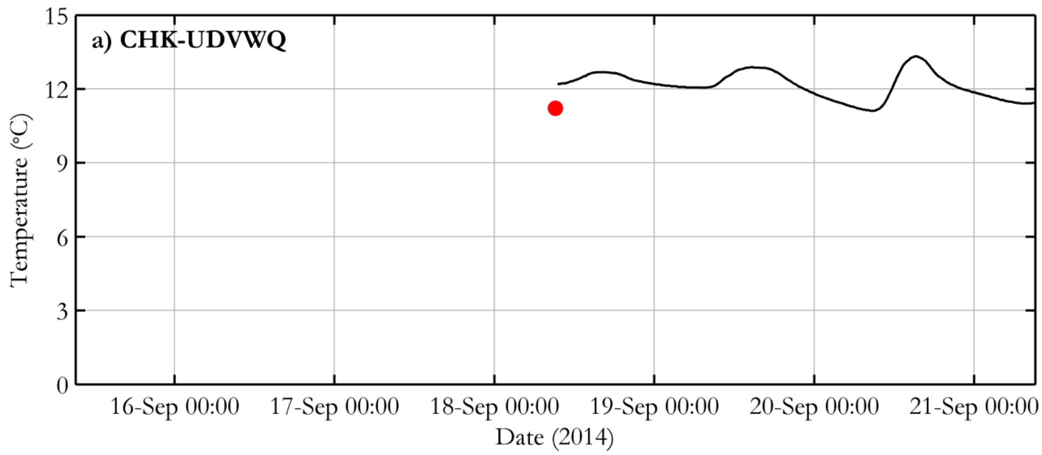
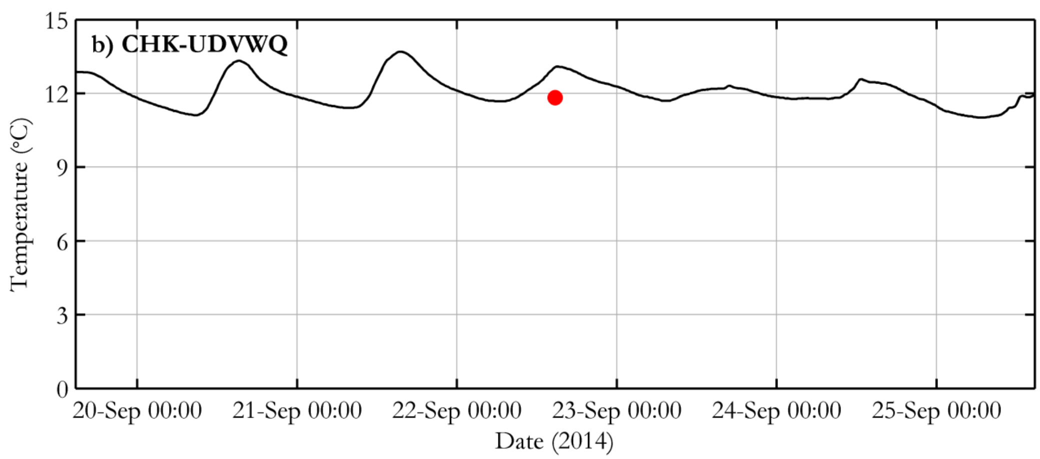


Figure 4. Comparison of water temperature spot measurements and data logged at CHK-UDVWQ during the period of record.





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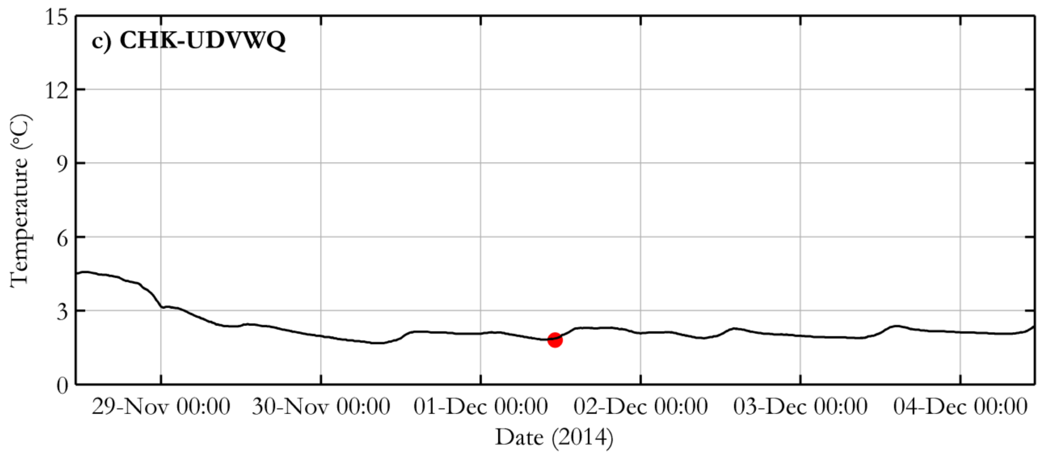

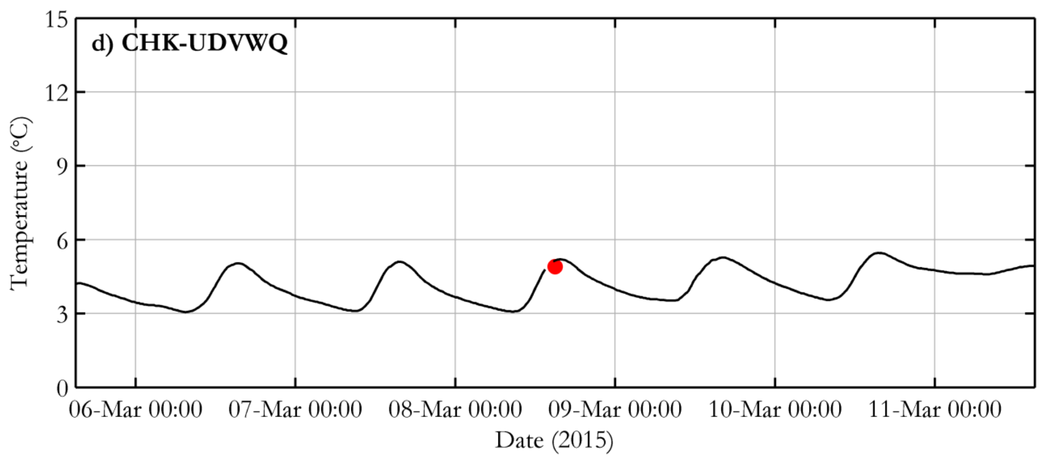

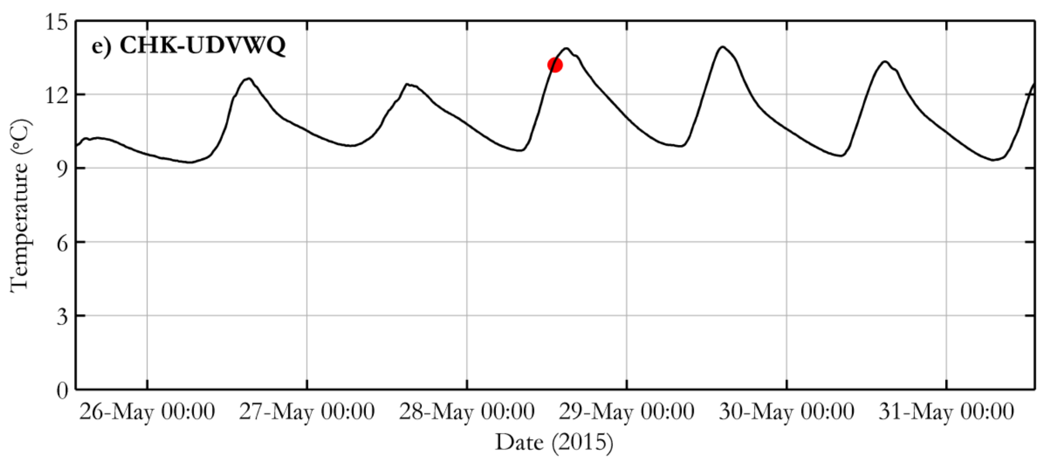

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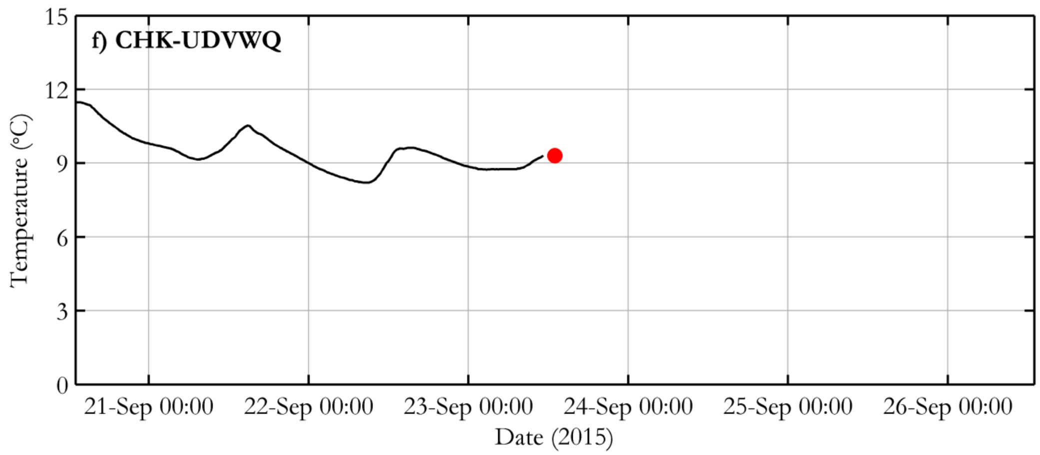

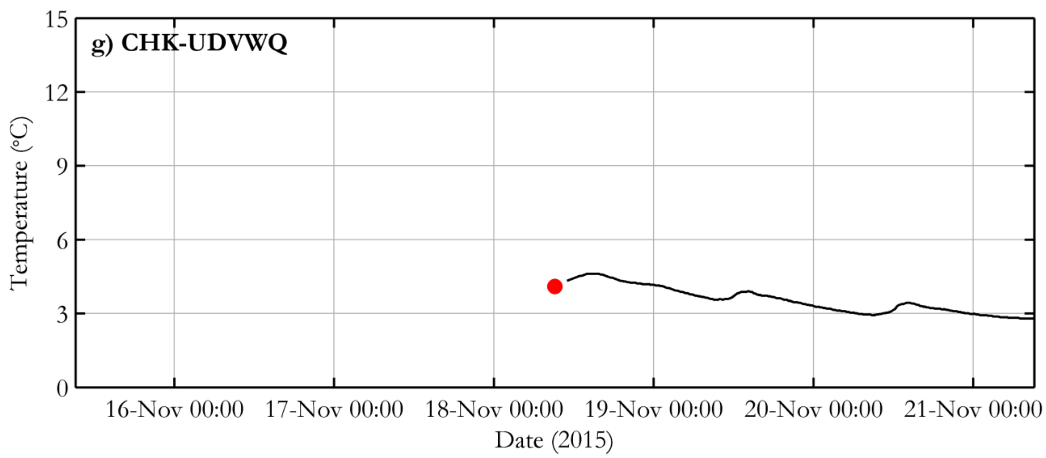

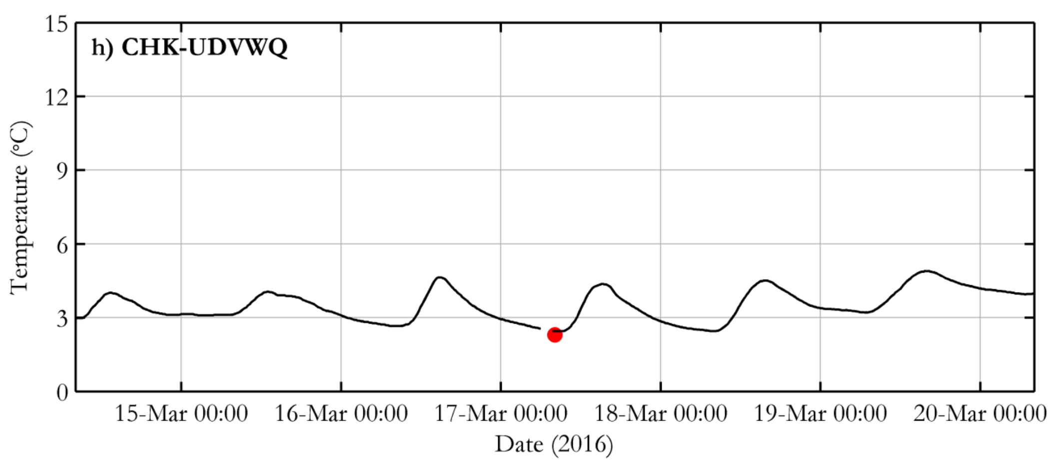

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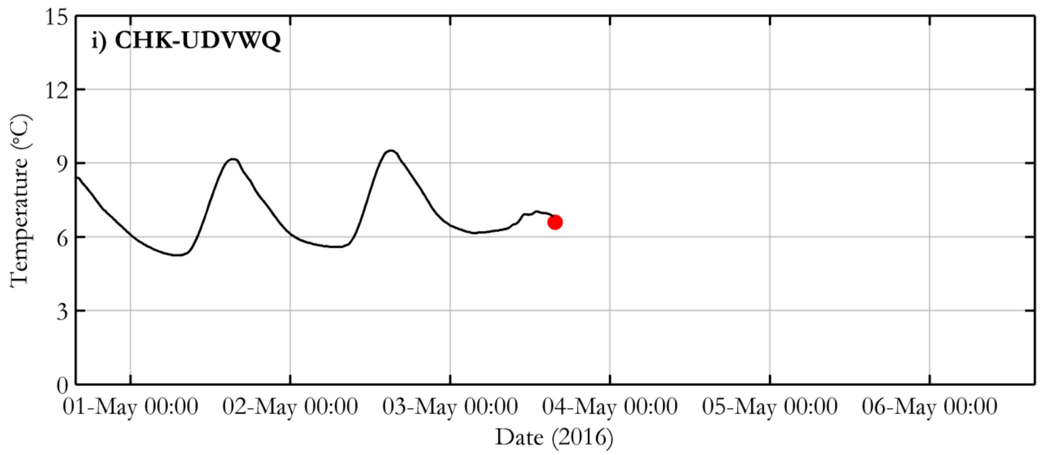
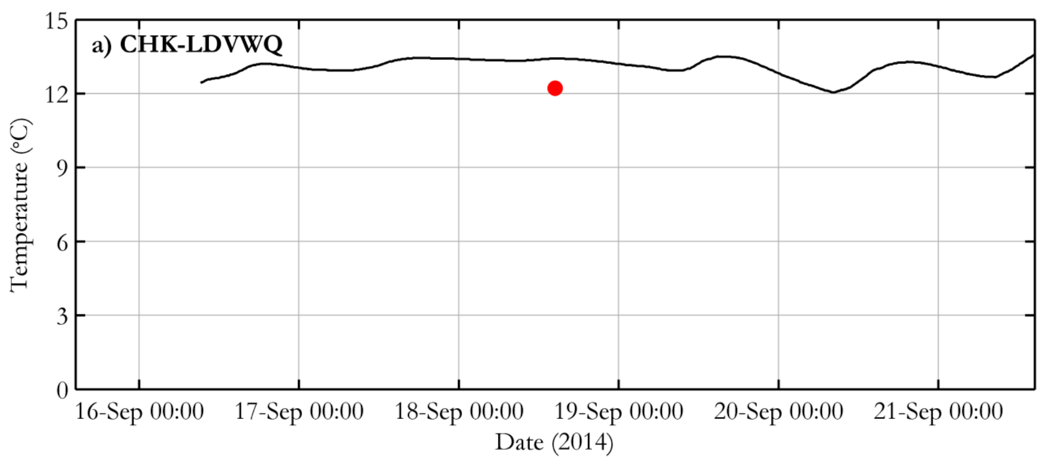
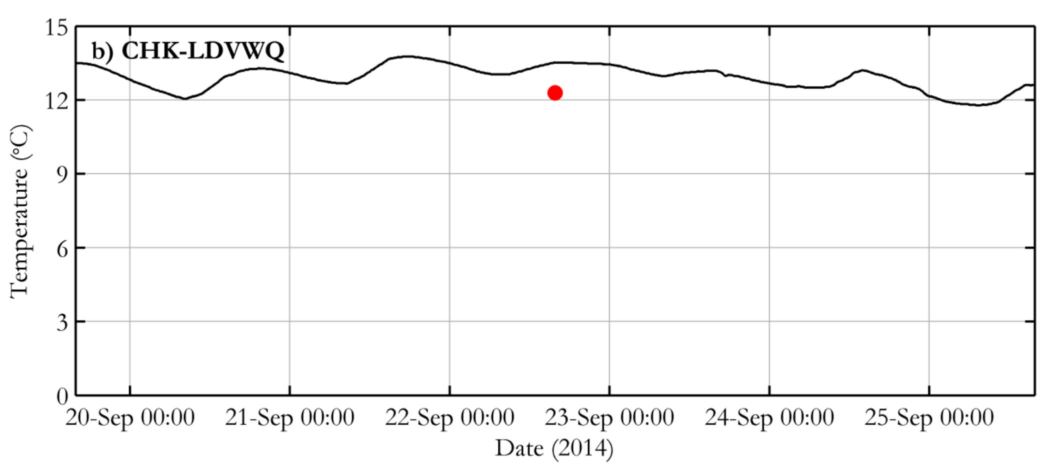


Figure 5. Comparison of water temperature spot measurements and data logged at CHK-LDVWQ during the period of record.





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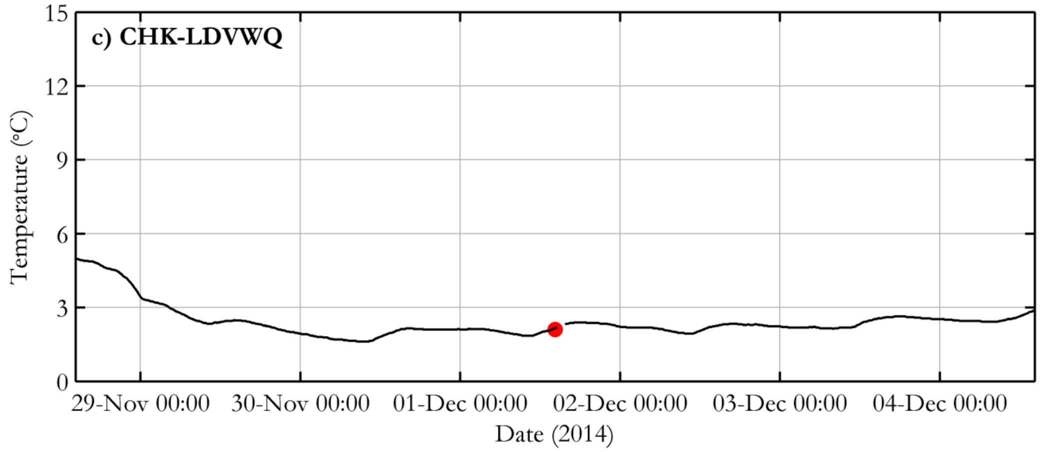

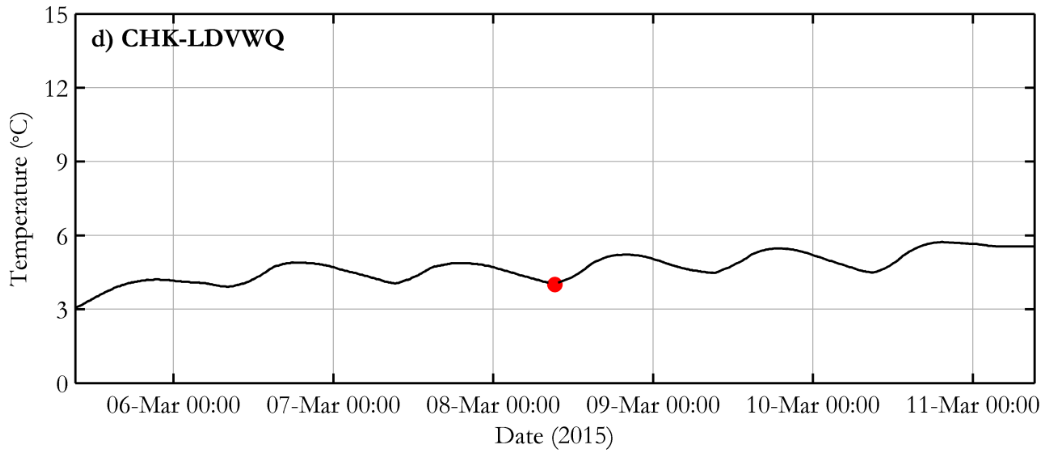

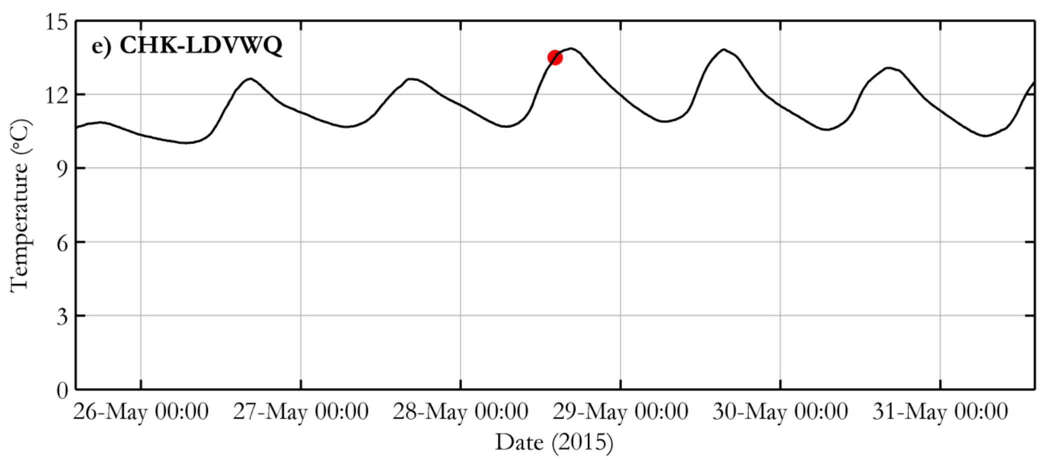

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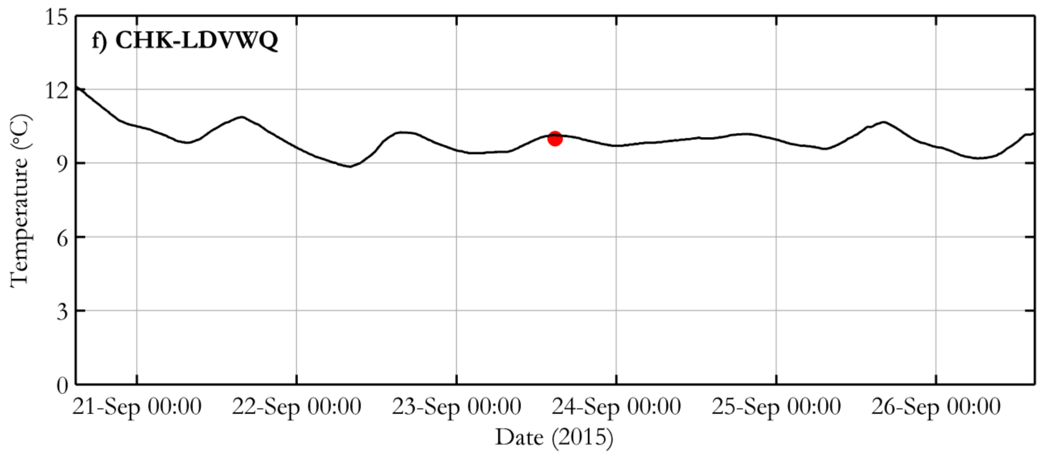

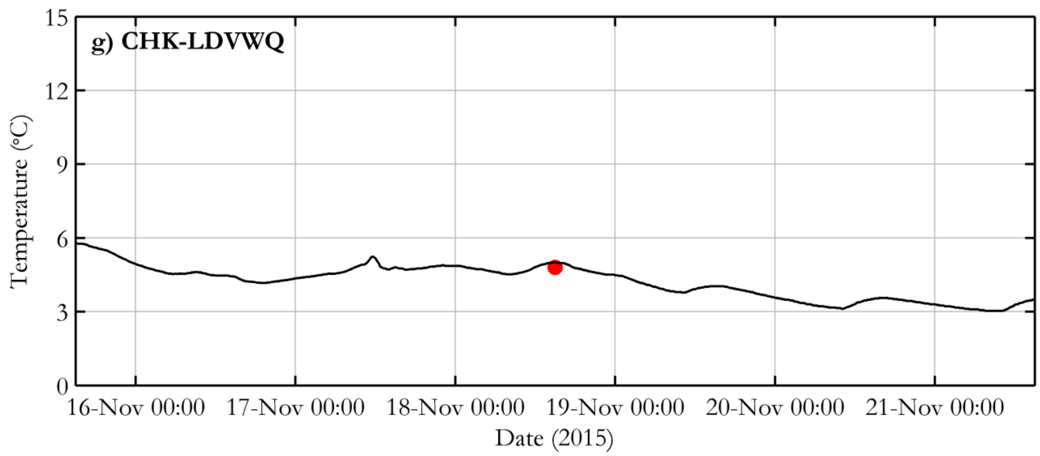

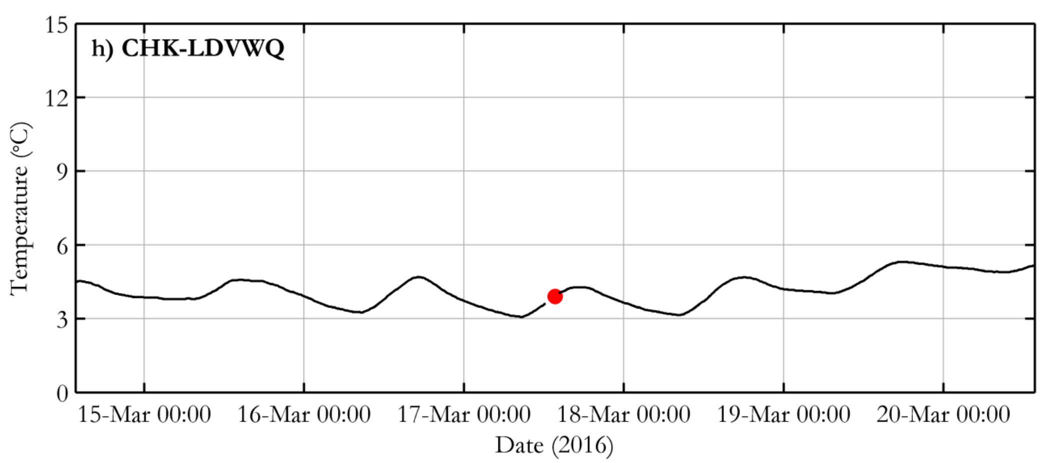

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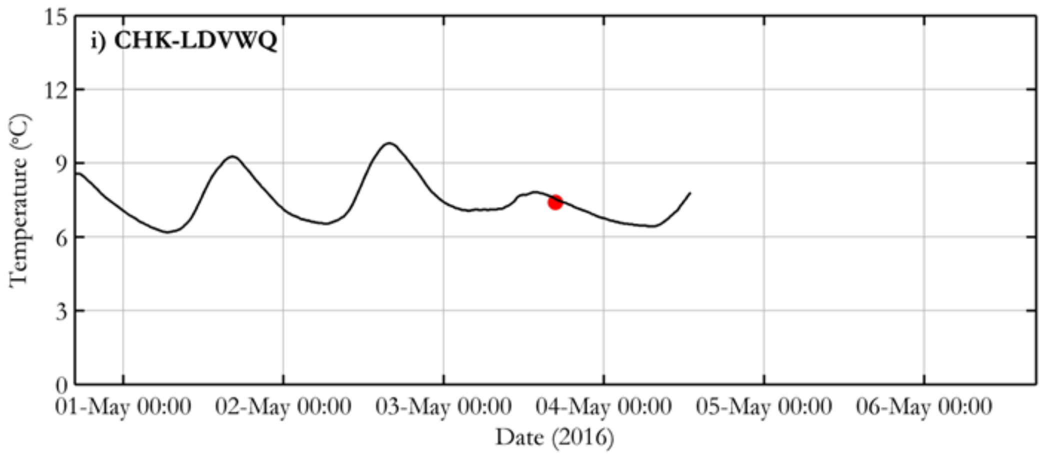
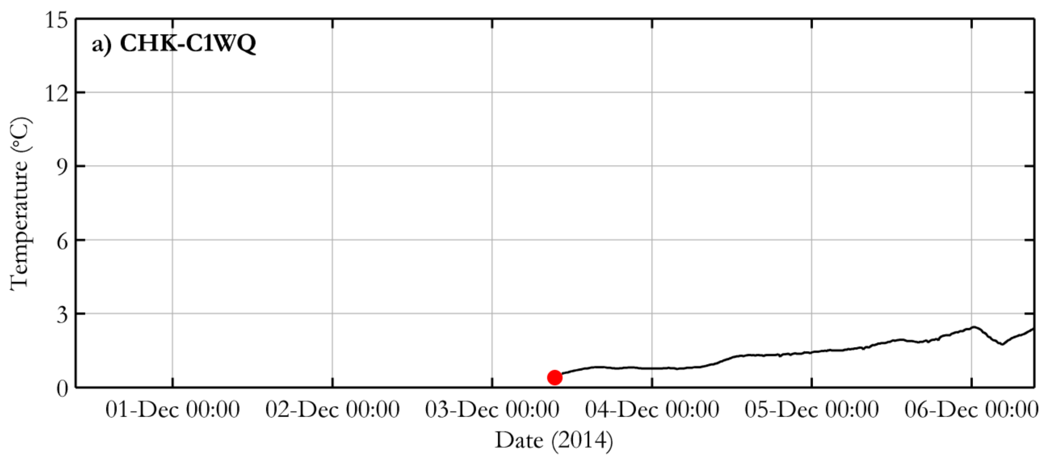
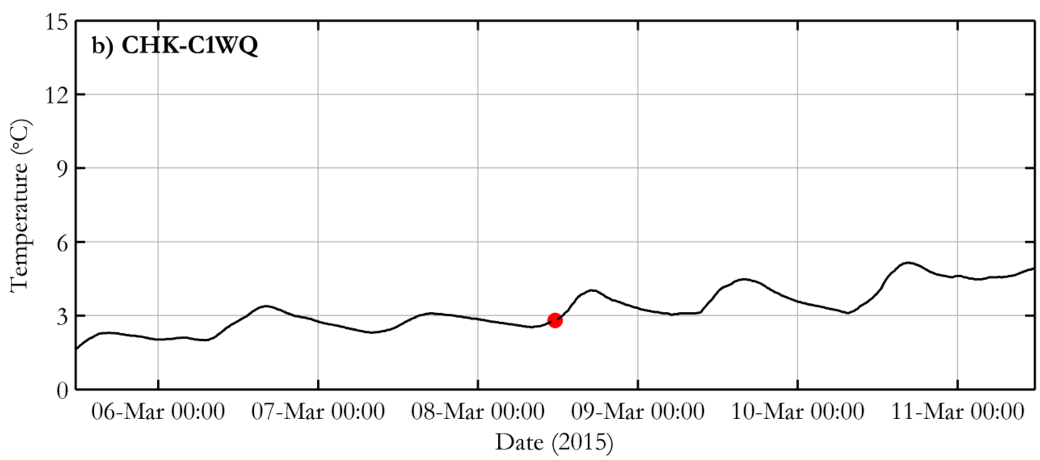


Figure 6. Comparison of water temperature spot measurements and data logged at CHK-C1WQ during the period of record.





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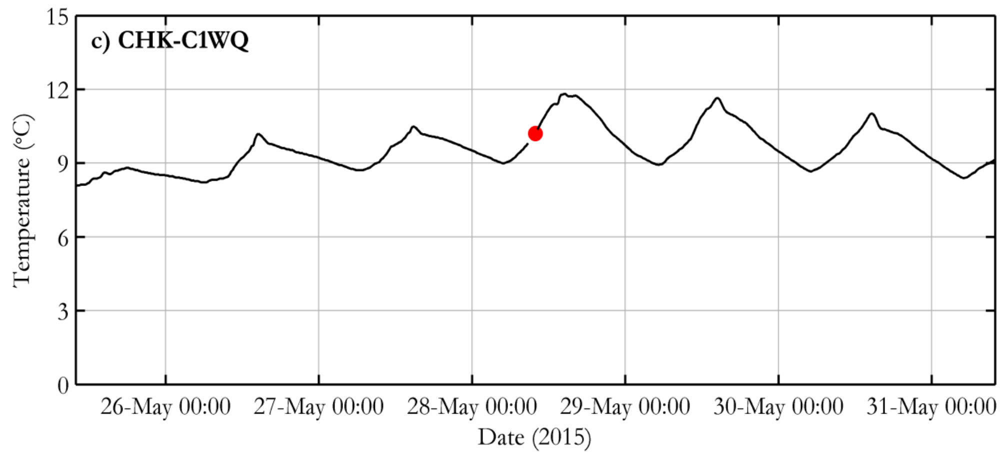


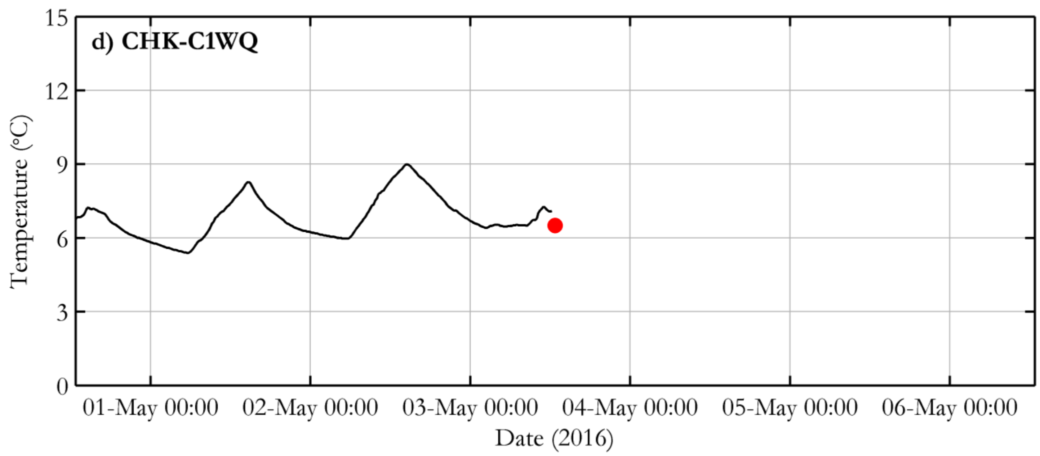


Figure 7. Comparison of water temperature spot measurements and data logged at CHK-C2WQ during the period of record.

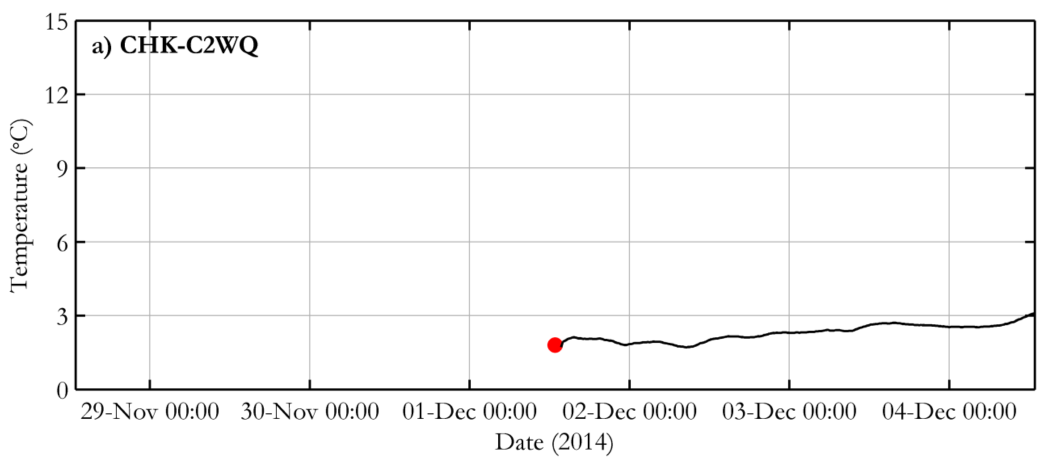
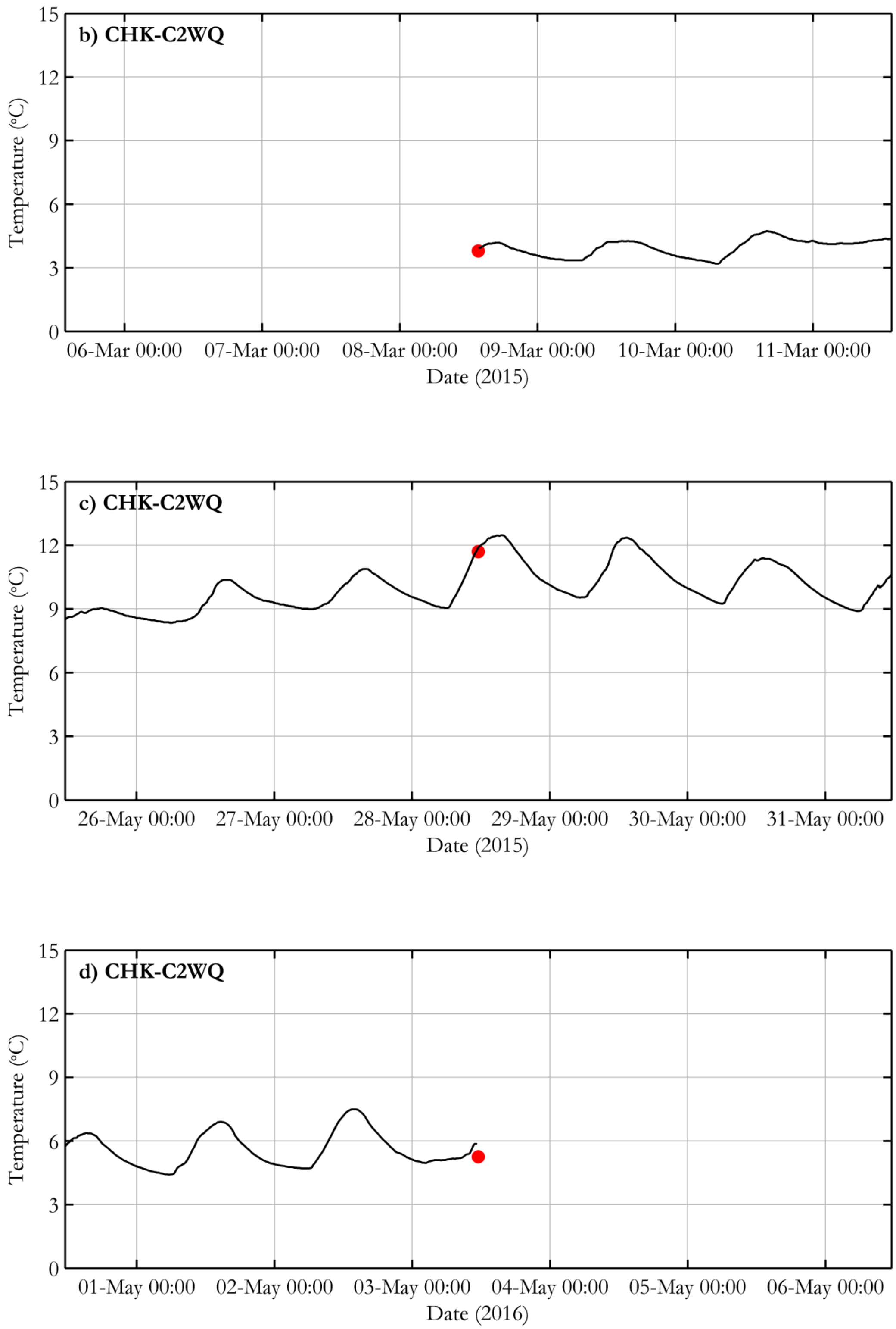
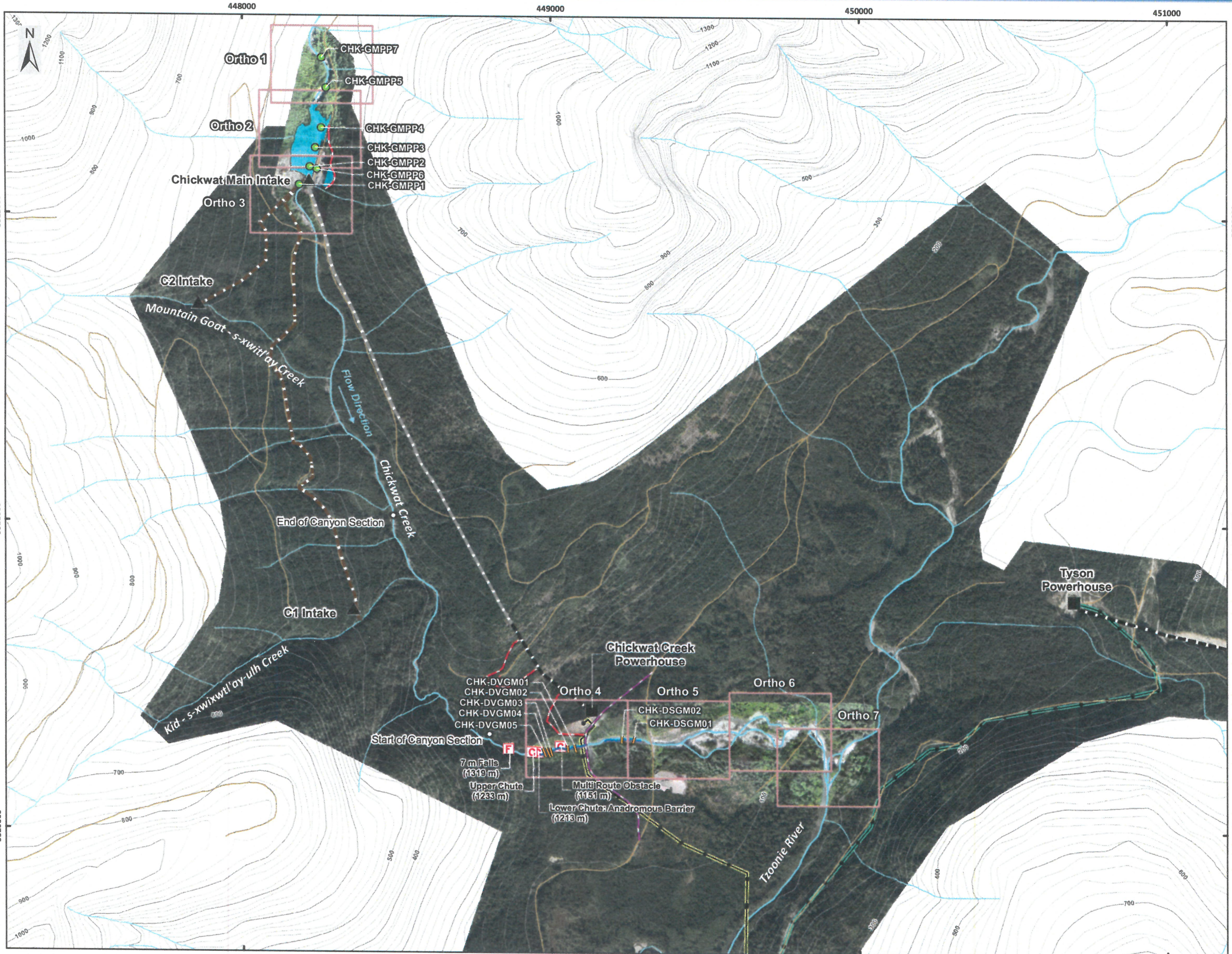


Figure 7. (Continued).



Appendix F. Chickwat Creek Baseline Geomorphic Survey



NARROWS INLET HYDRO PROJECT

Chickwat Creek
Baseline Geomorphic Survey

Legend

- Headpond oblique photo points
- Channel Morphology Monitoring Transect
- Surveyed Thalweg

Ecofish Research Ltd. Fish Barriers

- C Chute
- F Falls

Infrastructure

- Intake
- Powerhouse
- Surface Mounted Penstock
- Tributary Tap
- Buried Penstock
- Overhead Transmission Line
- Overhead Transmission Line - Existing
- Proposed Headpond Backwater Extent

Roads

- Existing Road
- New Road - Permanent
- New Road - Temporary

Land Designations and Features

- Index Contour (100 m)
- Intermediate Contour (20 m)

MAP SHOULD NOT BE USED FOR LEGAL OR NAVIGATIONAL PURPOSES

0 100 200 400 500 m

Scale: 1:12,000

NO.	DATE	REVISION	BY
1	03/02/2017	1132_CHK_GeomorphicSurveyOverview_2017Feb01	
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3			
4			
5			

Date Saved: 03/02/2017
Coordinate System: NAD 1983 UTM Zone 10N

ECOFISH RESEARCH

Mapbook 1

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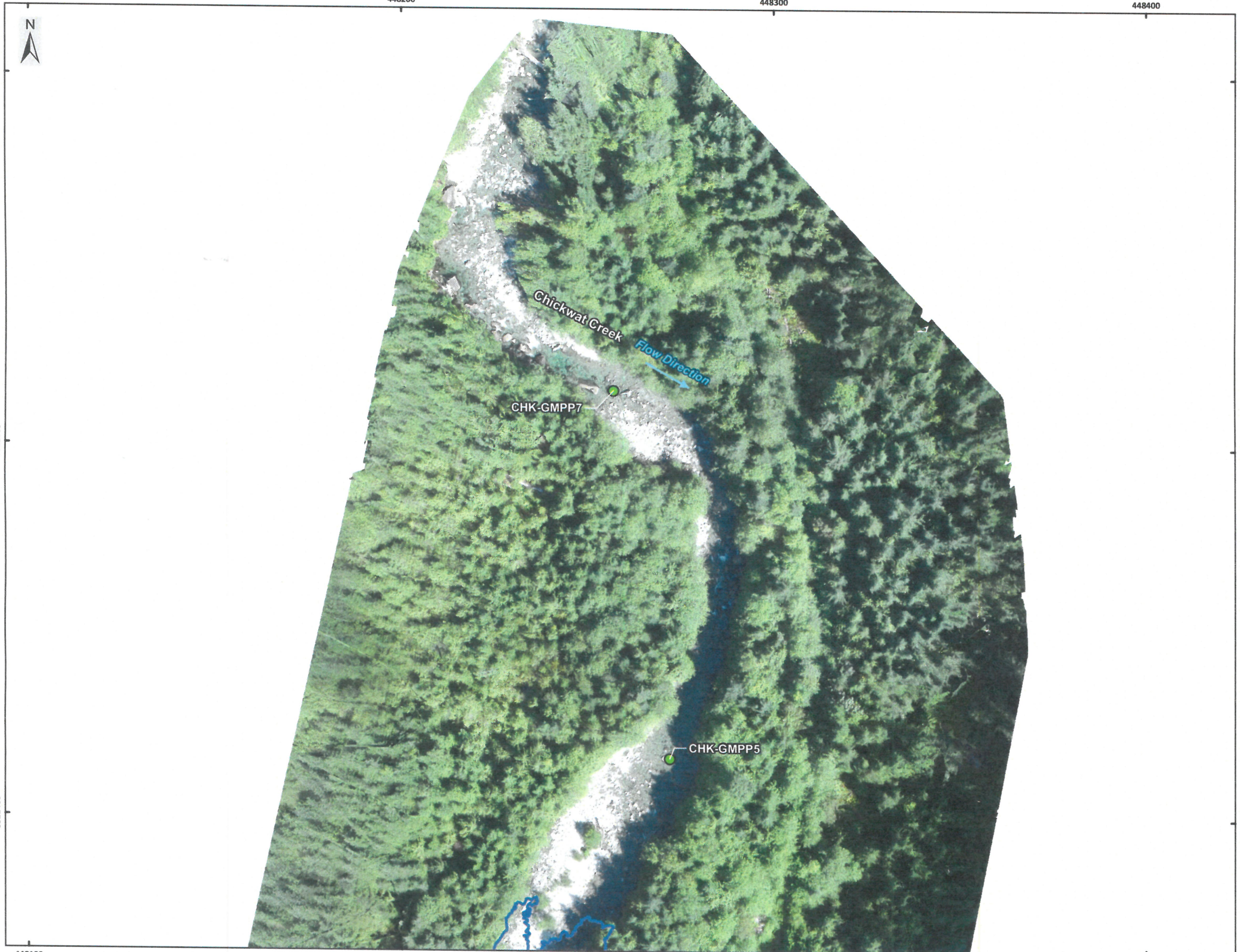

NARROWS INLET HYDRO PROJECT

Chickwat Creek
Baseline Geomorphic Survey

Legend

- Headpond oblique photo points
- Proposed Headpond Backwater Extent

MAP SHOULD NOT BE USED FOR LEGAL OR NAVIGATIONAL PURPOSES

0 5 10 20 30 40 50 m

Scale: 1:1,000

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Date Saved: 03/02/2017
Coordinate System: NAD 1983 UTM Zone 10N

ECOFISH RESEARCH

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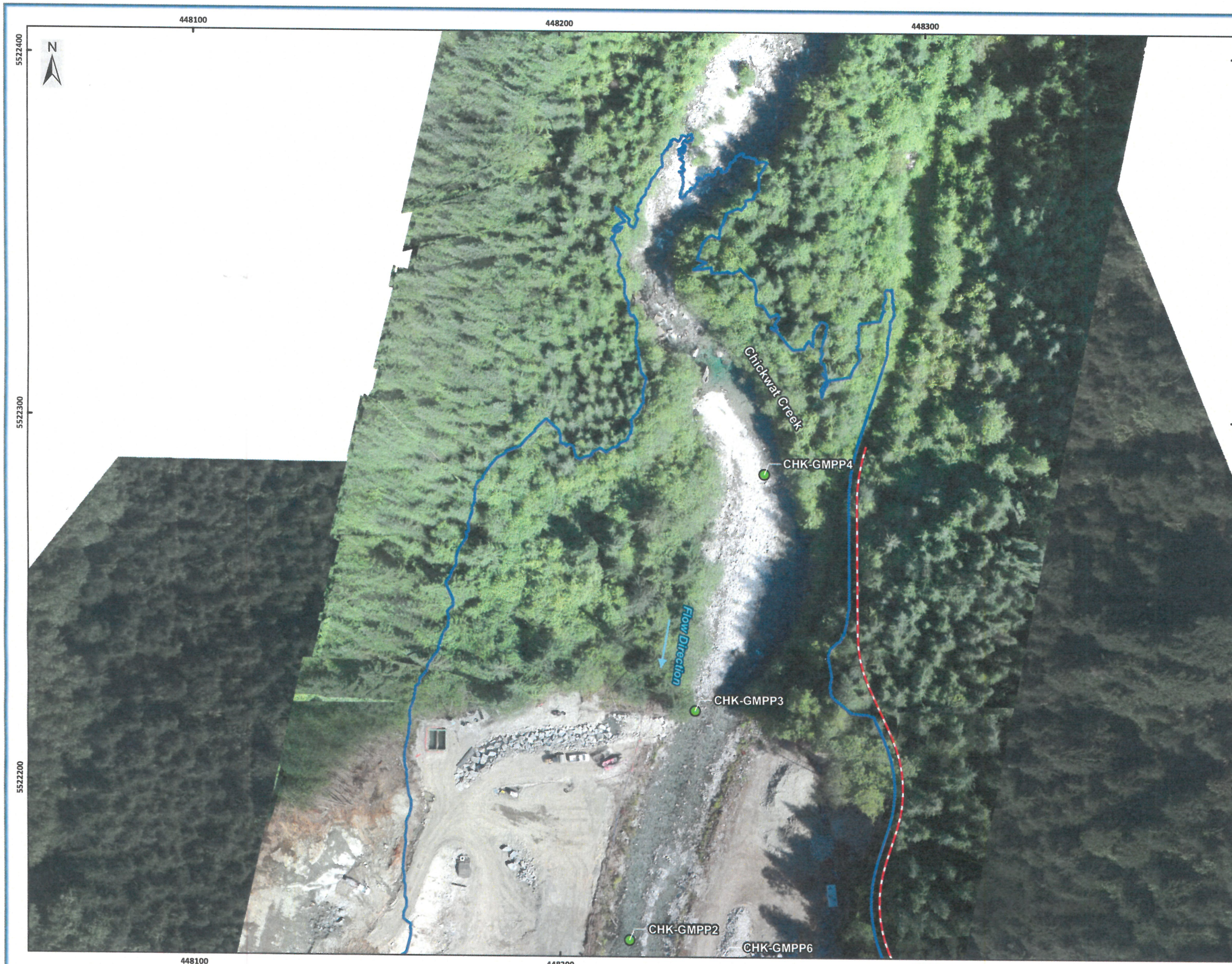

NARROWS INLET HYDRO PROJECT

Chickwat Creek
Baseline Geomorphic Survey

Legend

Headpond oblique photo points

Proposed Headpond Backwater Extent

Roads

New Road - Temporary

MAP SHOULD NOT BE USED FOR LEGAL OR NAVIGATIONAL PURPOSES

0 5 10 20 30 40 50 m

Scale: 1:1,000

NO.	DATE	REVISION	BY
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Date Saved: 03/02/2017
Coordinate System: NAD 1983 UTM Zone 10N

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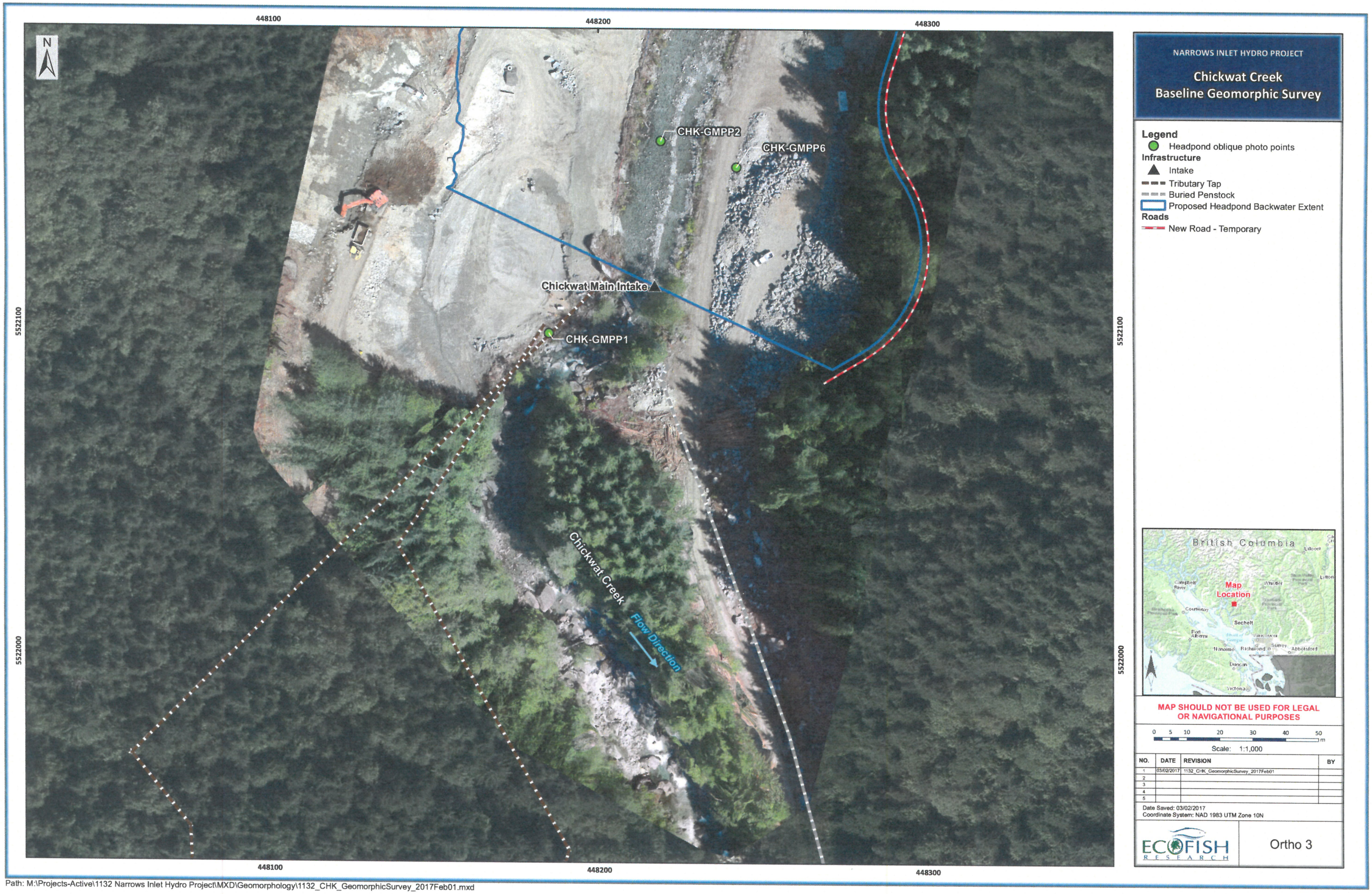

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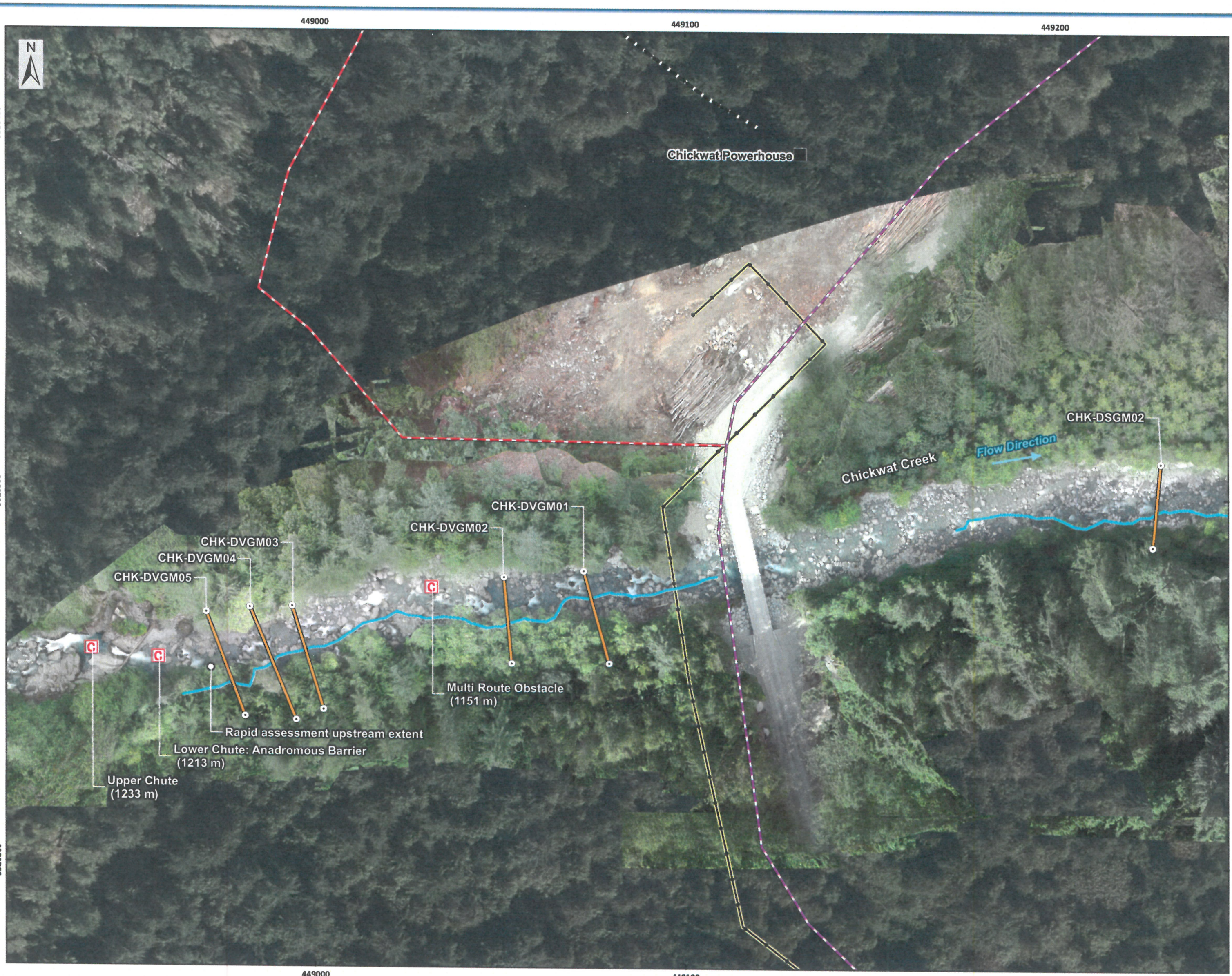

NARROWS INLET HYDRO PROJECT

Chickwat Creek Baseline Geomorphic Survey

Legend

- Channel Morphology Monitoring Transect
- Surveyed Thalweg

Ecofish Research Ltd. Fish Barriers

- C Chute

Infrastructure

- Powerhouse
- Surface Mounted Penstock
- Overhead Transmission Line

Roads

- New Road - Permanent
- New Road - Temporary

MAP SHOULD NOT BE USED FOR LEGAL OR NAVIGATIONAL PURPOSES

0 5 10 20 30 40 50 m

Scale: 1:1,000

NO.	DATE	REVISION	BY
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3			
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5			

Date Saved: 03/02/2017
Coordinate System: NAD 1983 UTM Zone 10N

ECOFISH RESEARCH

Ortho 4

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NARROWS INLET HYDRO PROJECT

Chickwat Creek
Baseline Geomorphic Survey

Legend

- Channel Morphology Monitoring Transect
- Surveyed Thalweg

MAP SHOULD NOT BE USED FOR LEGAL OR NAVIGATIONAL PURPOSES

0 5 10 20 30 40 50 m

Scale: 1:1,000

NO.	DATE	REVISION	BY
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4			
5			

Date Saved: 03/02/2017
Coordinate System: NAD 1983 UTM Zone 10N

ECOFISH RESEARCH

Ortho 5

Path: M:\Projects-Active\1132 Narrows Inlet Hydro Project\MXD\Geomorphology\1132_CHK_GeomorphicSurvey_2017Feb01.mxd

NARROWS INLET HYDRO PROJECT

Chickwat Creek
Baseline Geomorphic Survey

Legend

MAP SHOULD NOT BE USED FOR LEGAL OR NAVIGATIONAL PURPOSES

0 5 10 20 30 40 50 m

Scale: 1:1,000

NO.	DATE	REVISION	BY
1	03/02/2017	1132_CHK_GeomorphicSurvey_2017Feb01	
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Date Saved: 03/02/2017
Coordinate System: NAD 1983 UTM Zone 10N

ECOFISH RESEARCH

Ortho 6

Path: M:\Projects-Active\1132 Narrows Inlet Hydro Project\MXD\Geomorphology\1132_CHK_GeomorphicSurvey_2017Feb01.mxd

NARROWS INLET HYDRO PROJECT

Chickwat Creek
Baseline Geomorphic Survey

Legend

Overhead Transmission Line - Existing

MAP SHOULD NOT BE USED FOR LEGAL OR NAVIGATIONAL PURPOSES

0 5 10 20 30 40 50 m

Scale: 1:1,000

NO.	DATE	REVISION	BY
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3			
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Date Saved: 03/02/2017
Coordinate System: NAD 1983 UTM Zone 10N

ECOFISH RESEARCH

Ortho 7

Path: M:\Projects-Active\1132 Narrows Inlet Hydro Project\MXD\Geomorphology\1132_CHK_GeomorphicSurvey_2017Feb01.mxd

Appendix G. Geomorphology assessment figures and tables

LIST OF TABLES

LIST OF FIGURES

Figure 1. Chickwat Creek lower diversion reach thalweg spanning transects CHK-DVGM01 to CHK-DVGM05, October 16, 2015.

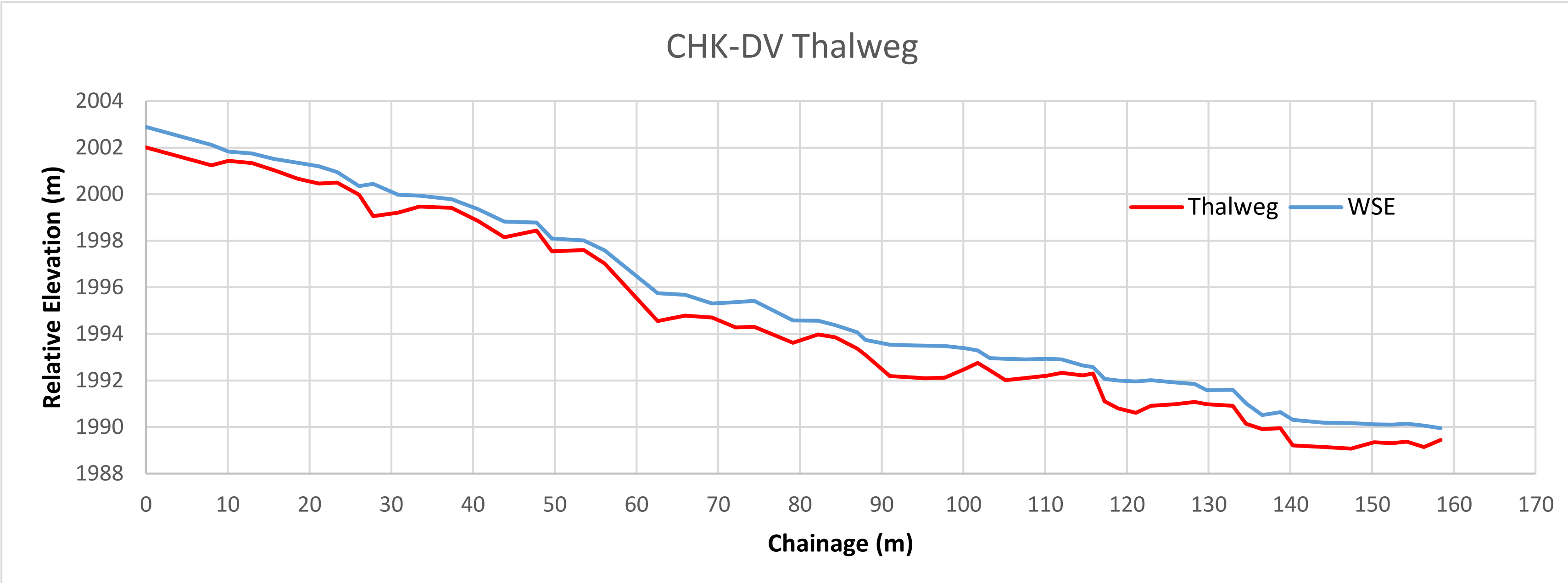


Figure 2. Chickwat Creek downstream reach thalweg spanning transects CHK-DSGM01 to CHK-DSGM02, October 16, 2015.

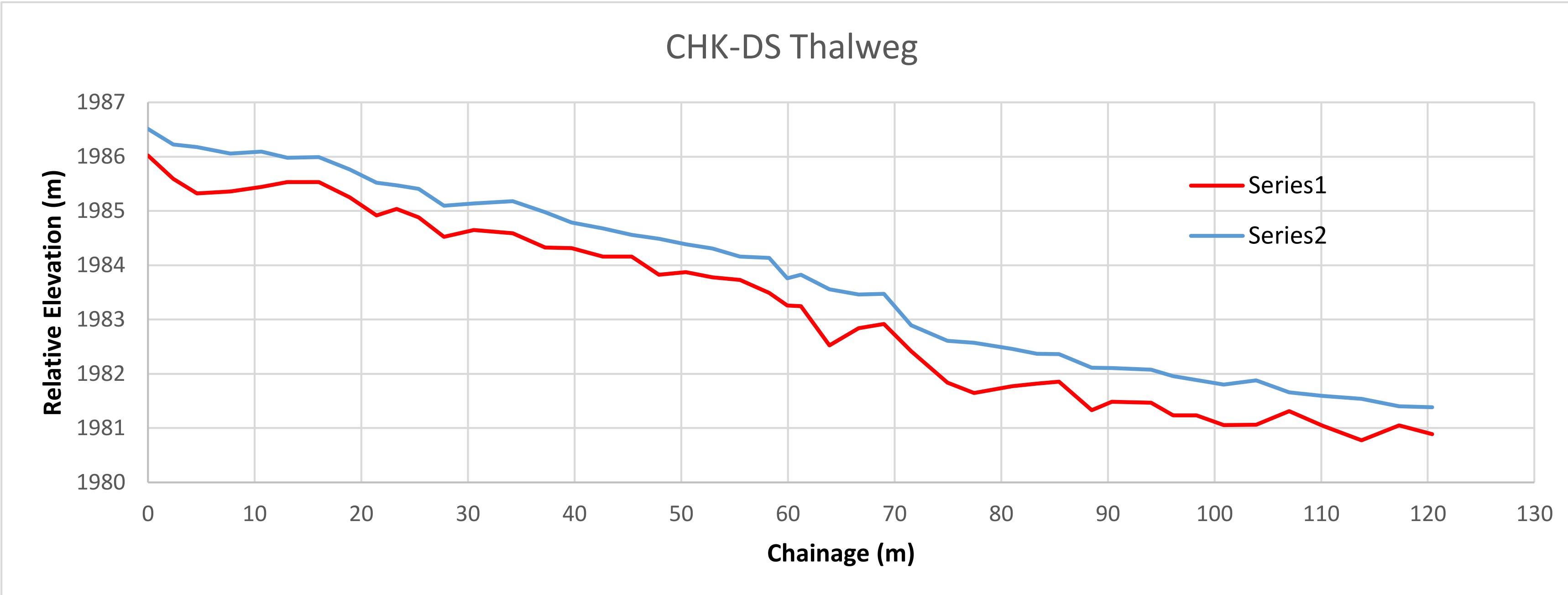


Figure 3. Chickwat Creek Bed Profile at Transect CHK-DVGM01, October 16, 2015.

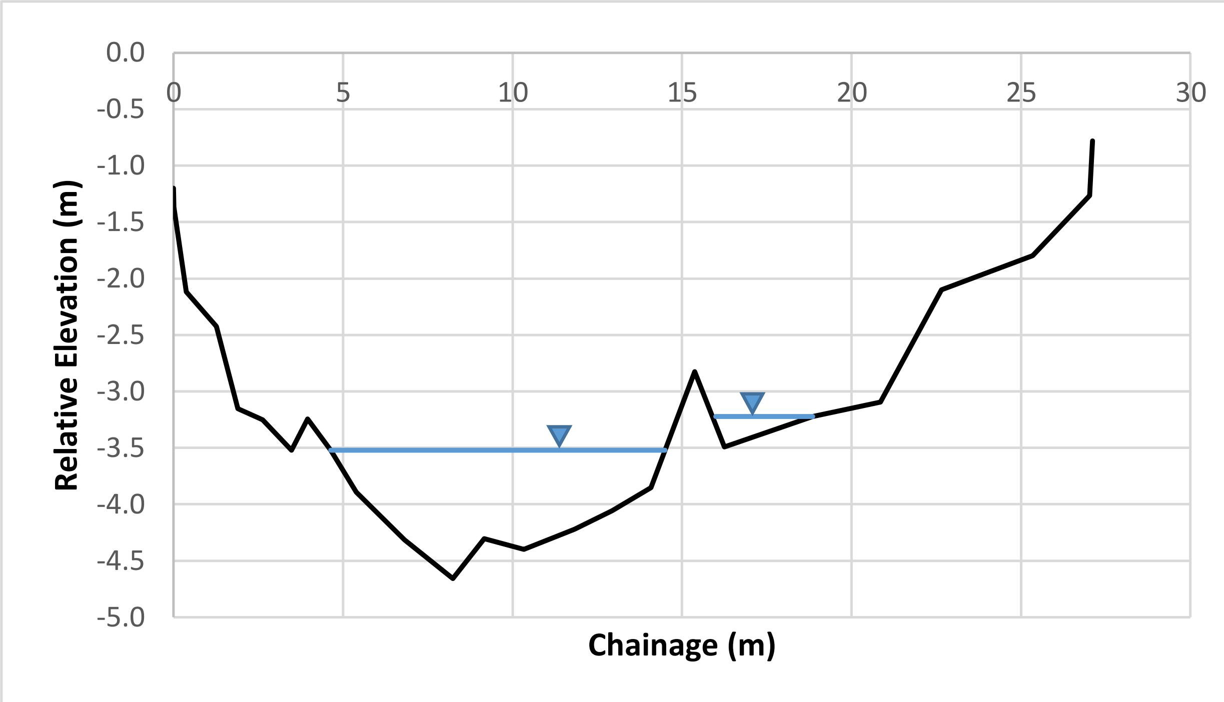


Figure 4. Chickwat Creek Bed Profile at Transect CHK-DVGM02, October 16, 2015.

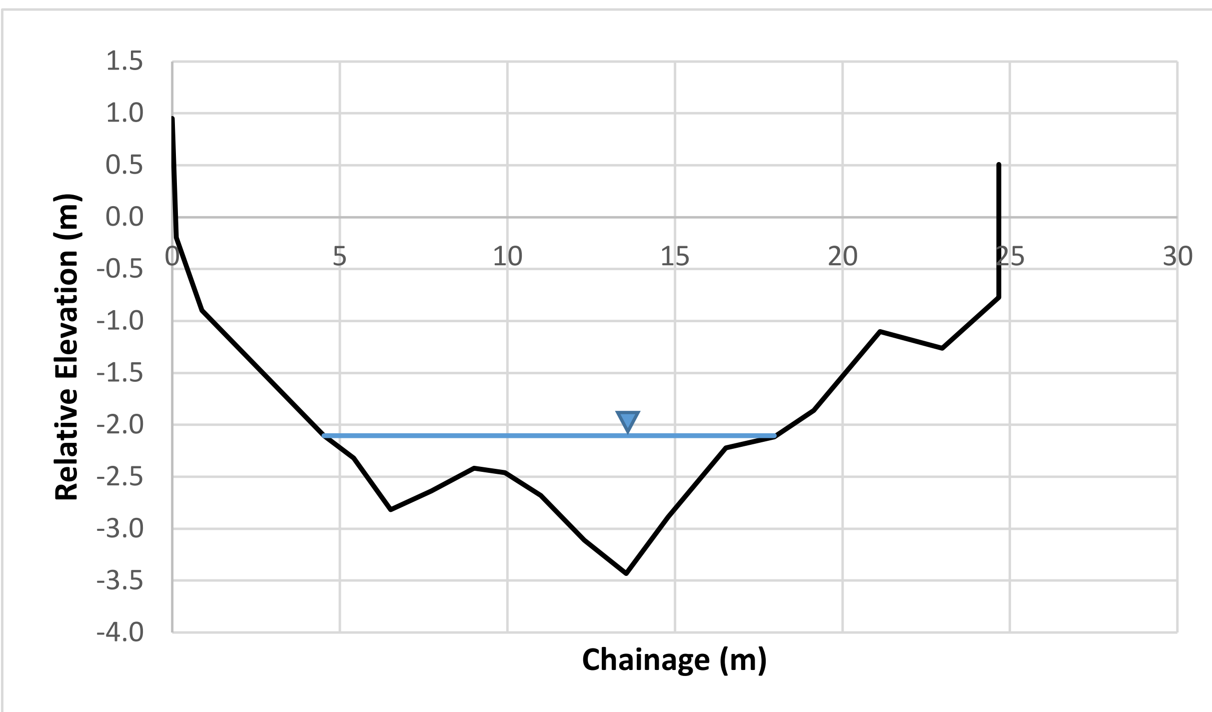


Figure 5. Chickwat Creek Bed Profile at Transect CHK-DVGM03, October 16, 2015.

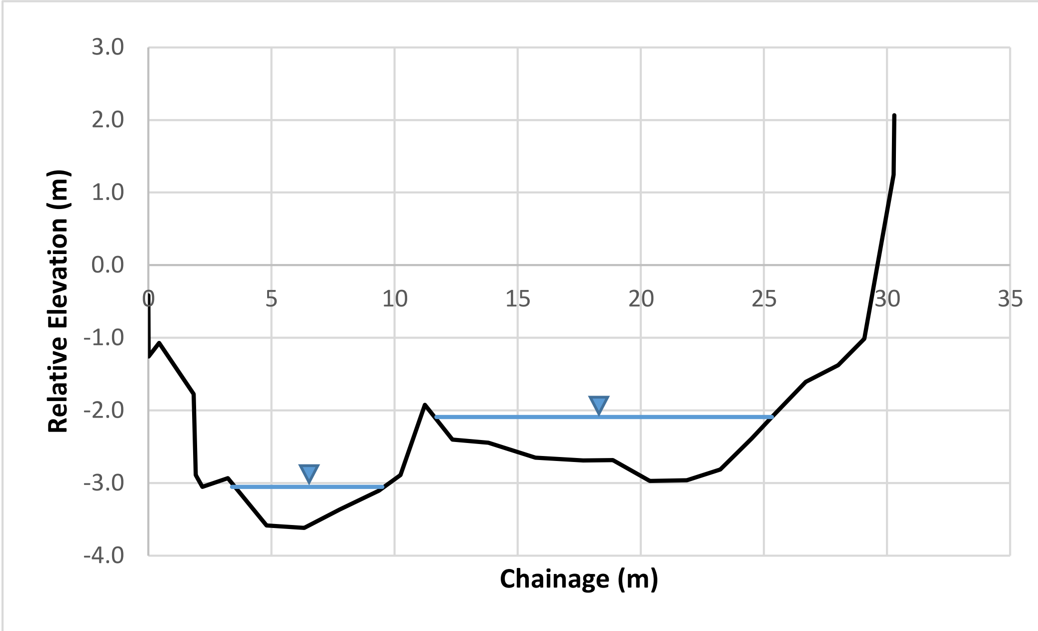


Figure 6. Chickwat Creek Bed Profile at Transect CHK-DVGM04, October 16, 2015.

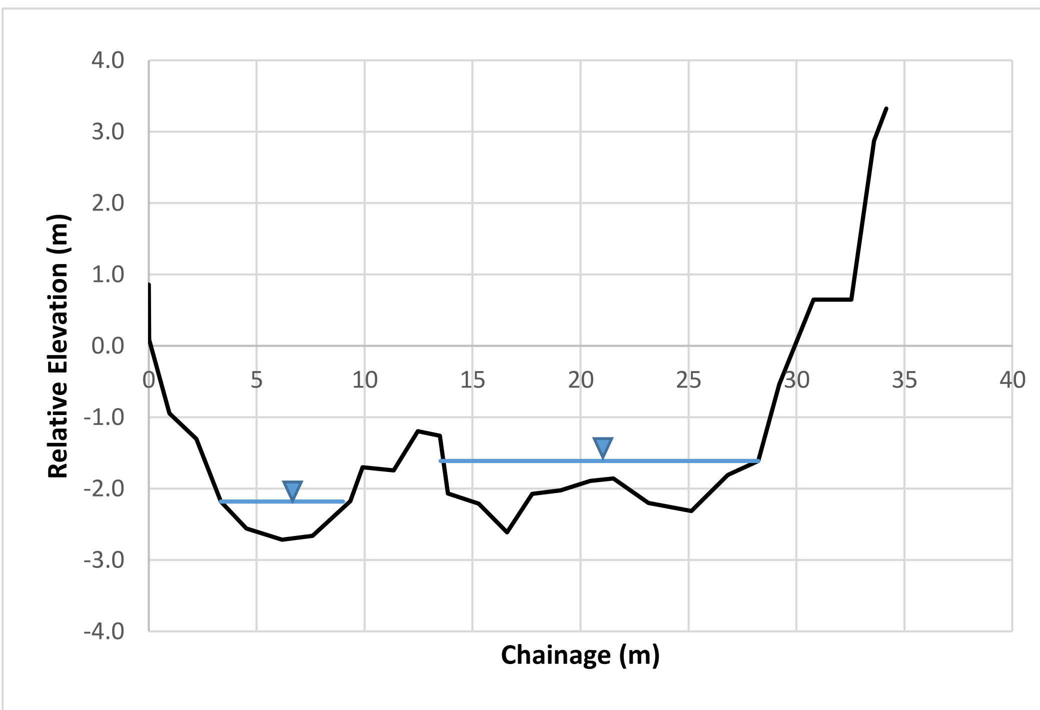


Figure 7. Chickwat Creek Bed Profile at Transect CHK-DVGM05, October 16, 2015.

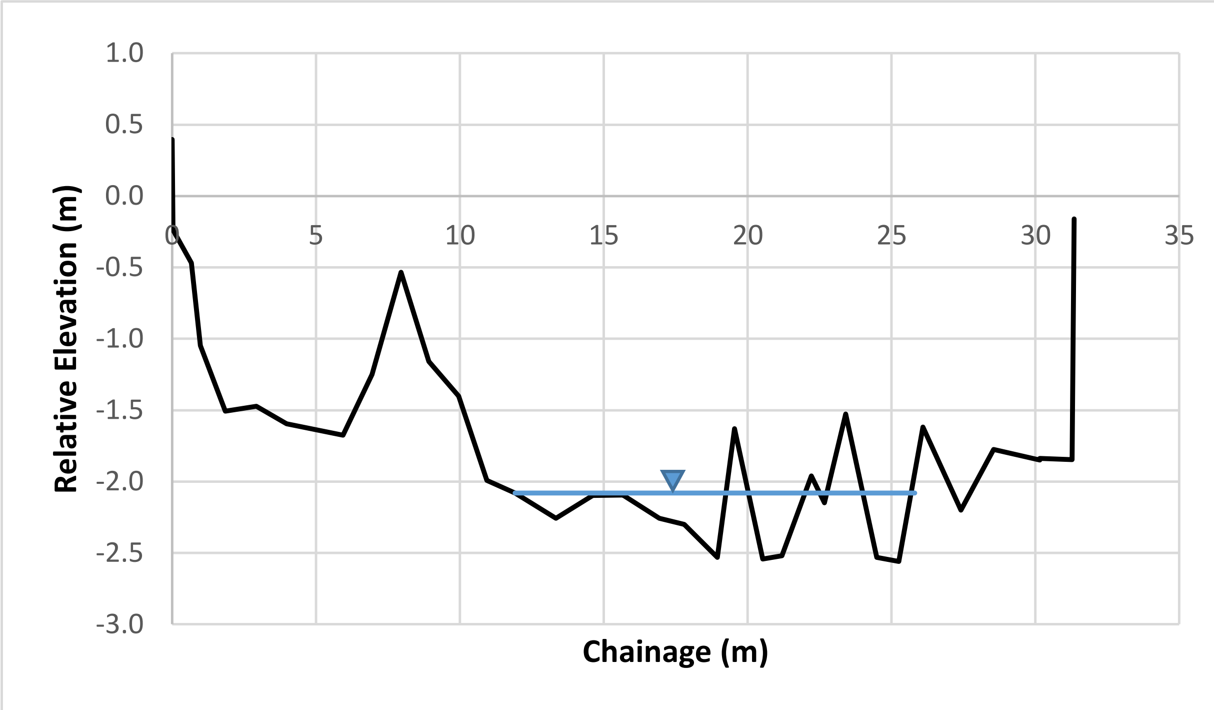


Figure 8. Chickwat Creek Bed Profile at Transect CHK-DSGM01, October 16, 2015.

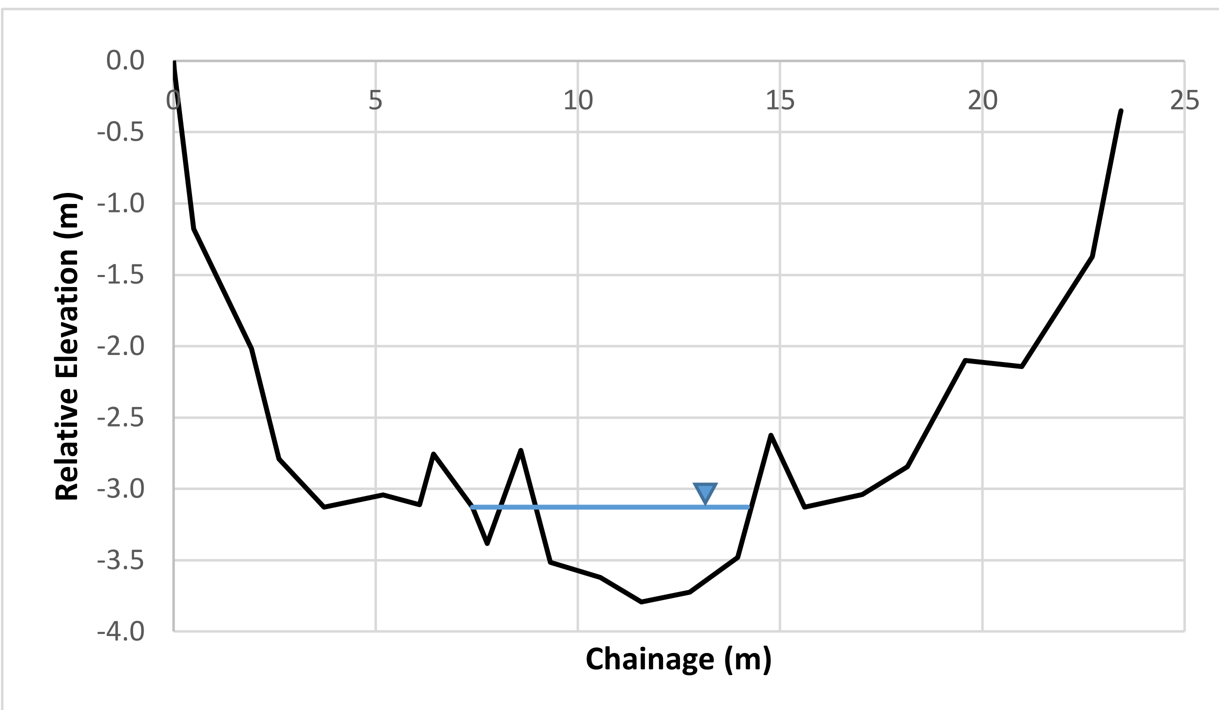


Figure 9. Chickwat Creek Bed Profile at Transect CHK-DSGM02, October 16, 2015.

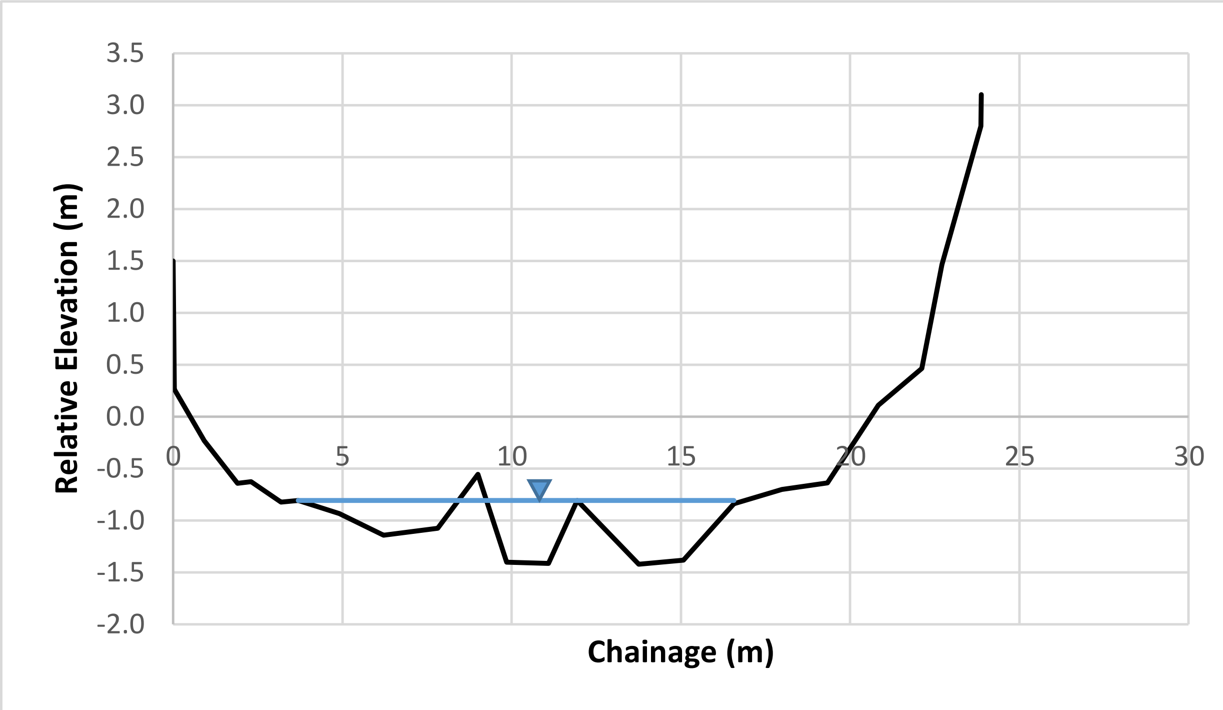


Table 1. Chickwat Creek lower diversion reach transect survey, October 16, 2015.

Y	X	Elev.	Desc.	Y	X	Elev.	Desc.	Y	X	Elev.	Desc.
9993.212	5076.093	1995.471	**BM**	9981.623	5003.988	2001.962	**BM**	9978.521	4986.075	2003.769	**BM**
10019.859	5083.420	1994.272	PIN	10011.590	5013.631	2000.067	**BM**	10008.224	4891.433	2004.165	PIN
10019.864	5083.478	1994.105	DVGM01	10009.830	5004.679	2001.550	PIN	10008.205	4981.44	2003.53	DVGM05
10019.511	5083.587	1993.353	DVGM01	10009.820	5004.682	2000.710	DVGM03	10007.605	4981.663	2003.3	DVGM05
10018.653	5083.825	1993.045	DVGM01	10009.419	5004.804	2000.890	DVGM03	10007.305	4981.775	2002.72	DVGM05
10018.040	5083.972	1992.316	DVGM01	10008.079	5005.210	2000.190	DVGM03	10006.499	4982.074	2002.26	DVGM05
10017.340	5084.180	1992.219	DVGM01	10007.993	5005.236	1999.070	DVGM03	10005.478	4982.454	2002.3	DVGM05
10016.515	5084.385	1991.949	DVGM01	10007.734	5005.314	1998.910	LWE	10004.494	4982.82	2002.18	DVGM05
10016.054	5084.517	1992.227	DVGM01	10006.748	5005.613	1999.030	BO	10002.656	4983.503	2002.09	DVGM05
10015.396	5084.689	1991.949	LWE	10005.236	5006.071	1998.380	DVGM03	10001.71	4983.855	2002.52	DVGM05
10014.678	5084.908	1991.579	DVGM01	10003.772	5006.514	1998.340	DVGM03	10000.772	4984.204	2003.24	DVGM05
10013.311	5085.292	1991.154	DVGM01	10002.394	5006.932	1998.600	DVGM03	9999.863	4984.542	2002.61	DVGM05
10011.883	5085.491	1990.814	DVGM01	10000.872	5007.393	1998.850	DVGM03	9998.898	4984.901	2002.37	DVGM05
10010.988	5085.743	1991.165	DVGM01	10000.040	5007.645	1999.070	BO	9997.979	4985.242	2001.78	DVGM05
10009.894	5086.179	1991.072	DVGM01	9999.082	5007.935	2000.040	BO	9997.061	4985.584	2001.69	LWE
10008.423	5086.450	1991.251	DVGM01	9998.020	5008.257	1999.560	DVGM03	9995.73	4986.079	2001.51	DVGM05
10007.358	5086.764	1991.413	DVGM01	9996.623	5008.680	1999.520	DVGM03	9994.521	4986.528	2001.67	DVGM05
10006.270	5087.142	1991.618	DVGM01	9994.785	5009.237	1999.310	DVGM03	9993.537	4986.894	2001.68	DVGM05
10005.043	5087.510	1992.645	BO	9992.929	5009.800	1999.270	DVGM03	9992.356	4987.333	2001.51	DVGM05
10004.196	5087.750	1991.978	DVGM01	9991.780	5010.148	1999.280	DVGM03	9991.549	4987.633	2001.47	DVGM05
10001.679	5088.440	1992.249	RWE	9990.335	5010.585	1998.990	DVGM03	9990.462	4988.037	2001.24	DVGM05
9999.747	5088.918	1992.377	DVGM01	9988.909	5011.018	1999.000	DVGM03	9989.909	4988.243	2002.14	BO
9998.021	5089.467	1993.372	DVGM01	9987.598	5011.415	1999.150	DVGM03	9988.991	4988.585	2001.23	DVGM05
9995.407	5090.106	1993.675	DVGM01	9986.383	5011.783	1999.570	DVGM03	9988.363	4988.818	2001.25	DVGM05
9993.791	5090.566	1994.204	DVGM01	9985.598	5012.021	1999.870	RWE	9987.407	4989.174	2001.81	BO
9993.701	5090.543	1994.691	PIN	9984.277	5012.421	2000.360	DVGM03	9986.985	4989.33	2001.62	DVGM05
9993.212	5076.093	1995.471	**BM**	9983.023	5012.801	2000.580	DVGM03	9986.291	4989.588	2002.24	BO
10018.122	5061.981	1996.419	PIN	9982.009	5013.108	2000.950	DVGM03	9985.279	4989.965	2001.24	DVGM05
10018.003	5061.992	1995.273	DVGM02	9980.860	5013.456	2003.210	DVGM03	9984.557	4990.233	2001.21	DVGM05
10017.245	5062.059	1994.571	DVGM02	9980.844	5013.461	2004.030	PIN	9983.77	4990.526	2002.15	BO
10013.610	5062.380	1993.365	LWE	9981.623	5003.988	2001.962	**BM**	9982.533	4990.986	2001.57	RWE
10012.733	5062.458	1993.150	DVGM02	10009.495	4993.252	2002.820	PIN	9981.464	4991.383	2002	DVGM05
10011.637	5062.555	1992.655	DVGM02	10009.477	4993.260	2002.050	DVGM04	9979.964	4991.941	2001.92	DVGM05
10010.422	5062.662	1992.833	DVGM02	10008.606	4993.614	2001.020	DVGM04	9979.964	4991.941	2001.93	DVGM05
10009.157	5062.774	1993.053	DVGM02	10007.458	4994.083	2000.660	DVGM04	9978.905	4992.335	2001.92	DVGM05
10008.231	5062.856	1993.011	DVGM02	10006.402	4994.513	1999.780	LWE	9978.845	4992.357	2003.609	PIN
10007.165	5062.950	1992.790	DVGM02	10005.310	4994.959	1999.400	DVGM04				
10005.870	5063.065	1992.360	DVGM02	10003.772	4995.585	1999.240	DVGM04				
10004.625	5063.175	1992.039	DVGM02	10002.467	4996.118	1999.300	DVGM04				
10003.390	5063.284	1992.584	DVGM02	10000.856	4996.775	1999.790	RWE				
10001.666	5063.437	1993.248	DVGM02	10000.328	4996.990	2000.260	BAR				
10000.222	5063.564	1993.355	RWE	9998.985	4997.537	2000.220	BAR				
9999.056	5063.667	1993.607	DVGM02	9997.948	4997.960	2000.770	BAR				
9997.084	5063.842	1994.367	DVGM02	9997.003	4998.345	2000.700	BAR				
9995.231	5064.006	1994.208	DVGM02	9996.661	4998.485	1999.890	LWE				
9993.548	5064.155	1994.697	DVGM02	9995.337	4999.025	1999.750	DVGM04				
9993.548	5064.155	1995.979	PIN	9994.124	4999.519	1999.350	DVGM04				
				9993.049	4999.957	1999.890	DVGM04				
				9991.827	5000.456	1999.940	DVGM04				
				9990.559	5000.973	2000.070	DVGM04				
				9989.568	5001.377	2000.110	DVGM04				
				9988.0583	5001.9921	1999.76	DVGM04				
				9986.2248	5002.7397	1999.65	DVGM04				
				9984.6506	5003.3815	2000.16	DVGM04				
				9983.3543	5003.9101	2000.35	RWE				
				9982.4468	5004.2801	2001.43	DVGM04				
				9980.9837	5004.8766	2002.61	DVGM04				
				9979.3632	5005.5373	2002.61	DVGM04				
				9978.3817	5005.9375	2004.83	DVGM04				
				9977.858	5006.151	2005.29	PIN				

Table 2. Chickwat Creek downstream reach transect survey, October 16, 2015.

Y	X	Elev.	Desc.
10047.751	5280.400	1985.017	**BM046**
10047.732	5280.395	1984.949	DSGM01
10047.269	5280.268	1983.839	DSGM01
10045.890	5279.890	1983.000	DSGM01
10045.234	5279.710	1982.226	DSGM01
10044.163	5279.417	1981.889	DSGM01
10042.755	5279.031	1981.974	DSGM01
10041.878	5278.790	1981.907	DSGM01
10041.550	5278.700	1982.262	DSGM01
10040.624	5278.446	1981.889	LWE
10040.267	5278.348	1981.635	DSGM01
10039.467	5278.129	1982.288	BO
10038.763	5277.936	1981.501	DSGM01
10037.567	5277.608	1981.395	DSGM01
10036.593	5277.341	1981.223	DSGM01
10035.435	5277.024	1981.292	DSGM01
10034.297	5276.712	1981.536	DSGM01
10033.507	5276.495	1982.394	BO
10032.706	5276.276	1981.890	DSGM01
10031.327	5275.898	1981.979	RWE
10030.247	5275.602	1982.173	DSGM01
10028.868	5275.224	1982.916	DSGM01
10027.518	5274.853	1982.873	DSGM01
10025.839	5274.393	1983.646	DSGM01
10025.184	5274.214	1984.630	DSGM01
10025.156	5274.206	1984.666	**BM036**
10047.751	5280.400	1985.017	**BM046**
10025.156	5274.206	1984.666	**BM036**
10049.827	5239.713	1986.515	PIN
10049.797	5239.710	1985.279	DSGM02
10048.911	5239.626	1984.786	DSGM02
10047.936	5239.534	1984.375	DSGM02
10047.537	5239.496	1984.391	DSGM02
10046.651	5239.412	1984.193	DSGM02
10046.144	5239.364	1984.211	LWE
10044.939	5239.250	1984.082	DSGM02
10043.635	5239.127	1983.876	DSGM02
10042.042	5238.976	1983.941	DSGM02
10040.857	5238.864	1984.461	BO
10040.021	5238.784	1983.615	DSGM02
10038.786	5238.668	1983.602	DSGM02
10037.940	5238.587	1984.209	BO
10036.128	5238.416	1983.594	DSGM02
10034.814	5238.291	1983.634	DSGM02
10033.331	5238.151	1984.176	RWE
10031.927	5238.018	1984.314	DSGM02
10030.583	5237.891	1984.379	DSGM02
10029.090	5237.749	1985.125	DSGM02
10027.806	5237.628	1985.480	DSGM02
10027.218	5237.572	1986.482	DSGM02
10026.073	5237.464	1987.815	DSGM02
10026.057	5237.462	1988.119	PIN

Table 3. Chickwat Creek diversion and downstream reach thalweg survey, October 16, 2015.

Y	X	Elev.	Depth
9984.939	4975.46	2002.013	0.88
9986.682	4983.285	2001.246	0.87
9986.948	4985.343	2001.432	0.4
9988.323	4987.848	2001.334	0.42
9987.724	4990.447	2001.037	0.48
9987.25	4993.339	2000.656	0.7
9989.603	4994.382	2000.453	0.75
9991.834	4994.722	2000.501	0.45
9992.258	4997.38	1999.971	0.37
9993.155	4998.844	1999.059	1.39
9995.386	5000.918	1999.2	0.78
9996.182	5003.415	1999.467	0.47
9996.964	5007.255	1999.418	0.37
9997.967	5010.329	1998.853	0.5
9998.177	5013.523	1998.144	0.68
9999.728	5017.182	1998.44	0.34
10000.838	5018.67	1997.547	0.55
10003.017	5021.926	1997.597	0.42
10004.589	5023.954	1997.029	0.55
10006.134	5030.243	1994.552	1.19
10007.954	5033.058	1994.777	0.9
10006.8	5036.151	1994.701	0.6
10006.615	5039.039	1994.276	1.08
10005.996	5041.231	1994.297	1.12
10006.543	5045.903	1993.621	0.95
10006.255	5048.996	1993.977	0.58
10005.984	5051.086	1993.846	0.52
10004.726	5053.413	1993.37	0.7
10004.659	5054.441	1993.093	0.65
10003.574	5057.219	1992.188	1.34
10003.93	5059.75	1992.132	1.38
10003.979	5061.541	1992.091	1.4
10005.049	5063.666	1992.114	1.37
10005.663	5066.025	1992.492	0.89
10006.264	5067.483	1992.75	0.54
10005.927	5068.936	1992.434	0.52
10005.65	5070.849	1992.012	0.91
10005.477	5073.345	1992.103	0.8
10006.535	5075.627	1992.194	0.73
10008.142	5076.556	1992.327	0.58
10010.413	5077.791	1992.214	0.43
10011.346	5078.59	1992.301	0.27
10012.001	5079.83	1991.106	0.95
10012.075	5081.48	1990.799	1.19
10011.819	5083.679	1990.609	1.34
10011.798	5085.497	1990.904	1.1
10012.698	5088.318	1990.982	0.93
10013.403	5090.626	1991.074	0.77
10012.956	5092	1990.983	0.6
10012.974	5095.187	1990.911	0.69
10012.304	5096.638	1990.144	0.87
10012.726	5098.597	1989.905	0.6
10012.864	5100.846	1989.951	0.68
10012.983	5102.364	1989.203	1.1
10014.244	5105.949	1989.136	1.04
10014.767	5109.223	1989.061	1.1
10015.556	5111.918	1989.338	0.77
10016.045	5114.044	1989.301	0.8
10016.911	5115.63	1989.374	0.76
10017.591	5117.607	1989.135	0.92
10017.945	5119.611	1989.433	0.51
10031.156	5184.388	1986.019	0.49
10031.79	5186.668	1985.593	0.63
10033.787	5187.644	1985.324	0.85
10034.332	5190.716	1985.358	0.700
10034.754	5193.597	1985.441	0.650
10035.395	5195.954	1985.531	0.450
10035.500	5198.906	1985.531	0.460
10035.452	5201.784	1985.254	0.510
10035.123	5204.274	1984.919	0.600
10034.580	5206.098	1985.035	0.440
10034.700	5208.169	1984.880	0.530
10034.818	5210.521	1984.526	0.570
10033.761	5213.129	1984.650	0.490
10032.192	5216.414	1984.588	0.590
10031.827	5219.435	1984.325	0.650
10032.828	5221.699	1984.316	0.470
10034.191	5224.286	1984.161	0.520
10033.774	5226.968	1984.162	0.400
10033.431	5229.486	1983.828	0.660
10033.586	5232.023	1983.875	0.510
10034.850	5234.170	1983.779	0.530
10034.882	5236.746	1983.731	0.430
10036.269	5239.101	1983.493	0.640
10036.761	5240.719	1983.259	0.500
10036.337	5241.926	1983.247	0.580
10036.919	5244.564	1982.526	1.030
10036.982	5247.288	1982.843	0.620
10036.361	5249.585	1982.921	0.550
10035.635	5252.024	1982.417	0.480
10036.064	5255.411	1981.841	0.770
10035.685	5257.864	1981.650	0.920
10035.261	5261.432	1981.772	0.690
10035.871	5263.639	1981.818	0.550
10036.913	5265.456	1981.856	0.510
10037.905	5268.339	1981.331	0.780
10038.258	5270.207	1981.488	0.620
10037.391	5273.771	1981.470	0.610
10036.979	5275.789	1981.236	0.720
10036.981	5277.992	1981.238	0.650
10036.433	5280.473	1981.055	0.750
10035.053	5283.178	1981.061	0.820
10033.868	5286.071	1981.311	0.350
10033.903	5289.18	1981.044	0.55
10033.824	5292.847	1980.779	0.76
10033.727	5296.369	1981.05	0.35
10032.283	5299.11	1980.887	0.5

Figure 10. Substrate Grain Distribution at Transect CHK-DVGM01 on October 15, 2015. (a) number of particles per size class, and (b) cumulative particle size distribution.

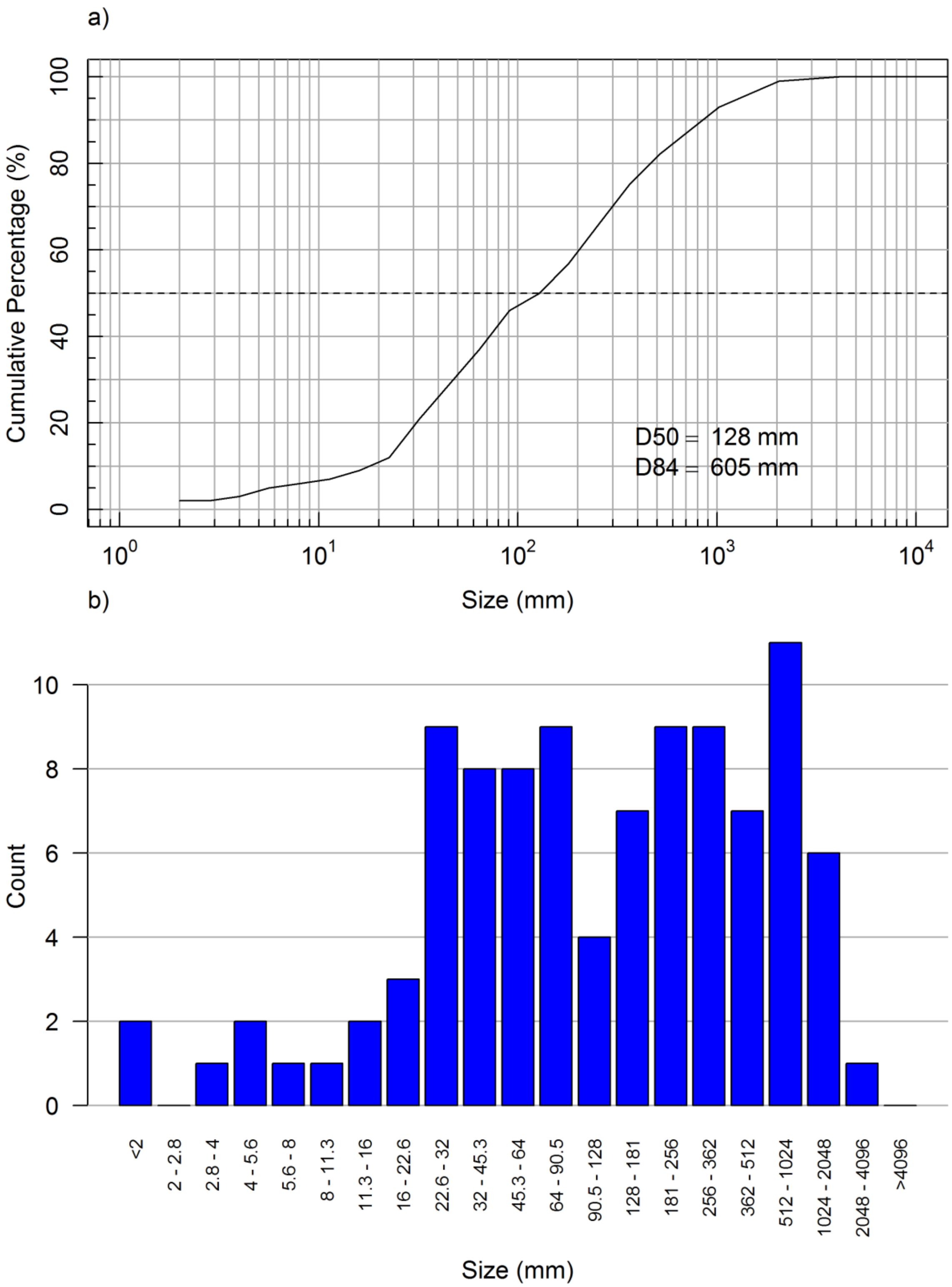
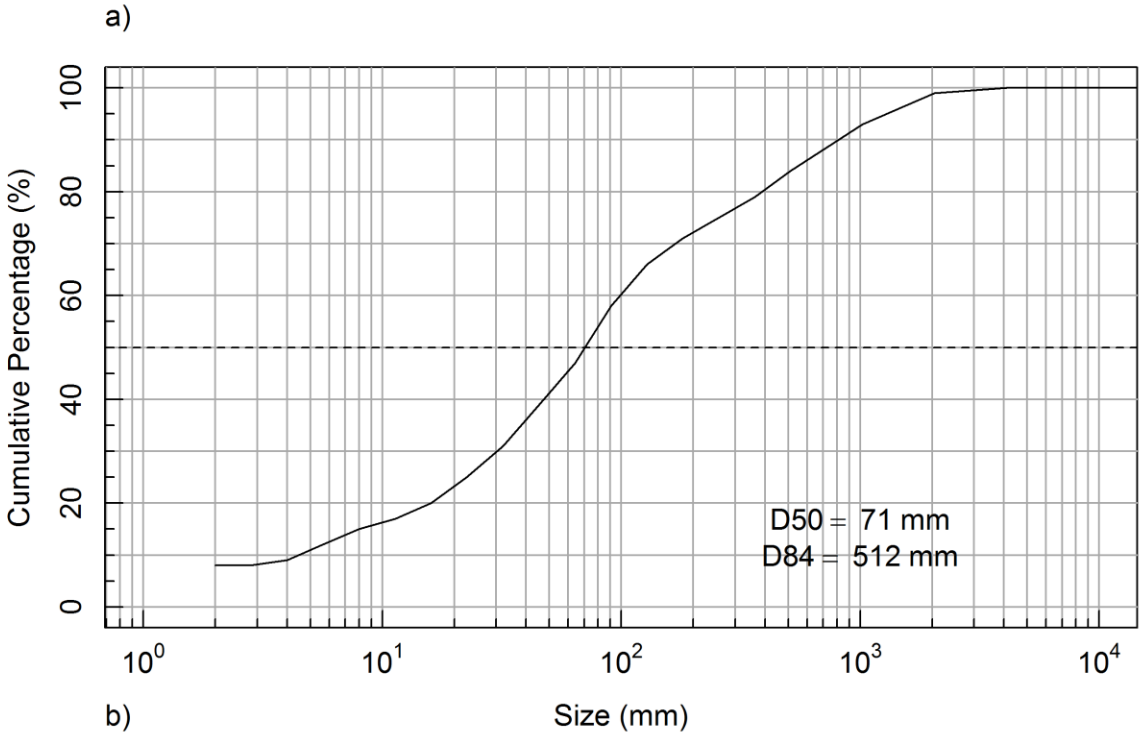


Figure 11. Substrate Grain Distribution at Transect CHK-DVGM02 on October 15, 2015. (a) number of particles per size class, and (b) cumulative particle size distribution.



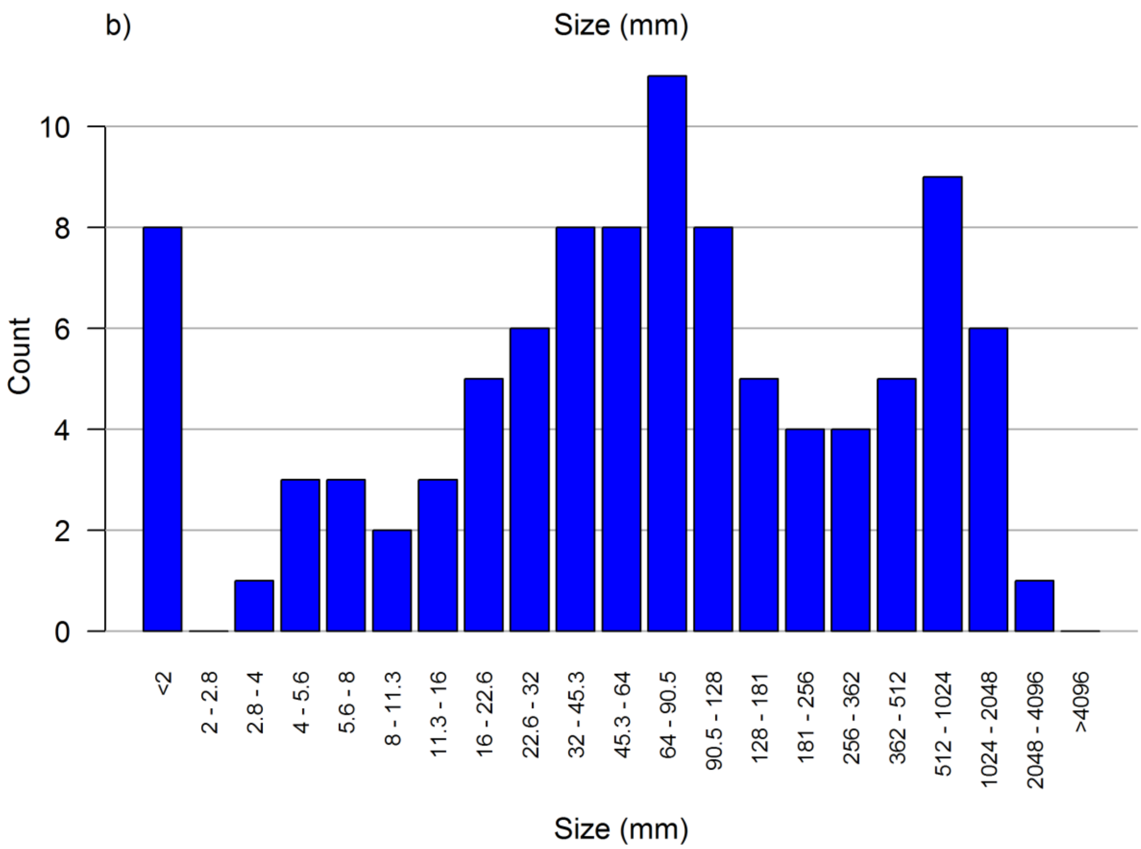


Figure 12. Substrate Grain Distribution at Transect CHK-DVGM03 on October 15, 2015. (a) number of particles per size class, and (b) cumulative particle size distribution.

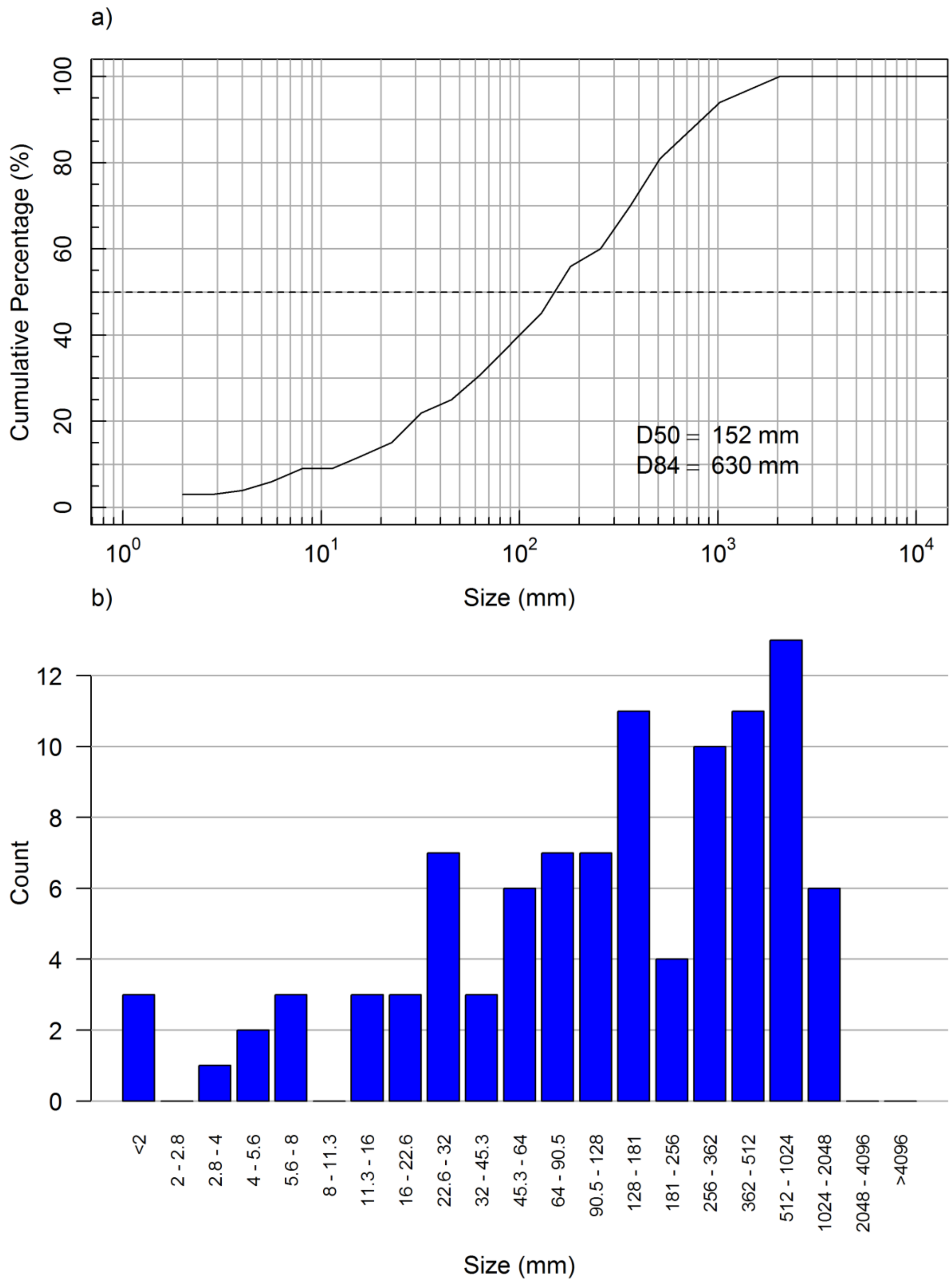


Figure 13. Substrate Grain Distribution at Transect CHK-DVGM04 on October 15, 2015. (a) number of particles per size class, and (b) cumulative particle size distribution.

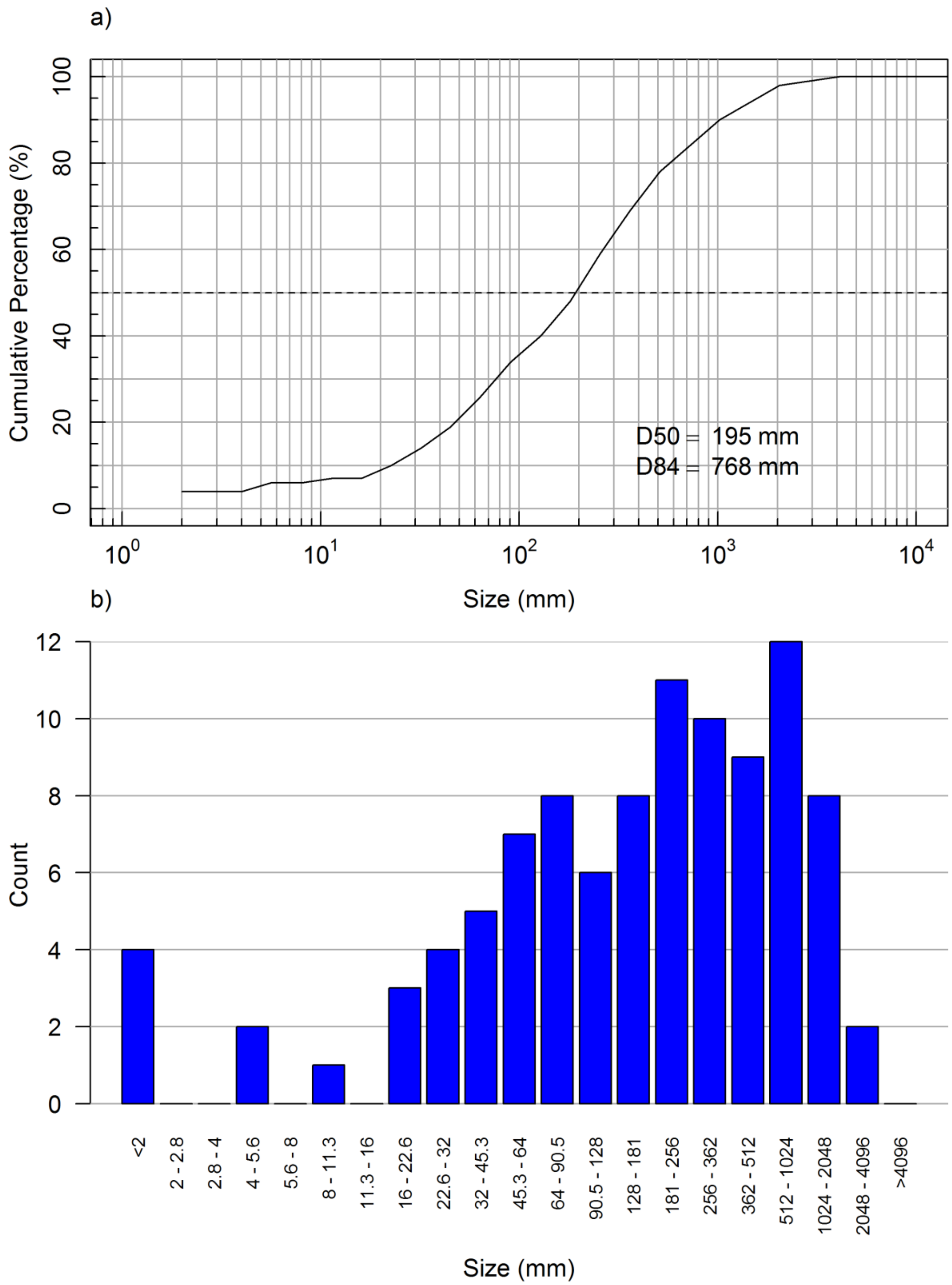


Figure 14. Substrate Grain Distribution at Transect CHK-DVGM05 on October 15, 2015. (a) number of particles per size class, and (b) cumulative particle size distribution.

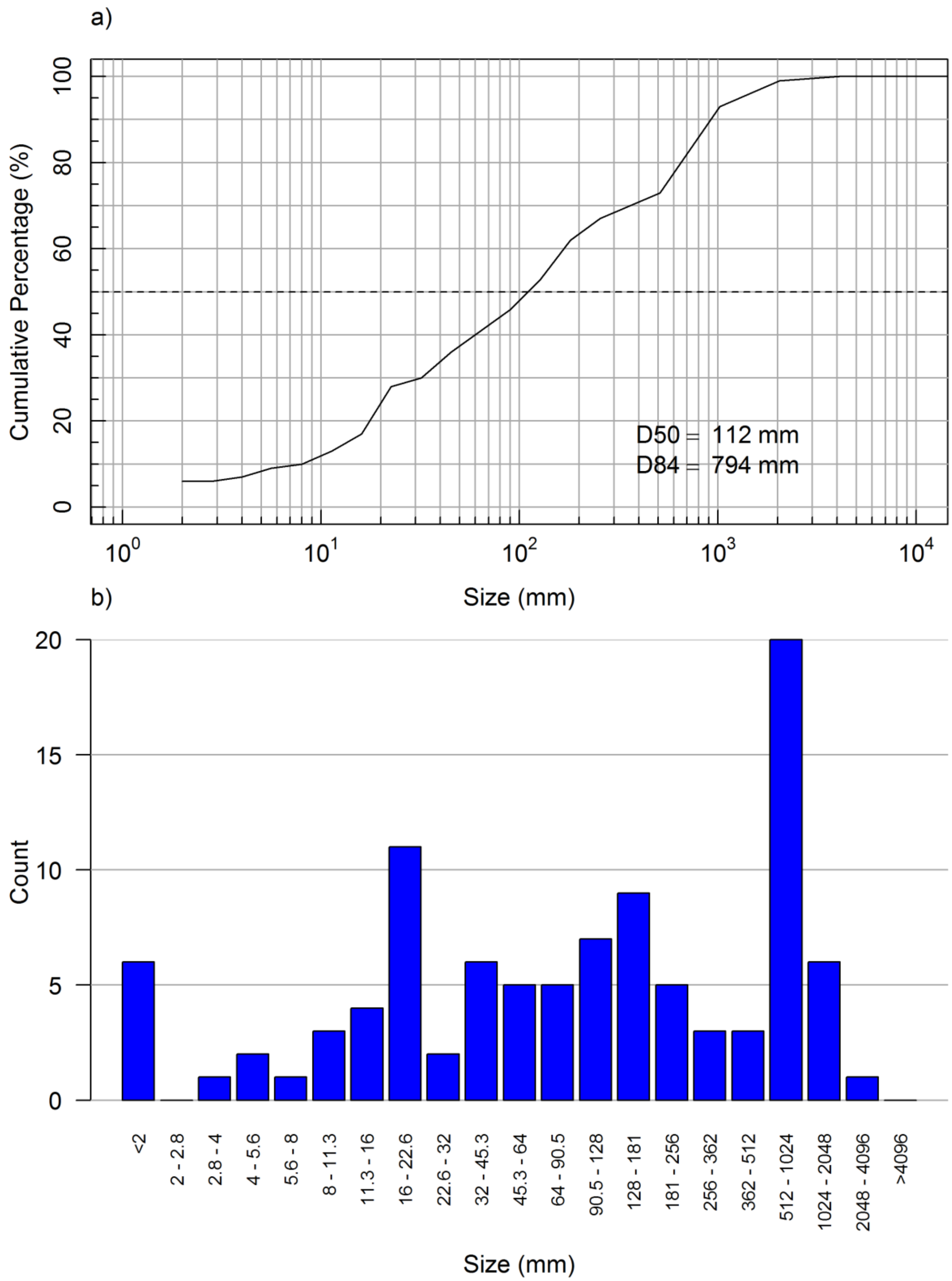


Figure 15. Substrate Grain Distribution at Transect CHK-DSGM01 on October 15, 2015. (a) number of particles per size class, and (b) cumulative particle size distribution.

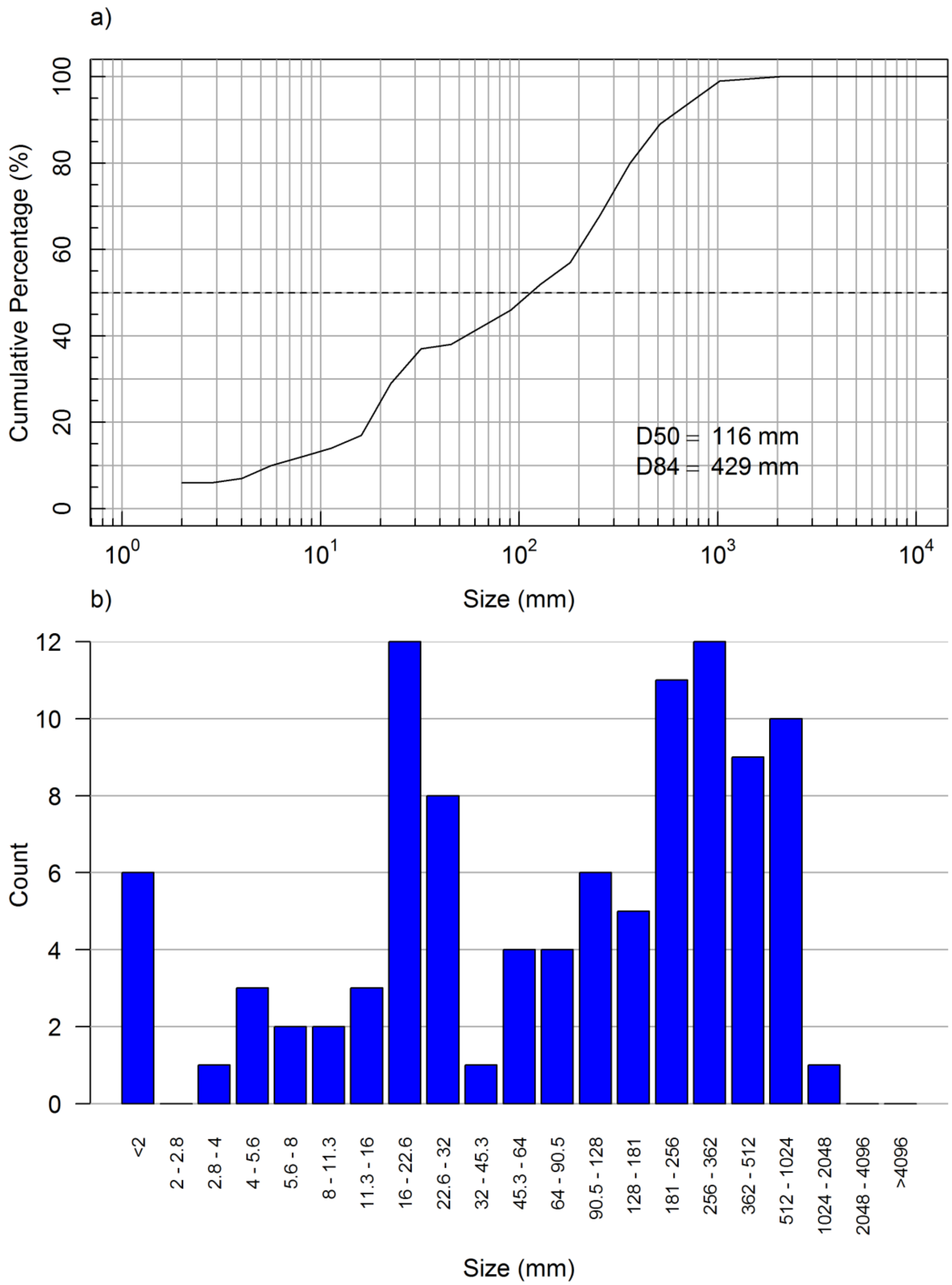
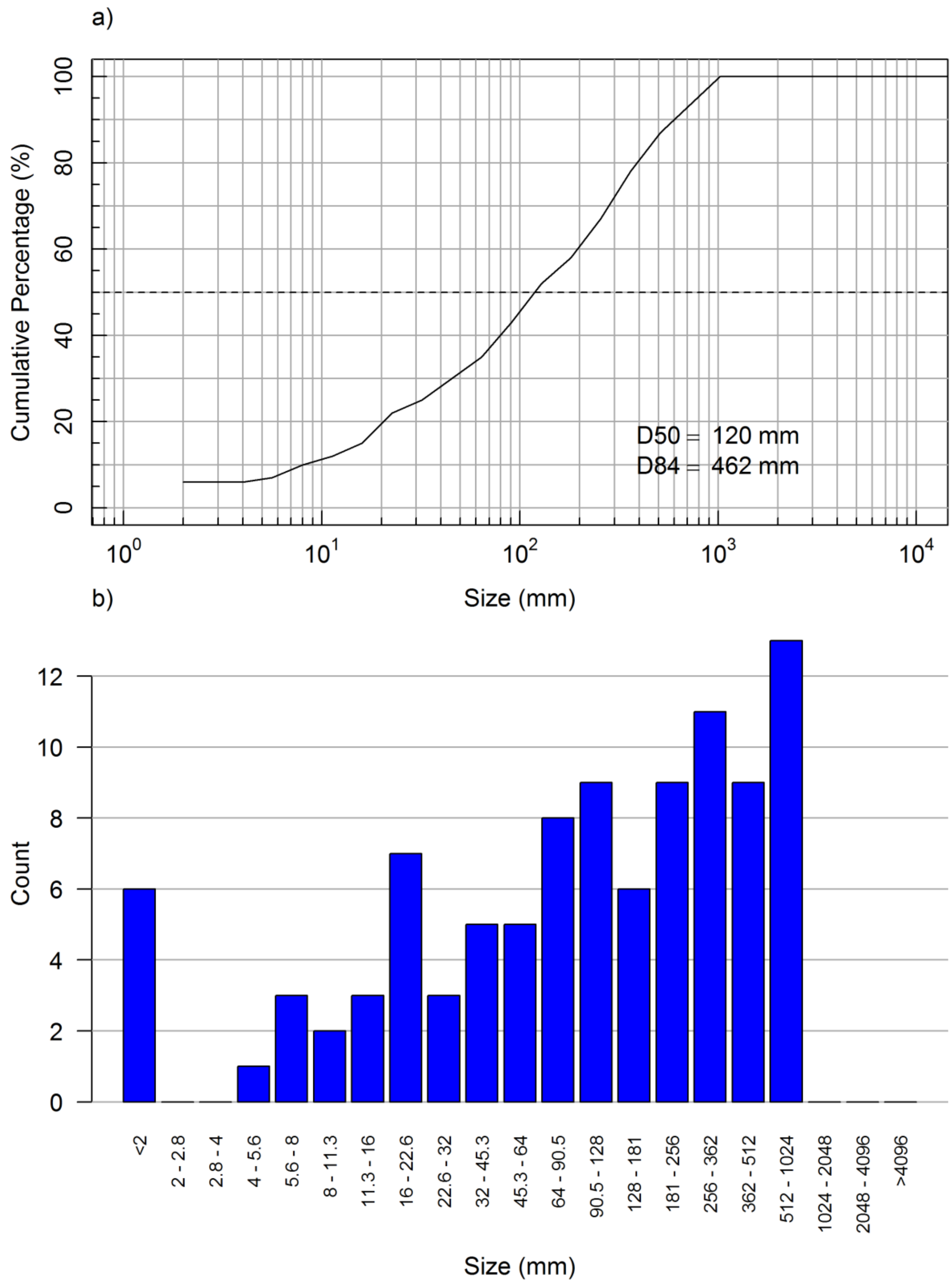


Figure 16. Substrate Grain Distribution at Transect CHK-DSGM02 on October 15, 2015. (a) number of particles per size class, and (b) cumulative particle size distribution.



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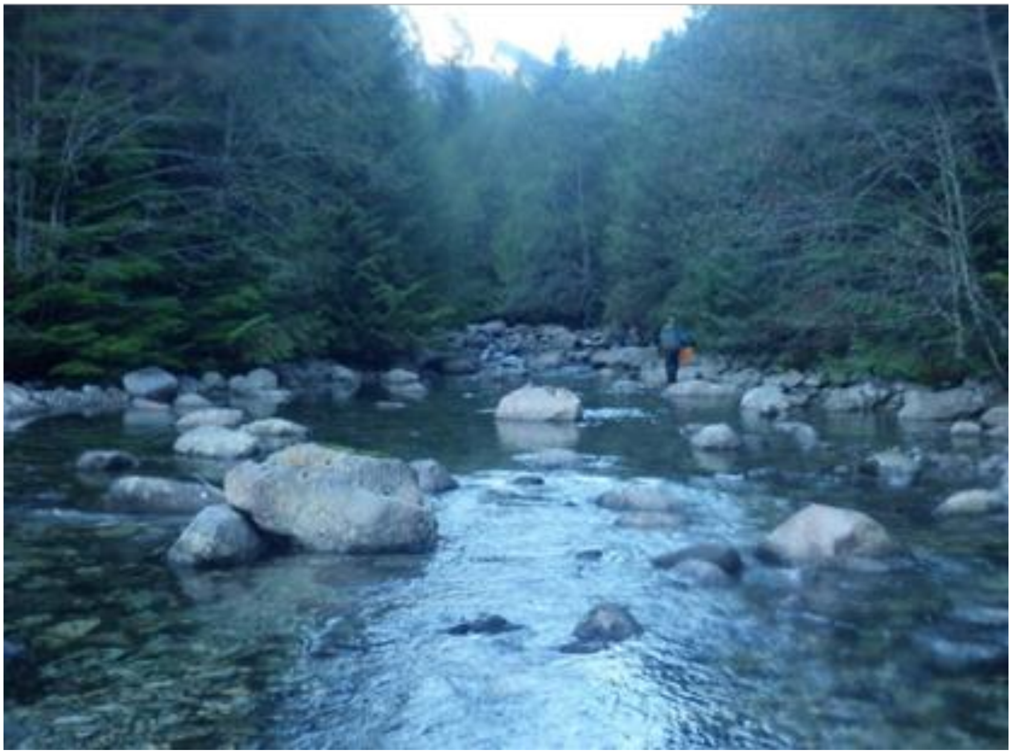

Figure 4. Looking downstream at CHK-USSN02 on October 9, 2014.

Figure 5. Looking upstream at CHK-USSN03 on October 9, 2014.

Figure 6. Looking downstream at CHK-USSN03 on October 9, 2014.

Figure 7. Looking upstream at CHK-USSN04 on October 9, 2014.

Figure 8. Looking downstream at CHK-USSN04 on October 9, 2014.

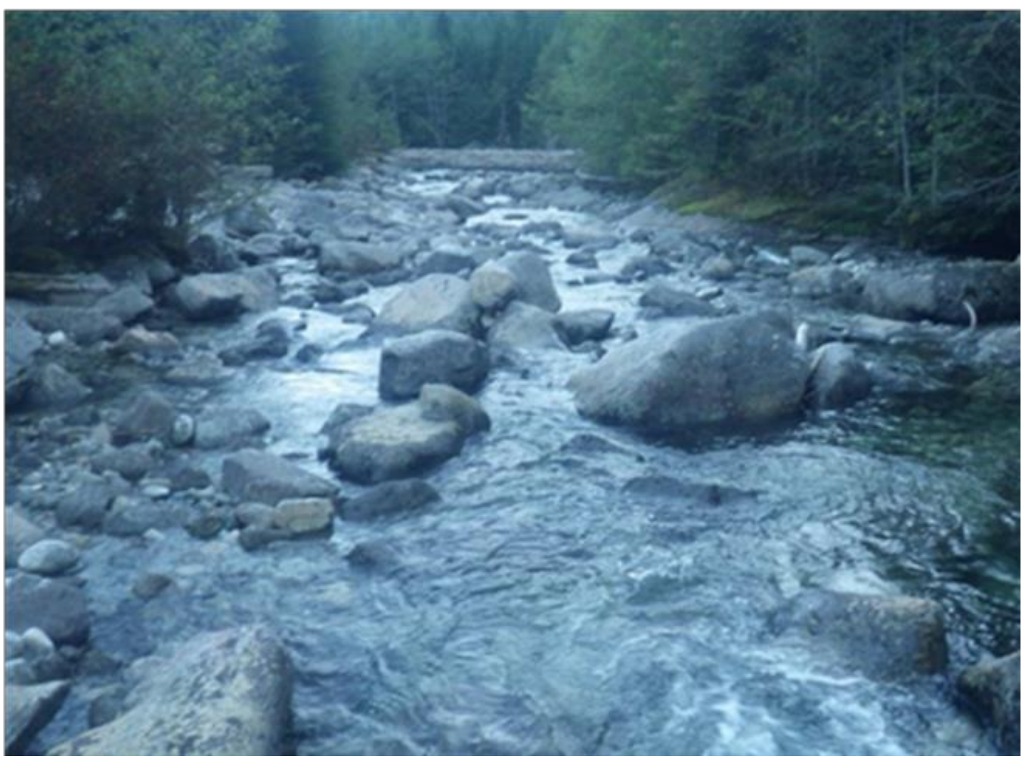

Figure 9. Looking upstream at CHK-USSN05 on October 9, 2014.

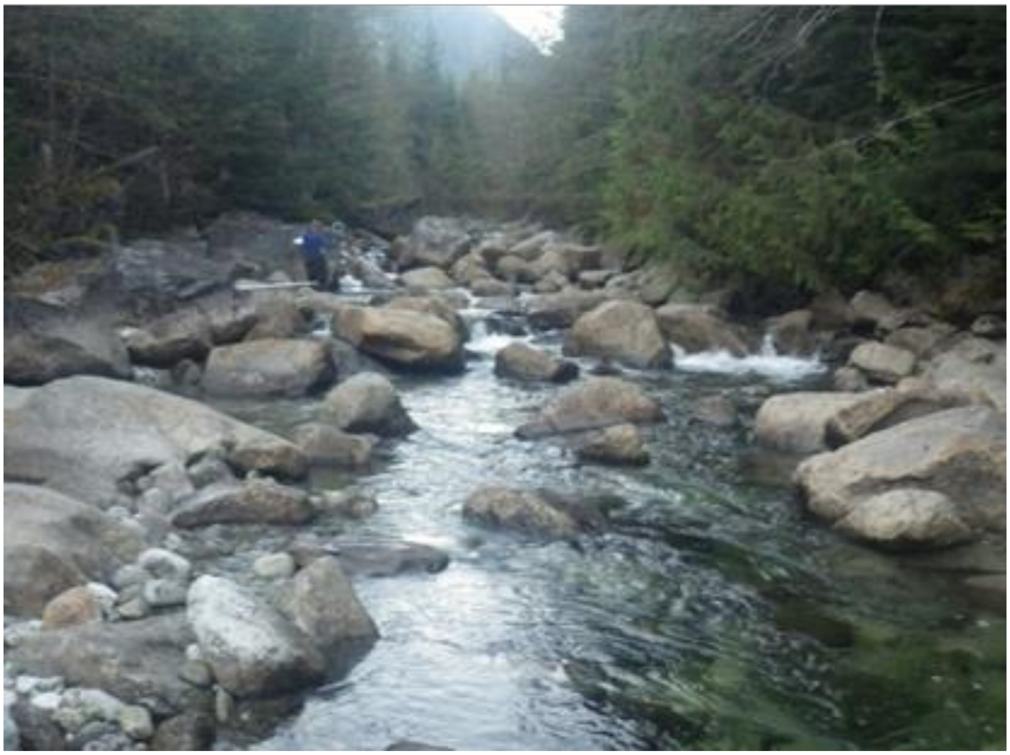

Figure 10. Looking downstream at CHK-USSN05 on October 9, 2014.

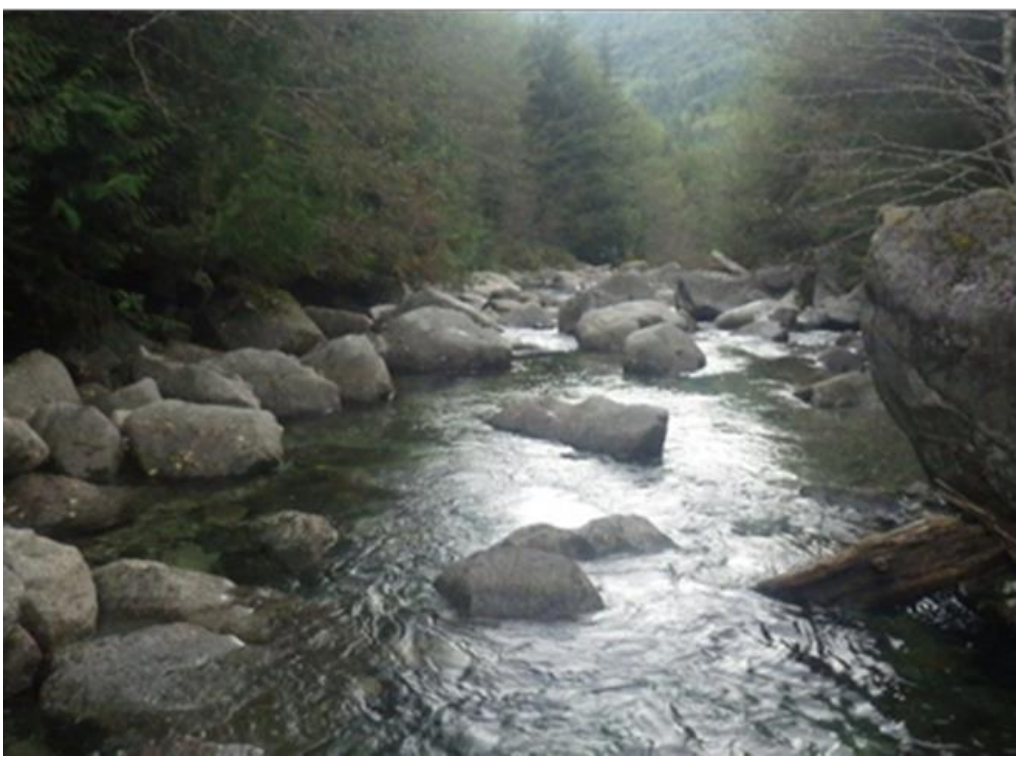

Figure 11. Looking upstream at CHK-UDVSN01 on October 10, 2014.

Figure 12. Looking downstream at CHK-UDVSN01 on October 10, 2014.

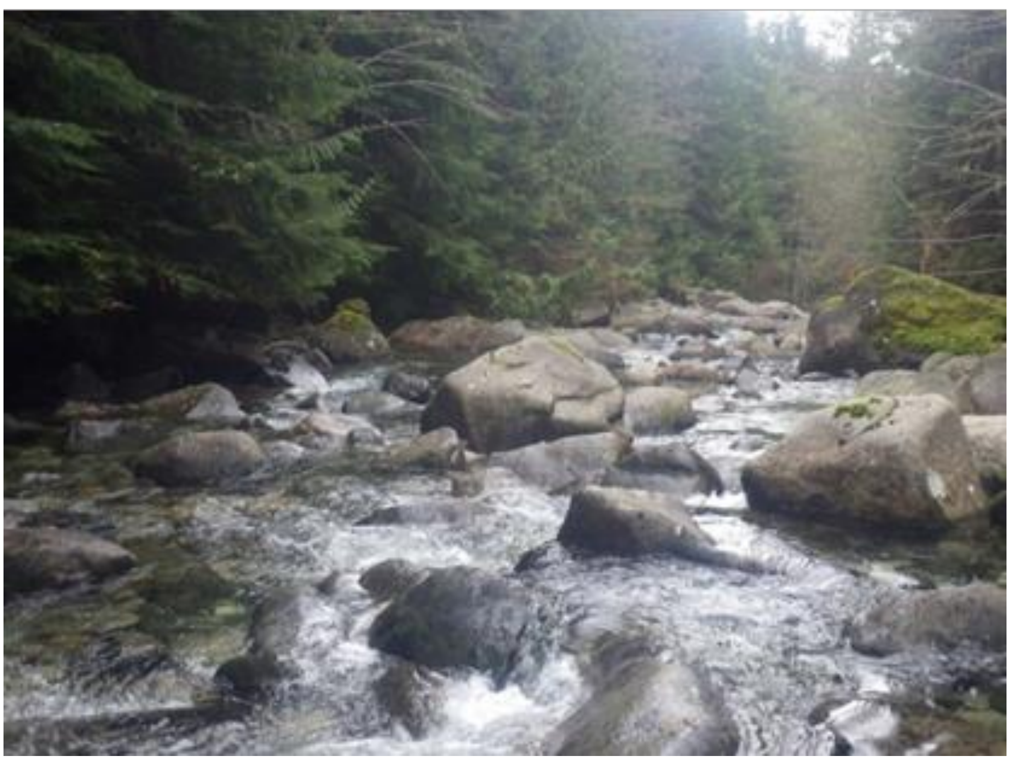

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Figure 16. Looking downstream at CHK-UDVSN03 on October 10, 2014.

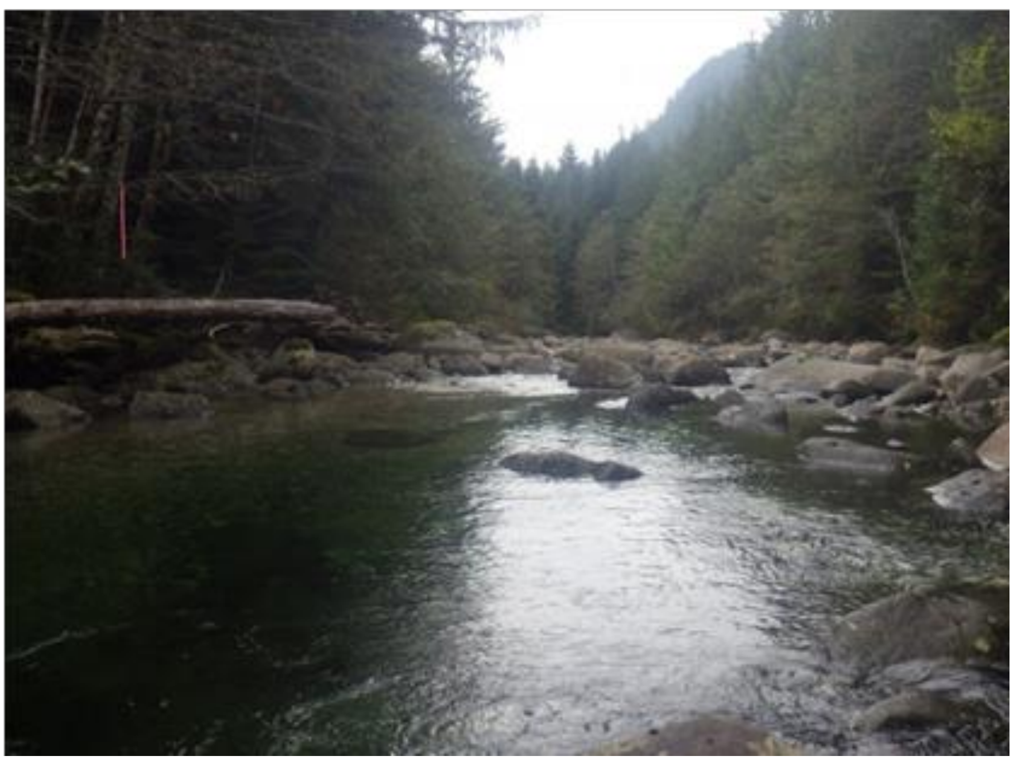

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Figure 18. Looking downstream at CHK-UDVSN04 on October 10, 2014.

Figure 19. Looking upstream at CHK-UDVSN05 on October 10, 2014.

Figure 20. Looking downstream at CHK-UDVSN05 on October 10, 2014.

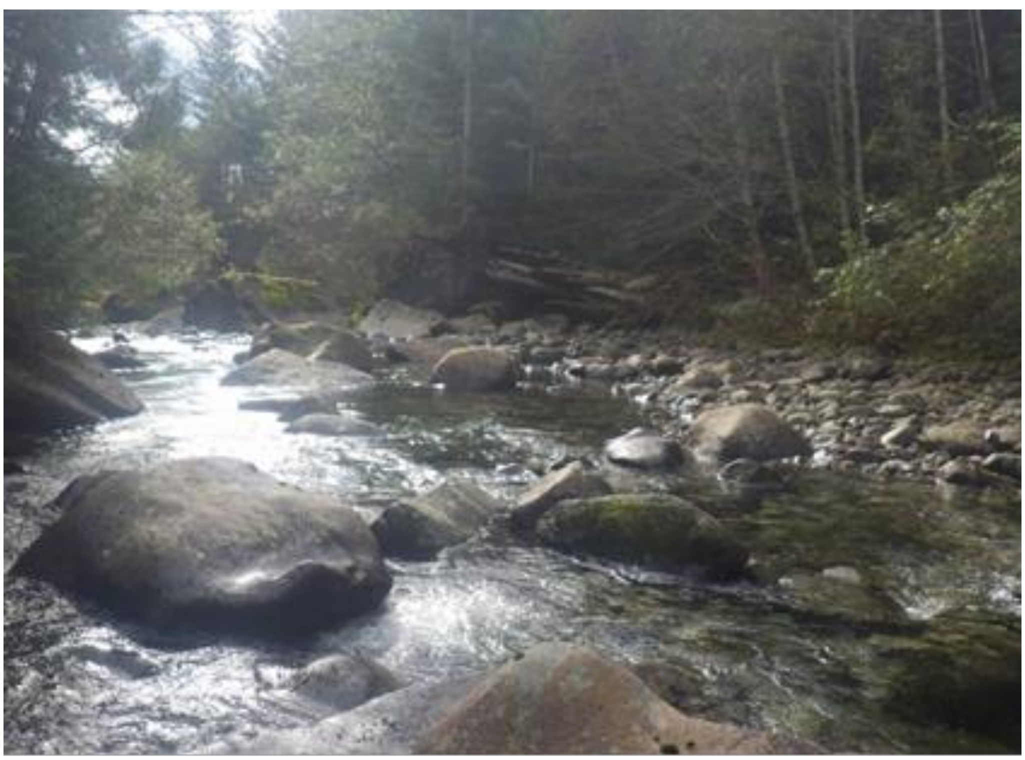

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Figure 24. Looking downstream at CHK-USSN02 on October 28, 2015.

Figure 25. Looking upstream at CHK-USSN03 on October 28, 2015.

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Figure 28. Looking downstream at CHK-USSN04 on October 28, 2015.

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Figure 31. Looking upstream at CHK-USSN06 on October 28, 2015.

Figure 32. Looking downstream at CHK-USSN06 on October 28, 2015.

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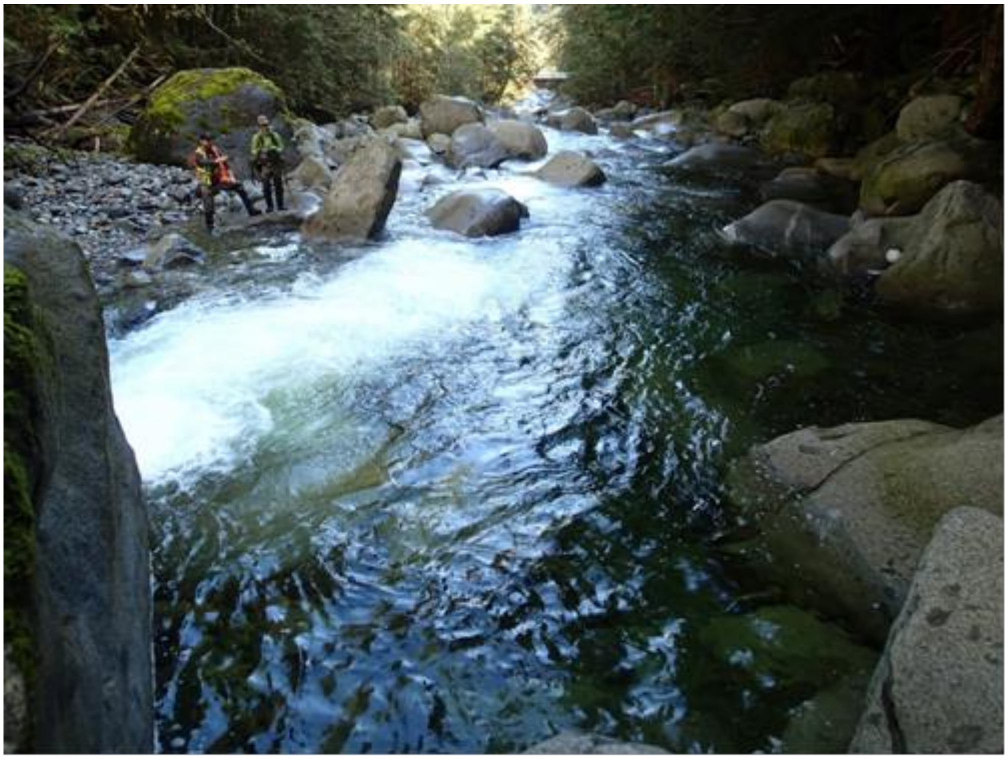

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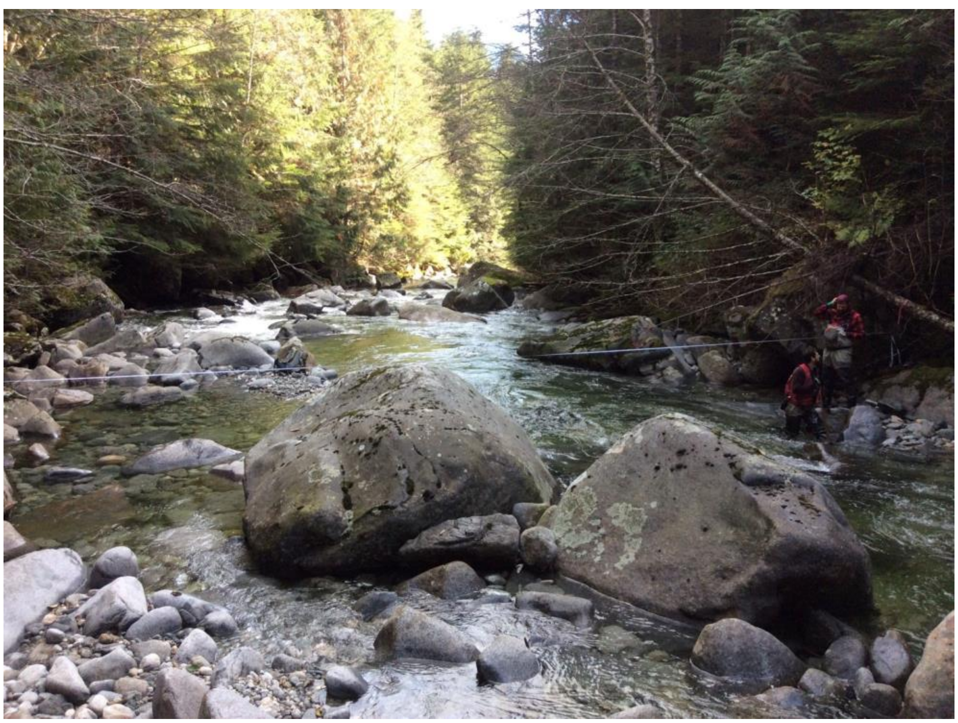


Figure 3. Looking upstream at CHK-UDVSN02 on October 14, 2015

Figure 4. Looking downstream at CHK-UDVSN02 on October 14, 2015

Figure 5. Looking upstream at CHK-UDVSN03 on October 14, 2015

Figure 6. Looking downstream at CHK-UDVSN03 on October 14, 2015

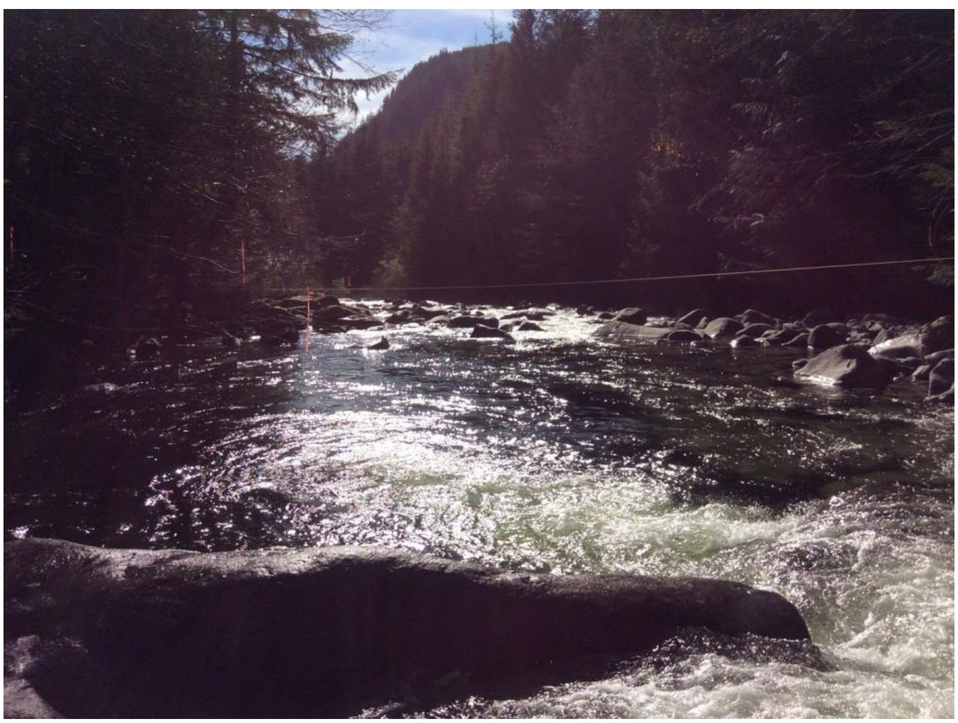
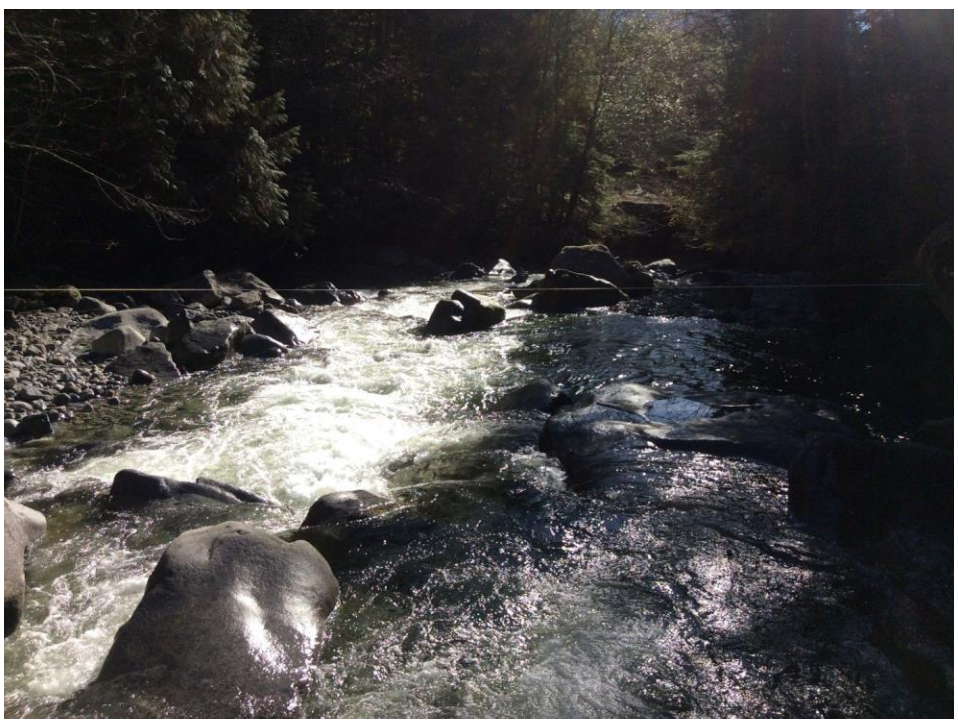


Figure 7. Looking upstream at CHK-UDVSN04 on October 14, 2015

Figure 8. Looking downstream at CHK-UDVSN04 on October 14, 2015



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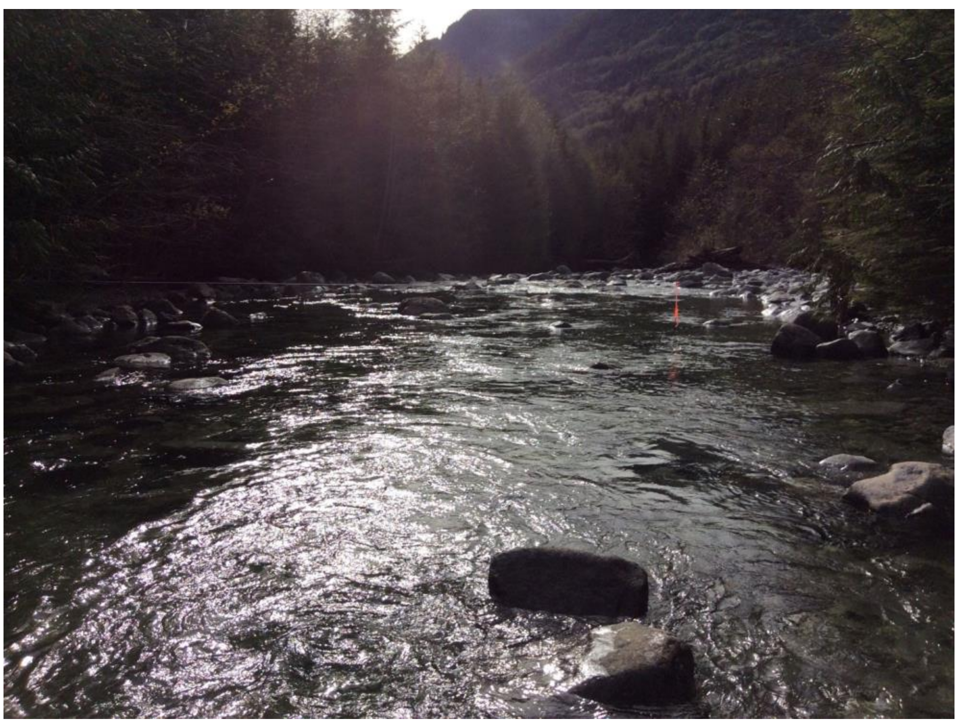

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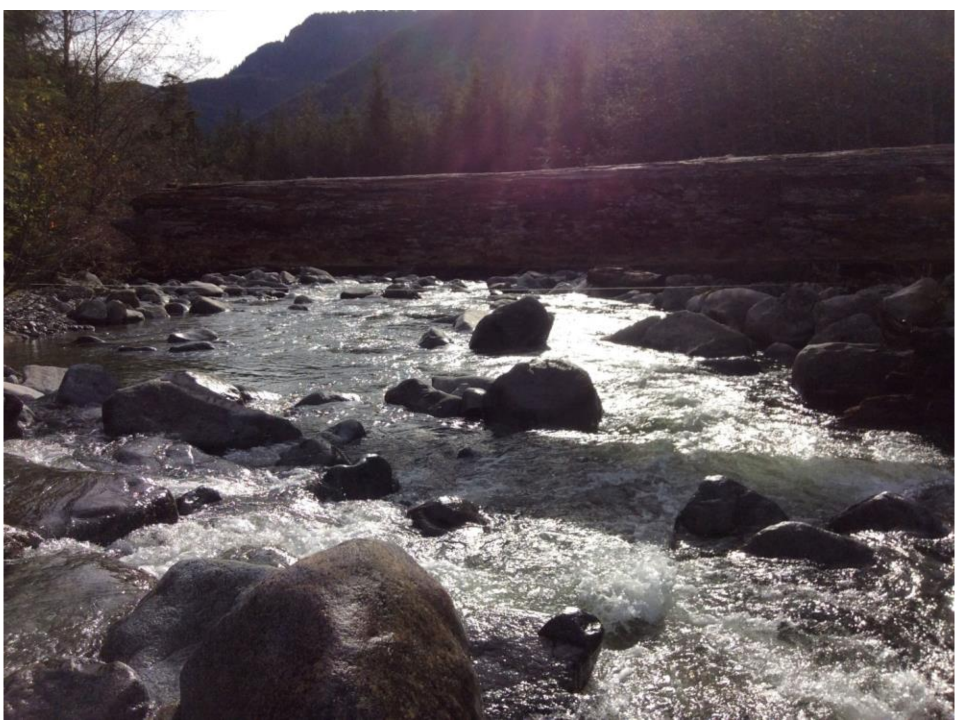

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Figure 20. Looking downstream at CHK-USSN05 on October 15, 2015

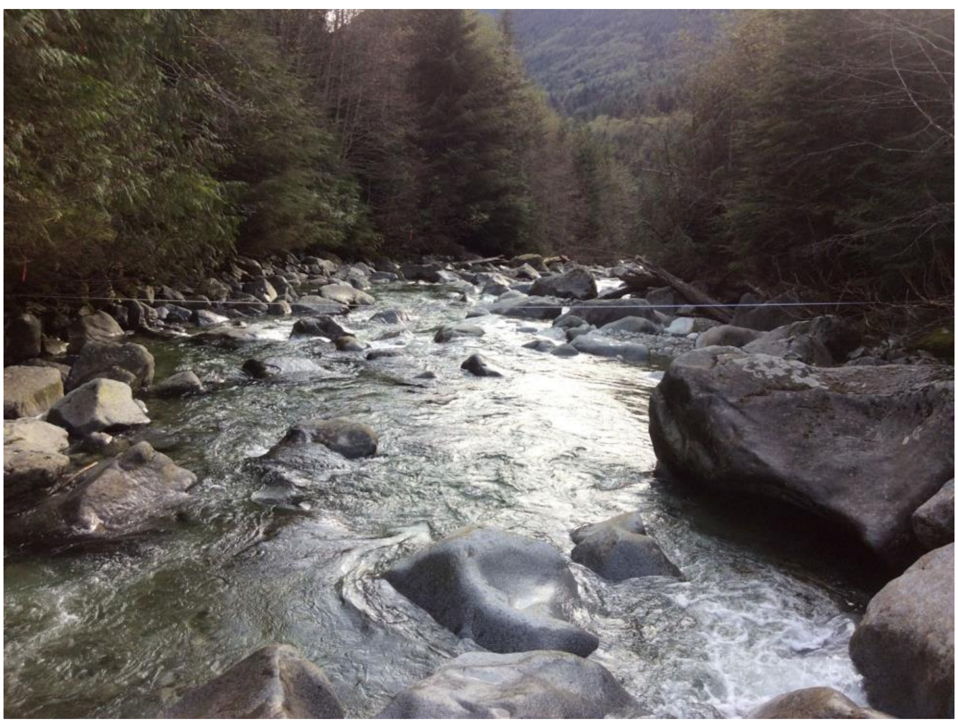

Figure 21. Looking upstream at CHK-USSN06 on October 15, 2015

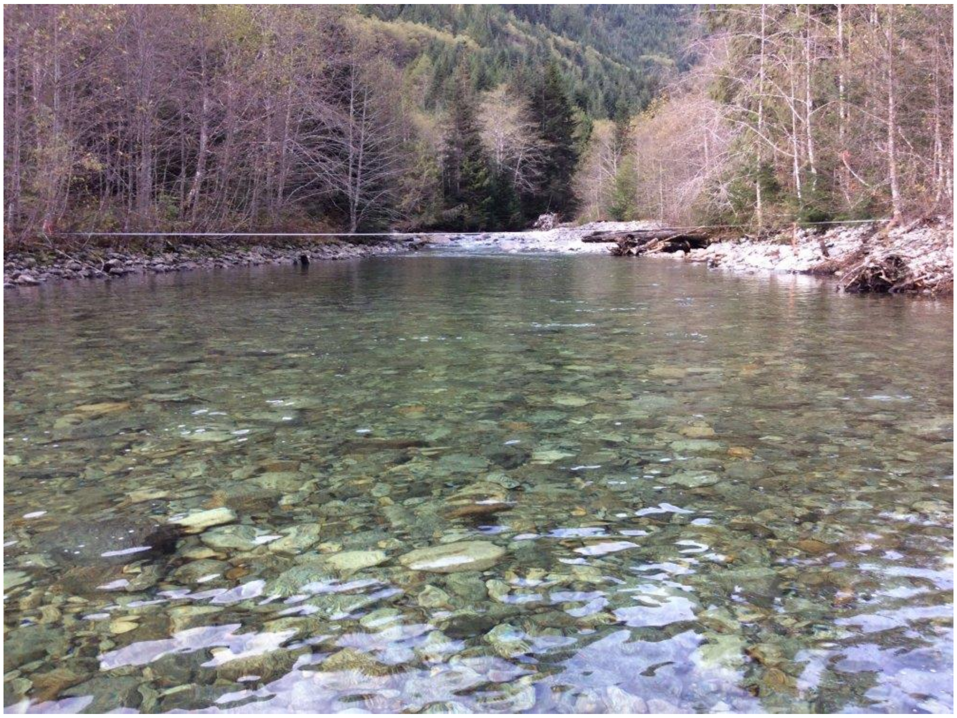

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Figure 32. Looking river left to river right at TZN-SN01 on October 6, 2016

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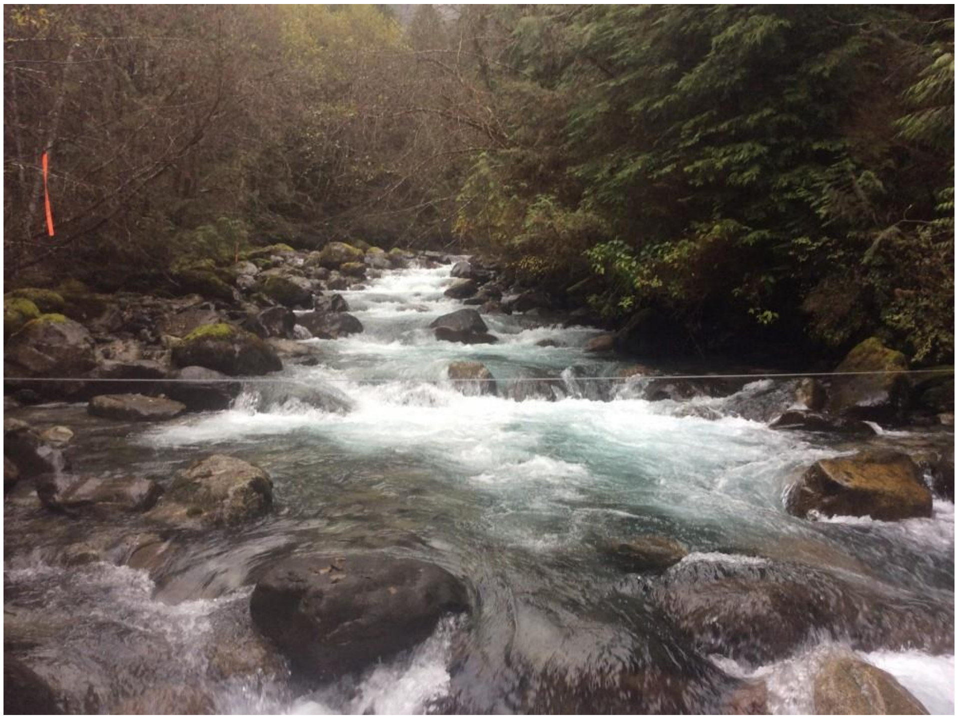


Figure 34. Looking downstream at TZN-SN02 on October 6, 2016

Figure 35. Looking upstream at TZN-SN03 on October 6, 2016

Figure 36. Looking downstream at TZN-SN03 on October 6, 2016

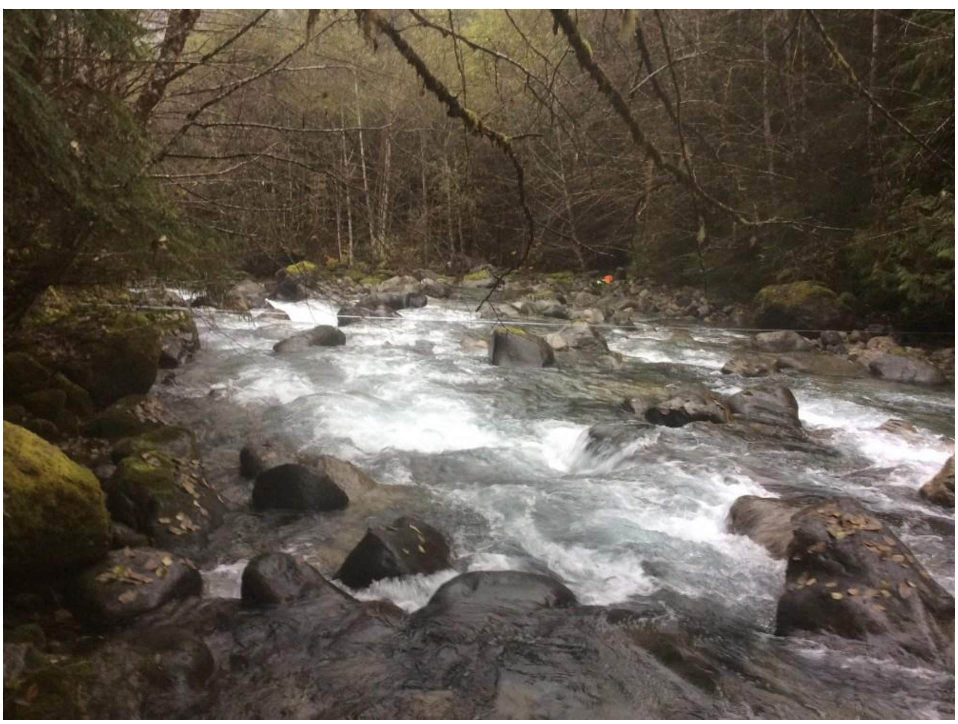


Figure 37. Looking upstream at TZN-SN04 on October 6, 2016

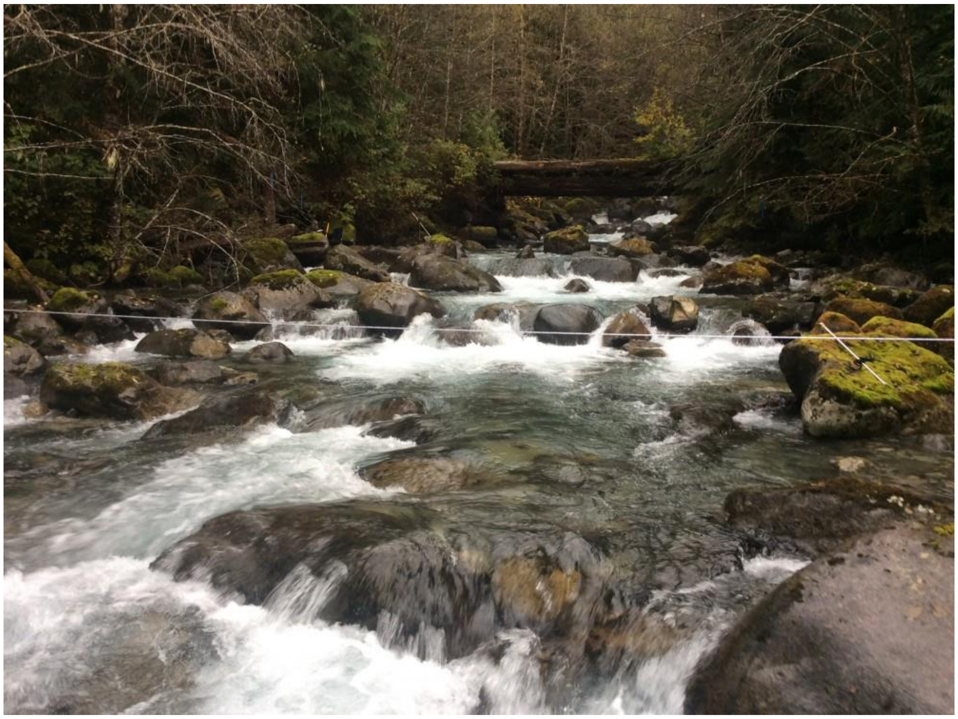
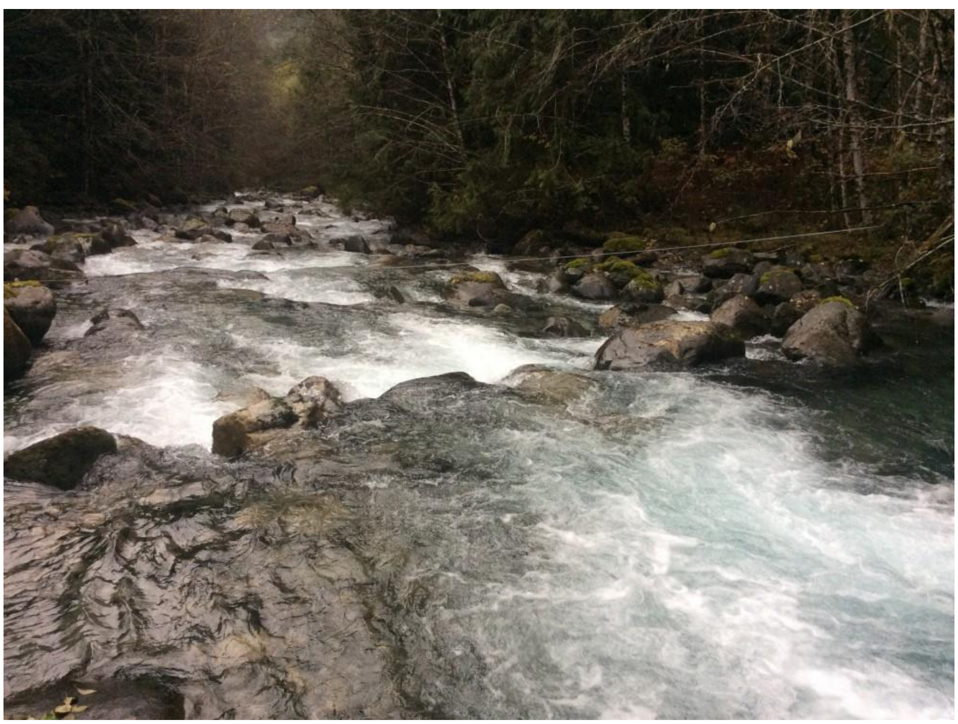


Figure 38. Looking downstream at TZN-SN04 on October 6, 2016



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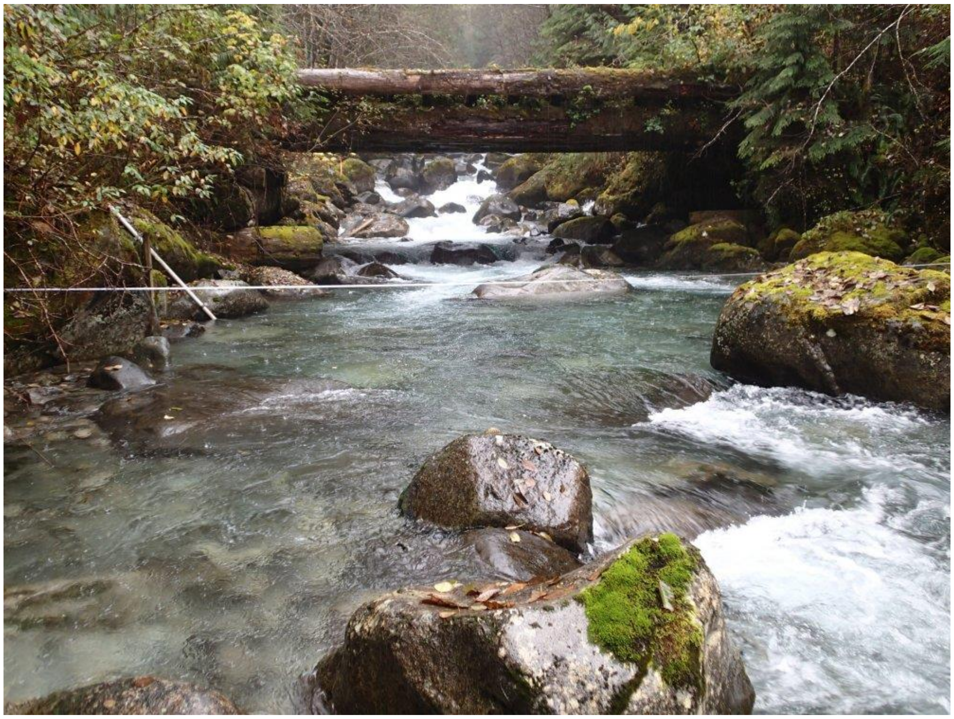
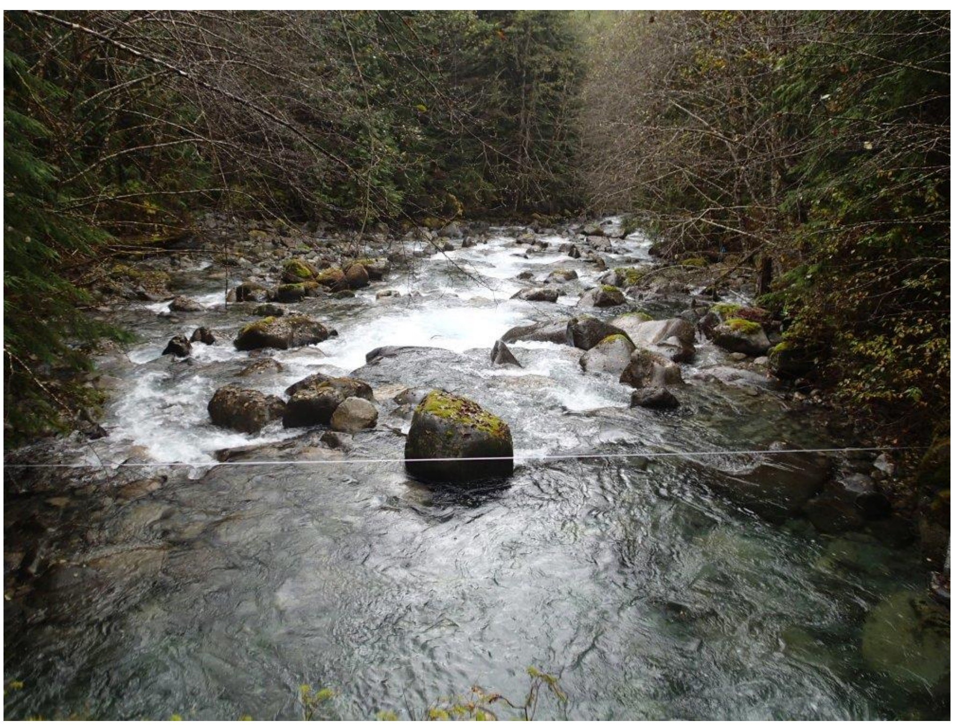


Figure 40. Looking downstream at TZN-SN05 on October 5, 2016



Appendix J. Anadromous Snorkel Survey Fish Sizes 2011 – 2016

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Table 1. Size categories of fish observed during anadromous spawner surveys in Chickwat Creek in 2011.

Year	Season	Date	Reach	Section	Species[1]	Fry (0-80 mm)	Parr (80-150 mm)	Adult			
								151-250 mm	251-350 mm	351-450 mm	450+ mm
2011	Fall	7-Sep-11	Lower Diversion	1	DV	0	9	2	0	0	0
2011	Fall	7-Sep-11	Lower Diversion	1	RB	0	19	10	4	0	0
2011	Fall	7-Sep-11	Downstream	2	CT	0	1	2	0	0	0
2011	Fall	7-Sep-11	Downstream	2	DV	0	1	0	0	0	0
2011	Fall	7-Sep-11	Downstream	2	RB	0	42	36	7	1	0
2011	Fall	7-Sep-11	Downstream	3	CO	0	30	0	0	0	0
2011	Fall	7-Sep-11	Downstream	3	CT	0	0	0	0	2	0
2011	Fall	7-Sep-11	Downstream	3	DV	0	14	4	0	0	0
2011	Fall	7-Sep-11	Downstream	3	RB	0	97	24	20	1	0
2011	Fall	7-Sep-11	Downstream	4	CO	0	107	0	0	0	0
2011	Fall	7-Sep-11	Downstream	4	CT	0	1	2	1	0	0
2011	Fall	7-Sep-11	Downstream	4	DV	0	6	0	0	0	0
2011	Fall	7-Sep-11	Downstream	4	RB	0	10	4	0	0	0
2011	Fall	7-Sep-11	Tzoonie River	5	CT	0	0	0	0	4	3
2011	Fall	13-Sep-11	Lower Diversion	1	DV	0	9	0	0	0	0
2011	Fall	13-Sep-11	Lower Diversion	1	RB	0	67	3	1	0	0
2011	Fall	13-Sep-11	Downstream	2	DV	0	1	0	0	0	0
2011	Fall	13-Sep-11	Downstream	2	RB	0	122	3	0	0	0
2011	Fall	13-Sep-11	Downstream	3	CO	0	137	0	0	0	0
2011	Fall	13-Sep-11	Downstream	3	CT	0	0	0	0	0	2
2011	Fall	13-Sep-11	Downstream	3	DV	0	15	0	0	0	0
2011	Fall	13-Sep-11	Downstream	3	RB	2	298	5	1	0	0
2011	Fall	13-Sep-11	Downstream	4	CO	0	155	0	0	0	0
2011	Fall	13-Sep-11	Downstream	4	CT	0	2	0	0	0	0
2011	Fall	13-Sep-11	Downstream	4	DV	0	11	0	0	0	0
2011	Fall	13-Sep-11	Downstream	4	RB	3	130	0	0	0	0
2011	Fall	19-Sep-11	Lower Diversion	1	DV	0	5	0	0	0	0
2011	Fall	19-Sep-11	Lower Diversion	1	RB	0	0	7	0	0	0
2011	Fall	19-Sep-11	Downstream	2	RB	0	0	6	0	0	0
2011	Fall	19-Sep-11	Downstream	3	CT	0	0	0	0	2	0
2011	Fall	19-Sep-11	Downstream	3	DV	0	7	0	0	0	0
2011	Fall	19-Sep-11	Downstream	3	RB	0	0	0	9	1	0
2011	Fall	19-Sep-11	Downstream	4	DV	0	5	0	0	0	0
2011	Fall	19-Sep-11	Downstream	4	RB	0	0	0	2	0	0
2011	Fall	19-Sep-11	Tzoonie River	5	CO	0	0	0	0	0	2
2011	Fall	19-Sep-11	Tzoonie River	5	CT	0	0	0	0	0	2
2011	Fall	30-Sep-11	Lower Diversion	1	CO	1	0	0	0	0	0
2011	Fall	30-Sep-11	Lower Diversion	1	CT	0	17	10	2	0	0
2011	Fall	30-Sep-11	Lower Diversion	1	DV	0	4	1	0	0	0
2011	Fall	30-Sep-11	Lower Diversion	1	RB	0	66	50	6	0	0
2011	Fall	30-Sep-11	Downstream	2	CO	1	0	0	0	0	0
2011	Fall	30-Sep-11	Downstream	2	CT	0	9	5	0	0	0
2011	Fall	30-Sep-11	Downstream	2	RB	1	82	32	5	0	0
2011	Fall	30-Sep-11	Downstream	3	CO	54	0	0	0	0	0
2011	Fall	30-Sep-11	Downstream	3	CT	0	4	1	0	0	0
2011	Fall	30-Sep-11	Downstream	3	DV	0	1	0	0	0	0
2011	Fall	30-Sep-11	Downstream	3	RB	0	65	65	0	0	0
2011	Fall	30-Sep-11	Downstream	4	CO	69	0	0	0	0	0
2011	Fall	30-Sep-11	Downstream	4	CT	0	4	0	1	1	0
2011	Fall	30-Sep-11	Downstream	4	RB	3	32	31	0	0	0

[1] CO = Coho Salmon, SA = Salmon sp., CT = Cutthroat Trout, DV = Dolly Varden, RB = Rainbow Trout, ST = Steelhead, TR = Trout sp., L = Lamprey sp., UNK = Unknown sp., NFO = no fish observed.

Table 1. (Continued).

Year	Season	Date	Reach	Section	Species[1]	Fry (0-80 mm)	Parr (80-150 mm)	Adult 151-250 mm	Adult 251-350 mm	Adult 351-450 mm	Adult 450+ mm
2011	Fall	30-Sep-11	Tzoonie River	5	CO	0	0	0	0	0	20
2011	Fall	30-Sep-11	Tzoonie River	5	CT	0	0	0	0	0	2
2011	Fall	7-Oct-11	Lower Diversion	1	CO	0	0	0	0	0	1
2011	Fall	7-Oct-11	Lower Diversion	1	CT	0	0	1	0	0	0
2011	Fall	7-Oct-11	Lower Diversion	1	DV	0	2	2	0	0	0
2011	Fall	7-Oct-11	Lower Diversion	1	RB	0	61	33	13	4	0
2011	Fall	7-Oct-11	Downstream	2	RB	0	40	22	3	2	0
2011	Fall	7-Oct-11	Downstream	3	CO	24	0	0	0	0	0
2011	Fall	7-Oct-11	Downstream	3	RB	0	36	77	19	5	0
2011	Fall	7-Oct-11	Downstream	4	CO	1	0	0	0	0	0
2011	Fall	7-Oct-11	Tzoonie River	5	CO	0	0	0	0	0	10
2011	Fall	7-Oct-11	Tzoonie River	5	CT	0	0	0	0	5	0
2011	Fall	17-Oct-11	Lower Diversion	1	CO	0	0	0	0	0	1
2011	Fall	17-Oct-11	Lower Diversion	1	RB	0	127	19	0	1	0
2011	Fall	17-Oct-11	Downstream	2	RB	0	37	4	0	0	0
2011	Fall	17-Oct-11	Downstream	3	CO	31	0	0	0	0	0
2011	Fall	17-Oct-11	Downstream	3	RB	2	76	4	0	0	0
2011	Fall	17-Oct-11	Downstream	4	CO	34	0	0	0	0	0
2011	Fall	17-Oct-11	Downstream	4	CT	0	0	0	1	1	0
2011	Fall	17-Oct-11	Downstream	4	RB	0	10	0	0	0	0
2011	Fall	27-Oct-11	Lower Diversion	1	DV	0	2	0	0	0	0
2011	Fall	27-Oct-11	Lower Diversion	1	RB	0	36	1	18	0	0
2011	Fall	27-Oct-11	Downstream	2	CO	0	0	0	0	0	1
2011	Fall	27-Oct-11	Downstream	2	RB	0	7	0	3	1	0
2011	Fall	27-Oct-11	Downstream	3	CO	18	0	0	0	0	0
2011	Fall	27-Oct-11	Downstream	3	CT	0	0	0	1	0	0
2011	Fall	27-Oct-11	Downstream	3	RB	0	18	3	5	5	0
2011	Fall	27-Oct-11	Downstream	4	CO	33	0	0	0	0	0
2011	Fall	27-Oct-11	Downstream	4	RB	0	7	0	1	0	0
2011	Fall	27-Oct-11	Tzoonie River	5	CO	0	0	0	0	0	12
2011	Fall	27-Oct-11	Tzoonie River	5	CT	0	0	0	0	0	2
2011	Fall	4-Nov-11	Lower Diversion	1	CT	0	1	0	0	0	0
2011	Fall	4-Nov-11	Lower Diversion	1	RB	0	63	5	2	0	0
2011	Fall	4-Nov-11	Downstream	2	RB	0	26	4	1	0	0
2011	Fall	4-Nov-11	Downstream	3	CO	18	0	0	0	0	0
2011	Fall	4-Nov-11	Downstream	3	DV	0	1	0	0	0	0
2011	Fall	4-Nov-11	Downstream	3	RB	3	39	4	2	0	0
2011	Fall	4-Nov-11	Downstream	4	CO	15	0	0	0	0	0
2011	Fall	4-Nov-11	Downstream	4	RB	9	9	1	0	0	0
2011	Fall	4-Nov-11	Tzoonie River	5	CO	43	0	0	0	0	6
2011	Fall	4-Nov-11	Tzoonie River	5	CT	0	0	0	0	0	2
2011	Fall	20-Nov-11	Lower Diversion	1	RB	0	8	3	0	0	0
2011	Fall	20-Nov-11	Downstream	2	NFO	0	0	0	0	0	0
2011	Fall	20-Nov-11	Downstream	3	CO	53	0	0	0	0	0
2011	Fall	20-Nov-11	Downstream	3	RB	0	7	18	5	0	0
2011	Fall	20-Nov-11	Downstream	4	CO	21	0	0	0	0	0
2011	Fall	20-Nov-11	Downstream	4	RB	0	1	5	0	0	0
2011	Fall	20-Nov-11	Tzoonie River	5	CO	21	0	0	0	0	3
2011	Fall	20-Nov-11	Tzoonie River	5	CT	0	0	0	0	0	5
2011	Fall	20-Nov-11	Tzoonie River	5	RB	0	4	3	0	0	0

[1] CO = Coho Salmon, SA = Salmon sp., CT = Cutthroat Trout, DV = Dolly Varden, RB = Rainbow Trout, ST = Steelhead, TR = Trout sp., L = Lamprey sp., UNK = Unknown sp., NFO = no fish observed.

Table 1. (Continued).

Year	Season	Date	Reach	Section	Species[1]	Fry (0-80 mm)	Parr (80-150 mm)	Adult			
								151-250 mm	251-350 mm	351-450 mm	450+ mm
2011	Fall	8-Dec-11	Lower Diversion	1	RB	0	0	2	0	0	0
2011	Fall	8-Dec-11	Downstream	2	NFO	0	0	0	0	0	0
2011	Fall	8-Dec-11	Downstream	3	CO	11	0	0	0	0	0
2011	Fall	8-Dec-11	Downstream	3	RB	0	12	0	0	0	0
2011	Fall	8-Dec-11	Downstream	4	NFO	0	0	0	0	0	0
2011	Fall	8-Dec-11	Tzoonie River	5	CO	0	40	0	0	0	3
2011	Fall	8-Dec-11	Tzoonie River	5	CT	0	0	0	0	5	0

[1] CO = Coho Salmon, SA = Salmon sp., CT = Cutthroat Trout, DV = Dolly Varden, RB = Rainbow Trout, ST = Steelhead, TR = Trout sp., L = Lamprey sp., UNK = Unknown sp., NFO = no fish observed.

Table 2. Size categories of fish observed during anadromous spawner surveys in Chickwat Creek in 2013.

Year	Season	Date	Reach	Section	Species[1]	Fry (0-80 mm)	Parr (80-150 mm)	Adult 151-250 mm	Adult 251-350 mm	Adult 351-450 mm	Adult 450+ mm
2013	Spring	25-Mar-13	Lower Diversion	1	RB	0	2	16	0	0	0
2013	Spring	25-Mar-13	Downstream	2	RB	0	0	4	0	0	0
2013	Spring	25-Mar-13	Downstream	3	RB	0	0	1	0	0	0
2013	Spring	25-Mar-13	Downstream	4	RB	0	0	1	0	0	0
2013	Spring	25-Mar-13	Tzoonie River	5	NFO	0	0	0	0	0	0
2013	Spring	11-Apr-13	Lower Diversion	1	RB	0	0	3	1	0	0
2013	Spring	11-Apr-13	Downstream	2	RB	0	0	2	0	0	0
2013	Spring	11-Apr-13	Downstream	3	NFO	0	0	0	0	0	0
2013	Spring	11-Apr-13	Downstream	4	NFO	0	0	0	0	0	0
2013	Spring	11-Apr-13	Tzoonie River	5	NFO	0	0	0	0	0	0
2013	Spring	18-Apr-13	Lower Diversion	1	RB	0	5	25	2	0	0
2013	Spring	18-Apr-13	Downstream	2	NFO	0	0	0	0	0	0
2013	Spring	18-Apr-13	Downstream	3	RB	0	1	0	0	0	0
2013	Spring	18-Apr-13	Downstream	4	NFO	0	0	0	0	0	0
2013	Spring	18-Apr-13	Tzoonie River	5	CO	0	1	0	0	0	0
2013	Spring	24-Apr-13	Lower Diversion	1	RB	0	4	10	2	0	0
2013	Spring	24-Apr-13	Downstream	2	NFO	0	0	0	0	0	0
2013	Spring	24-Apr-13	Downstream	3	NFO	0	0	0	0	0	0
2013	Spring	24-Apr-13	Downstream	4	NFO	0	0	0	0	0	0
2013	Spring	24-Apr-13	Tzoonie River	5	CO	2	0	0	0	0	0
2013	Spring	3-May-13	Lower Diversion	1	RB	0	1	1	1	0	0
2013	Spring	3-May-13	Downstream	2	NFO	0	0	0	0	0	0
2013	Spring	3-May-13	Downstream	3	NFO	0	0	0	0	0	0
2013	Spring	3-May-13	Downstream	4	NFO	0	0	0	0	0	0
2013	Spring	3-May-13	Tzoonie River	5	NFO	0	0	0	0	0	0
2013	Spring	10-May-13	Lower Diversion	1	RB	0	2	1	1	0	0
2013	Spring	10-May-13	Downstream	2	NFO	0	0	0	0	0	0
2013	Spring	10-May-13	Downstream	3	NFO	0	0	0	0	0	0
2013	Spring	10-May-13	Downstream	4	NFO	0	0	0	0	0	0
2013	Spring	10-May-13	Tzoonie River	5	NFO	0	0	0	0	0	0
2013	Spring	17-May-13	Lower Diversion	1	RB	0	2	8	0	0	0
2013	Spring	17-May-13	Downstream	2	RB	0	1	2	1	0	0
2013	Spring	17-May-13	Downstream	3	RB	0	0	0	2	0	0
2013	Spring	17-May-13	Downstream	4	NFO	0	0	0	0	0	0
2013	Spring	17-May-13	Tzoonie River	5	NFO	0	0	0	0	0	0
2013	Spring	28-May-13	Lower Diversion	1	RB	0	1	5	0	0	0
2013	Spring	28-May-13	Downstream	2	RB	0	4	3	0	0	0
2013	Spring	28-May-13	Downstream	3	CT	0	0	1	1	0	0
2013	Spring	28-May-13	Downstream	3	RB	0	8	4	0	0	0
2013	Spring	28-May-13	Downstream	4	NFO	0	0	0	0	0	0
2013	Spring	28-May-13	Tzoonie River	5	CO	1	0	0	0	0	0
2013	Spring	3-Jun-13	Lower Diversion	1	RB	0	1	7	4	0	0
2013	Spring	3-Jun-13	Downstream	2	RB	0	9	3	0	0	0
2013	Spring	3-Jun-13	Downstream	3	CT	0	0	0	0	1	0
2013	Spring	3-Jun-13	Downstream	3	DV	0	0	1	0	0	0
2013	Spring	3-Jun-13	Downstream	3	RB	0	10	11	2	0	0

[1] CO = Coho Salmon, SA = Salmon sp., CT = Cutthroat Trout, DV = Dolly Varden, RB = Rainbow Trout, ST = Steelhead, TR = Trout sp., L = Lamprey sp., UNK = Unknown sp., NFO = no fish observed.

Table 2. (Continued).

Year	Season	Date	Reach	Section	Species[1]	Fry (0-80 mm)	Parr (80-150 mm)	Adult 151-250 mm	Adult 251-350 mm	Adult 351-450 mm	Adult 450+ mm
2013	Spring	3-Jun-13	Downstream	3	ST	0	0	0	0	0	1
2013	Spring	3-Jun-13	Downstream	4	NFO	0	0	0	0	0	0
2013	Spring	3-Jun-13	Tzoonie River	5	CT	0	0	0	1	0	0
2013	Spring	3-Jun-13	Tzoonie River	5	ST	0	0	0	0	0	1
2013	Spring	12-Jun-13	Lower Diversion	1	DV	0	0	1	0	0	0
2013	Spring	12-Jun-13	Lower Diversion	1	RB	0	24	21	4	0	0
2013	Spring	12-Jun-13	Lower Diversion	1	UNK	0	0	0	0	1	0
2013	Spring	12-Jun-13	Downstream	2	DV	0	1	2	0	0	0
2013	Spring	12-Jun-13	Downstream	2	RB	0	0	36	6	0	0
2013	Spring	12-Jun-13	Downstream	3	DV	0	1	0	0	0	0
2013	Spring	12-Jun-13	Downstream	3	RB	0	32	15	1	1	0
2013	Spring	12-Jun-13	Downstream	4	CO	0	1	0	0	0	0
2013	Spring	12-Jun-13	Downstream	4	CT	0	0	0	1	1	0
2013	Spring	12-Jun-13	Downstream	4	RB	0	6	9	3	0	0
2013	Spring	12-Jun-13	Tzoonie River	5	NFO	0	0	0	0	0	0
2013	Fall	27-Sep-13	Downstream	2	NFO	0	0	0	0	0	0
2013	Fall	27-Sep-13	Downstream	3	CO	0	0	0	0	0	3
2013	Fall	27-Sep-13	Downstream	3	SA	0	0	0	0	0	1
2013	Fall	27-Sep-13	Downstream	4	CO	0	0	0	0	0	1
2013	Fall	27-Sep-13	Tzoonie River	5	CO	0	0	0	0	0	5
2013	Fall	27-Sep-13	Tzoonie River	5	CT	0	0	1	0	0	0
2013	Fall	27-Sep-13	Tzoonie River	5	RB	0	0	2	0	0	0

[1] CO = Coho Salmon, SA = Salmon sp., CT = Cutthroat Trout, DV = Dolly Varden, RB = Rainbow Trout, ST = Steelhead, TR = Trout sp., L = Lamprey sp., UNK = Unknown sp., NFO = no fish observed.

Table 3. Size categories of fish observed during anadromous spawner surveys in Chickwat Creek in 2014.

Year	Season	Date	Reach	Section	Species[1]	Fry (0-80 mm)	Parr (80-150 mm)	Adult 151-250 mm	Adult 251-350 mm	Adult 351-450 mm	Adult 450+ mm
2014	Fall	15-Sep-14	Lower Diversion	1	CO	0	22	0	0	0	0
2014	Fall	15-Sep-14	Lower Diversion	1	DV	0	0	0	0	0	0
2014	Fall	15-Sep-14	Lower Diversion	1	RB	0	105	37	21	0	0
2014	Fall	15-Sep-14	Downstream	2	CO	0	40	0	0	0	0
2014	Fall	15-Sep-14	Downstream	2	DV	0	1	0	0	0	0
2014	Fall	15-Sep-14	Downstream	2	RB	0	74	4	0	0	0
2014	Fall	15-Sep-14	Downstream	3	DV	0	9	0	0	0	0
2014	Fall	15-Sep-14	Downstream	3	RB	0	82	4	1	1	0
2014	Fall	15-Sep-14	Downstream	4	NFO	0	0	0	0	0	0
2014	Fall	15-Sep-14	Tzoonie River	5	CO	0	65	0	0	0	0
2014	Fall	15-Sep-14	Tzoonie River	5	CT	0	0	0	2	0	0
2014	Fall	15-Sep-14	Tzoonie River	5	DV	0	11	0	0	0	0
2014	Fall	15-Sep-14	Tzoonie River	5	RB	0	29	6	0	0	0
2014	Fall	30-Sep-14	Lower Diversion	1	CO	14	0	0	0	0	0
2014	Fall	30-Sep-14	Lower Diversion	1	RB	4	103	60	10	0	0
2014	Fall	30-Sep-14	Downstream	2	CO	25	0	0	0	0	0
2014	Fall	30-Sep-14	Downstream	2	RB	22	68	29	1	0	0
2014	Fall	30-Sep-14	Downstream	3	CO	72	0	0	0	0	1
2014	Fall	30-Sep-14	Downstream	3	RB	36	50	36	5	0	0
2014	Fall	30-Sep-14	Downstream	4	CO	146	0	0	0	0	0
2014	Fall	30-Sep-14	Downstream	4	CT	0	0	0	0	3	0
2014	Fall	30-Sep-14	Downstream	4	RB	3	15	11	4	0	0
2014	Fall	30-Sep-14	Tzoonie River	5	CO	0	0	0	0	0	3
2014	Fall	30-Sep-14	Tzoonie River	5	RB	0	0	0	1	0	0
2014	Fall	6-Oct-14	Lower Diversion	1	CO	15	0	0	0	0	0
2014	Fall	6-Oct-14	Lower Diversion	1	DV	0	1	0	0	0	0
2014	Fall	6-Oct-14	Lower Diversion	1	RB	16	129	52	11	0	0
2014	Fall	6-Oct-14	Downstream	2	CO	33	0	0	0	0	0
2014	Fall	6-Oct-14	Downstream	2	RB	43	84	30	5	0	0
2014	Fall	6-Oct-14	Downstream	3	CO	102	0	0	0	0	0
2014	Fall	6-Oct-14	Downstream	3	RB	39	109	30	6	0	0
2014	Fall	6-Oct-14	Downstream	4	CO	285	0	0	0	0	0
2014	Fall	6-Oct-14	Downstream	4	CT	0	0	1	0	2	0
2014	Fall	6-Oct-14	Downstream	4	L	0	0	0	0	0	1
2014	Fall	6-Oct-14	Downstream	4	RB	16	74	27	3	0	0
2014	Fall	6-Oct-14	Tzoonie River	5	CO	10	0	0	0	0	1
2014	Fall	6-Oct-14	Tzoonie River	5	RB	0	0	1	0	0	0
2014	Fall	16-Oct-14	Lower Diversion	1	CO	5	0	0	0	0	0
2014	Fall	16-Oct-14	Lower Diversion	1	RB	14	98	36	11	1	0
2014	Fall	16-Oct-14	Downstream	2	CO	9	0	0	0	0	0
2014	Fall	16-Oct-14	Downstream	2	DV	0	0	2	0	0	0
2014	Fall	16-Oct-14	Downstream	2	RB	14	66	16	3	0	0
2014	Fall	16-Oct-14	Downstream	3	CO	66	0	0	0	0	0
2014	Fall	16-Oct-14	Downstream	3	DV	0	1	0	0	0	0
2014	Fall	16-Oct-14	Downstream	3	RB	7	25	17	0	0	0

[1] CO = Coho Salmon, SA = Salmon sp., CT = Cutthroat Trout, DV = Dolly Varden, RB = Rainbow Trout, ST = Steelhead, TR = Trout sp., L = Lamprey sp., UNK = Unknown sp., NFO = no fish observed.

Table 3. (Continued).

Year	Season	Date	Reach	Section	Species[1]	Fry (0-80 mm)	Parr (80-150 mm)	Adult			
								151-250 mm	251-350 mm	351-450 mm	450+ mm
2014	Fall	16-Oct-14	Downstream	4	CO	16	0	0	0	0	0
2014	Fall	16-Oct-14	Downstream	4	CT	0	0	1	2	6	0
2014	Fall	16-Oct-14	Downstream	4	DV	0	0	0	0	0	0
2014	Fall	16-Oct-14	Downstream	4	RB	3	11	5	2	0	0
2014	Fall	16-Oct-14	Tzoonie River	5	SA	0	0	0	0	9	0
2014	Fall	8-Nov-14	Lower Diversion	1	CT	0	1	4	0	0	0
2014	Fall	8-Nov-14	Lower Diversion	1	DV	0	0	1	0	0	0
2014	Fall	8-Nov-14	Lower Diversion	1	RB	3	27	25	16	0	0
2014	Fall	8-Nov-14	Downstream	2	RB	7	25	16	8	0	0
2014	Fall	8-Nov-14	Downstream	3	CO	10	0	0	0	0	0
2014	Fall	8-Nov-14	Downstream	3	RB	11	32	12	6	0	0
2014	Fall	8-Nov-14	Downstream	4	CO	7	0	0	0	0	11
2014	Fall	8-Nov-14	Downstream	4	CT	0	0	0	11	7	0
2014	Fall	8-Nov-14	Downstream	4	RB	4	15	17	9	0	0
2014	Fall	8-Nov-14	Tzoonie River	5	CO	0	0	0	0	0	21
2014	Fall	8-Nov-14	Tzoonie River	5	CT	0	0	0	1	0	0
2014	Fall	8-Nov-14	Tzoonie River	5	RB	0	2	1	2	0	0
2014	Fall	25-Nov-14	Lower Diversion	1	CT	0	0	2	1	0	0
2014	Fall	25-Nov-14	Lower Diversion	1	RB	2	21	14	2	0	0
2014	Fall	25-Nov-14	Downstream	2	RB	1	8	4	1	0	0
2014	Fall	25-Nov-14	Downstream	3	CO	9	0	0	0	0	0
2014	Fall	25-Nov-14	Downstream	3	DV	0	0	1	0	0	0
2014	Fall	25-Nov-14	Downstream	3	RB	5	17	16	5	0	0
2014	Fall	25-Nov-14	Downstream	4	CO	33	0	0	0	0	8
2014	Fall	25-Nov-14	Downstream	4	CT	0	0	0	5	2	0
2014	Fall	25-Nov-14	Downstream	4	RB	5	9	11	2	0	0
2014	Fall	25-Nov-14	Tzoonie River	5	NFO	0	0	0	0	0	0
2014	Fall	3-Dec-14	Lower Diversion	1	CT	0	0	1	0	0	0
2014	Fall	3-Dec-14	Lower Diversion	1	DV	0	0	1	0	0	0
2014	Fall	3-Dec-14	Lower Diversion	1	RB	0	2	4	2	0	0
2014	Fall	3-Dec-14	Downstream	2	NFO	0	0	0	0	0	0
2014	Fall	3-Dec-14	Downstream	3	CO	1	0	0	0	0	0
2014	Fall	3-Dec-14	Downstream	3	CT	0	0	1	0	0	0
2014	Fall	3-Dec-14	Downstream	3	RB	0	8	1	0	0	0
2014	Fall	3-Dec-14	Downstream	4	CO	0	0	0	0	0	2
2014	Fall	3-Dec-14	Downstream	4	CT	0	0	1	6	0	0
2014	Fall	3-Dec-14	Downstream	4	RB	0	3	1	0	0	0
2014	Fall	3-Dec-14	Tzoonie River	5	CO	0	0	0	0	0	1
2014	Fall	3-Dec-14	Tzoonie River	5	CT	0	0	0	0	2	0
2014	Fall	17-Dec-14	Lower Diversion	1	NFO	0	0	0	0	0	0
2014	Fall	17-Dec-14	Downstream	2	NFO	0	0	0	0	0	0
2014	Fall	17-Dec-14	Downstream	3	NFO	0	0	0	0	0	0
2014	Fall	17-Dec-14	Downstream	4	CO	0	0	0	0	0	2
2014	Fall	17-Dec-14	Downstream	4	CT	0	0	2	0	0	0
2014	Fall	17-Dec-14	Tzoonie River	5	CT	0	0	0	0	1	1
2014	Fall	17-Dec-14	Tzoonie River	5	RB	0	0	1	1	0	0

[1] CO = Coho Salmon, SA = Salmon sp., CT = Cutthroat Trout, DV = Dolly Varden, RB = Rainbow Trout, ST = Steelhead, TR = Trout sp., L = Lamprey sp., UNK = Unknown sp., NFO = no fish observed.

Table 4. Size categories of fish observed during anadromous spawner surveys in Chickwat Creek in 2015.

Year	Season	Date	Reach	Section	Species[1]	Fry (0-80 mm)	Parr (80-150 mm)	Adult 151-250 mm	Adult 251-350 mm	Adult 351-450 mm	Adult 450+ mm
2015	Spring	2-Apr-15	Lower Diversion	1	NFO	0	0	0	0	0	0
2015	Spring	2-Apr-15	Downstream	2	RB	0	1	0	0	0	0
2015	Spring	2-Apr-15	Downstream	3	RB	0	0	0	0	1	0
2015	Spring	2-Apr-15	Downstream	4	NFO	0	0	0	0	0	0
2015	Spring	2-Apr-15	Tzoonie River	5	NFO	0	0	0	0	0	0
2015	Spring	2-May-15	Lower Diversion	1	CT	0	0	3	1	0	0
2015	Spring	2-May-15	Lower Diversion	1	DV	0	1	0	0	0	0
2015	Spring	2-May-15	Lower Diversion	1	RB	0	11	10	1	0	0
2015	Spring	2-May-15	Downstream	2	RB	1	10	9	4	0	0
2015	Spring	2-May-15	Downstream	3	DV	0	1	0	0	0	0
2015	Spring	2-May-15	Downstream	3	RB	0	4	5	2	0	0
2015	Spring	2-May-15	Downstream	4	CO	17	0	0	0	0	0
2015	Spring	2-May-15	Downstream	4	RB	0	2	4	2	0	0
2015	Spring	2-May-15	Tzoonie River	5	CO	11	0	0	0	0	0
2015	Spring	22-May-15	Lower Diversion	1	RB	0	6	10	6	0	0
2015	Spring	22-May-15	Downstream	2	CT	0	0	1	0	0	0
2015	Spring	22-May-15	Downstream	2	RB	1	11	10	0	0	0
2015	Spring	22-May-15	Downstream	3	CT	0	0	0	1	0	0
2015	Spring	22-May-15	Downstream	3	RB	0	9	4	0	0	0
2015	Spring	22-May-15	Downstream	4	CO	105	0	0	0	0	0
2015	Spring	22-May-15	Downstream	4	RB	0	1	0	0	0	0
2015	Spring	22-May-15	Tzoonie River	5	CO	130	0	0	0	0	0
2015	Spring	22-May-15	Tzoonie River	5	RB	0	1	0	0	0	0
2015	Spring	22-May-15	Tzoonie River	5	ST	0	0	0	0	0	1
2015	Spring	29-May-15	Lower Diversion	1	CT	0	0	3	3	0	0
2015	Spring	29-May-15	Lower Diversion	1	RB	1	8	13	6	0	0
2015	Spring	29-May-15	Downstream	2	RB	4	5	6	1	0	0
2015	Spring	29-May-15	Downstream	3	CT	0	0	0	1	0	0
2015	Spring	29-May-15	Downstream	3	RB	0	7	8	3	0	0
2015	Spring	29-May-15	Downstream	4	CO	163	0	0	0	0	0
2015	Spring	29-May-15	Downstream	4	RB	0	1	2	0	0	0
2015	Spring	29-May-15	Tzoonie River	5	CO	14	0	0	0	0	0
2015	Spring	4-Jun-15	Lower Diversion	1	CT	0	0	1	1	0	0
2015	Spring	4-Jun-15	Lower Diversion	1	RB	0	24	13	4	0	0
2015	Spring	4-Jun-15	Downstream	2	CT	0	0	0	1	0	0
2015	Spring	4-Jun-15	Downstream	2	RB	0	39	8	0	0	0
2015	Spring	4-Jun-15	Downstream	3	RB	5	9	8	5	0	0
2015	Spring	4-Jun-15	Downstream	4	CO	5	0	0	0	0	0
2015	Spring	4-Jun-15	Downstream	4	RB	0	3	2	0	0	0
2015	Spring	4-Jun-15	Tzoonie River	5	RB	0	1	0	0	0	0
2015	Spring	12-Jun-15	Lower Diversion	1	CT	0	0	0	3	0	0
2015	Spring	12-Jun-15	Lower Diversion	1	DV	0	2	0	0	0	0
2015	Spring	12-Jun-15	Lower Diversion	1	RB	1	34	22	5	0	0
2015	Spring	12-Jun-15	Downstream	2	CT	0	0	1	0	0	0
2015	Spring	12-Jun-15	Downstream	2	RB	2	39	6	1	0	0
2015	Spring	12-Jun-15	Downstream	3	CT	0	0	1	0	0	0
2015	Spring	12-Jun-15	Downstream	3	RB	2	26	8	0	0	0

[1] CO = Coho Salmon, SA = Salmon sp., CT = Cutthroat Trout, DV = Dolly Varden, RB = Rainbow Trout, ST = Steelhead, TR = Trout sp., L = Lamprey sp., UNK = Unknown sp., NFO = no fish observed.

Table 4. (Continued).

Year	Season	Date	Reach	Section	Species[1]	Fry (0-80 mm)	Parr (80-150 mm)	Adult			
								151-250 mm	251-350 mm	351-450 mm	450+ mm
2015	Spring	12-Jun-15	Downstream	3	ST	0	0	0	0	0	1
2015	Spring	12-Jun-15	Downstream	4	CO	85	0	0	0	0	0
2015	Spring	12-Jun-15	Tzoonie River	5	NFO	0	0	0	0	0	0
2015	Spring	18-Jun-15	Lower Diversion	1	DV	0	1	0	0	0	0
2015	Spring	18-Jun-15	Lower Diversion	1	RB	0	32	75	11	0	0
2015	Spring	18-Jun-15	Downstream	2	CT	0	0	1	0	0	0
2015	Spring	18-Jun-15	Downstream	2	RB	0	40	7	1	0	0
2015	Spring	18-Jun-15	Downstream	3	RB	0	17	8	3	1	0
2015	Spring	18-Jun-15	Downstream	4	CO	4	0	0	0	0	0
2015	Spring	25-Jun-15	Lower Diversion	1	CT	0	1	4	3	0	0
2015	Spring	25-Jun-15	Lower Diversion	1	DV	2	1	0	0	0	0
2015	Spring	25-Jun-15	Lower Diversion	1	RB	0	43	33	5	0	0
2015	Spring	25-Jun-15	Downstream	2	CT	0	0	0	1	0	0
2015	Spring	25-Jun-15	Downstream	2	DV	0	3	0	0	0	0
2015	Spring	25-Jun-15	Downstream	2	RB	0	31	25	3	1	0
2015	Spring	25-Jun-15	Downstream	3	CO	3	0	0	0	0	0
2015	Spring	25-Jun-15	Downstream	3	RB	0	37	16	3	1	0
2015	Spring	25-Jun-15	Downstream	4	CO	106	0	0	0	0	0
2015	Spring	25-Jun-15	Downstream	4	RB	0	3	0	0	0	0
2015	Spring	25-Jun-15	Downstream	4	TR	4	0	0	0	0	0
2015	Spring	25-Jun-15	Tzoonie River	5	NFO	0	0	0	0	0	0
2015	Fall	28-Aug-15	Lower Diversion	1	CO	0	0	0	0	0	2
2015	Fall	28-Aug-15	Lower Diversion	1	CT/RB	0	0	1	1	1	0

[1] CO = Coho Salmon, SA = Salmon sp., CT = Cutthroat Trout, DV = Dolly Varden, RB = Rainbow Trout, ST = Steelhead, TR = Trout sp., L = Lamprey sp., UNK = Unknown sp., NFO = no fish observed.

Table 5. Size categories of fish observed during anadromous spawner surveys in Chickwat Creek in 2016.

Year	Season	Date	Reach	Section	Species[1]	Fry (0-80 mm)	Parr (80-150 mm)	Adult 151-250 mm	Adult 251-350 mm	Adult 351-450 mm	Adult 450+ mm
2016	Spring	22-Mar-16	Lower Diversion	1	CT	0	0	0	0	1	0
2016	Spring	22-Mar-16	Lower Diversion	1	RB	3	1	0	0	0	0
2016	Spring	22-Mar-16	Downstream	2	CT	0	0	0	0	7	1
2016	Spring	22-Mar-16	Downstream	2	RB	0	0	1	0	0	0
2016	Spring	22-Mar-16	Downstream	3	NFO	0	0	0	0	0	0
2016	Spring	22-Mar-16	Downstream	4	NFO	0	0	0	0	0	0
2016	Spring	22-Mar-16	Tzoonie River	5	NFO	0	0	0	0	0	0
2016	Spring	6-Apr-16	Lower Diversion	1	CO	22	4	0	0	0	0
2016	Spring	6-Apr-16	Lower Diversion	1	CT	0	0	1	0	0	0
2016	Spring	6-Apr-16	Lower Diversion	1	RB	0	8	4	0	0	0
2016	Spring	6-Apr-16	Downstream	2	CT	0	0	0	0	1	0
2016	Spring	6-Apr-16	Downstream	2	RB	0	1	1	0	0	0
2016	Spring	6-Apr-16	Downstream	3	CT	0	0	0	0	1	0
2016	Spring	6-Apr-16	Downstream	3	RB	0	0	1	0	0	0
2016	Spring	6-Apr-16	Downstream	4	NFO	0	0	0	0	0	0
2016	Spring	6-Apr-16	Tzoonie River	5	NFO	0	0	0	0	0	0
2016	Spring	20-Apr-16	Lower Diversion	1	CO	23	0	0	0	0	0
2016	Spring	20-Apr-16	Lower Diversion	1	CT	0	0	2	2	1	0
2016	Spring	20-Apr-16	Lower Diversion	1	RB	0	10	1	0	0	0
2016	Spring	20-Apr-16	Downstream	2	CT	0	0	0	1	0	0
2016	Spring	20-Apr-16	Downstream	2	DV	0	0	0	1	0	0
2016	Spring	20-Apr-16	Downstream	2	RB	0	2	2	0	0	0
2016	Spring	20-Apr-16	Downstream	3	NFO	0	0	0	0	0	0
2016	Spring	20-Apr-16	Downstream	4	NFO	0	0	0	0	0	0
2016	Spring	20-Apr-16	Tzoonie River	5	CT	0	0	0	1	0	0
2016	Spring	20-Apr-16	Tzoonie River	5	ST	0	0	0	0	0	1
2016	Spring	5-May-16	Lower Diversion	1	CT	0	0	0	1	0	0
2016	Spring	5-May-16	Lower Diversion	1	DV	0	1	2	0	0	0
2016	Spring	5-May-16	Lower Diversion	1	RB	0	9	7	2	0	0
2016	Spring	5-May-16	Downstream	2	RB	0	0	3	2	0	0
2016	Spring	5-May-16	Downstream	3	CO	0	1	0	0	0	0
2016	Spring	5-May-16	Downstream	3	RB	0	5	2	1	0	0
2016	Spring	5-May-16	Downstream	4	NFO	0	0	0	0	0	0
2016	Spring	5-May-16	Tzoonie River	5	NFO	0	0	0	0	0	0
2016	Spring	6-May-16	Lower Diversion	1	CO	92	5	0	0	0	0
2016	Spring	6-May-16	Lower Diversion	1	CT	0	4	4	2	0	0
2016	Spring	6-May-16	Lower Diversion	1	RB	0	15	4	0	0	0
2016	Spring	6-May-16	Downstream	2	CT	0	3	0	0	0	0
2016	Spring	6-May-16	Downstream	2	RB	0	1	1	0	0	0
2016	Spring	18-May-16	Lower Diversion	1	CO	129	0	0	0	0	0
2016	Spring	18-May-16	Lower Diversion	1	CT	0	13	2	1	1	0
2016	Spring	18-May-16	Lower Diversion	1	DV	0	1	3	0	0	0
2016	Spring	18-May-16	Lower Diversion	1	RB	1	45	10	1	0	0
2016	Spring	18-May-16	Downstream	2	CT	0	3	4	2	0	0

[1] CO = Coho Salmon, SA = Salmon sp., CT = Cutthroat Trout, DV = Dolly Varden, RB = Rainbow Trout, ST = Steelhead, TR = Trout sp., L = Lamprey sp., UNK = Unknown sp., NFO = no fish observed.

Table 5. (Continued).

Year	Season	Date	Reach	Section	Species[1]	Fry (0-80 mm)	Parr (80-150 mm)	Adult 151-250 mm	Adult 251-350 mm	Adult 351-450 mm	Adult 450+ mm
2016	Spring	18-May-16	Downstream	2	RB	0	37	10	1	0	0
2016	Spring	18-May-16	Downstream	3	CT	0	4	1	0	0	0
2016	Spring	18-May-16	Downstream	3	RB	2	32	10	0	0	0
2016	Spring	18-May-16	Downstream	4	CT	0	0	0	1	0	0
2016	Spring	18-May-16	Downstream	4	RB	0	3	1	0	0	0
2016	Spring	18-May-16	Downstream	4	ST	0	0	0	0	1	0
2016	Spring	18-May-16	Tzoonie River	5	ST	0	0	0	0	0	1
2016	Spring	1-Jun-16	Lower Diversion	1	CO	95	0	0	0	0	0
2016	Spring	1-Jun-16	Lower Diversion	1	CT	0	1	4	1	0	0
2016	Spring	1-Jun-16	Lower Diversion	1	DV	0	0	4	0	0	0
2016	Spring	1-Jun-16	Lower Diversion	1	RB	1	32	31	5	0	0
2016	Spring	1-Jun-16	Downstream	2	CT	2	2	3	3	0	0
2016	Spring	1-Jun-16	Downstream	2	RB	19	46	19	1	1	0
2016	Spring	1-Jun-16	Downstream	3	CT	0	2	1	0	0	0
2016	Spring	1-Jun-16	Downstream	3	RB	32	28	9	2	0	0
2016	Spring	1-Jun-16	Downstream	4	CT	0	0	1	0	0	0
2016	Spring	1-Jun-16	Downstream	4	RB	5	5	4	0	0	0
2016	Spring	1-Jun-16	Tzoonie River	5	NFO	0	0	0	0	0	0
2016	Spring	15-Jun-16	Lower Diversion	1	CO	277	0	0	0	0	0
2016	Spring	15-Jun-16	Lower Diversion	1	CT	0	0	4	2	1	0
2016	Spring	15-Jun-16	Lower Diversion	1	DV	0	1	0	0	0	0
2016	Spring	15-Jun-16	Lower Diversion	1	RB	1	16	12	4	0	0
2016	Spring	15-Jun-16	Downstream	2	CT	0	0	1	0	0	0
2016	Spring	15-Jun-16	Downstream	2	NFO	0	0	0	0	0	0
2016	Spring	15-Jun-16	Downstream	2	RB	1	11	16	10	1	0
2016	Spring	15-Jun-16	Downstream	3	RB	0	1	2	1	0	0
2016	Spring	15-Jun-16	Downstream	4	RB	0	1	0	0	0	0
2016	Spring	15-Jun-16	Tzoonie River	5	NFO	0	0	0	0	0	0
2016	Fall	2-Sep-16	Lower Diversion	1	CO	0	0	0	0	0	1
2016	Fall	2-Sep-16	Lower Diversion	1	CT	0	0	4	5	11	0
2016	Fall	2-Sep-16	Lower Diversion	1	RB	125	299	114	44	1	0
2016	Fall	2-Sep-16	Downstream	2	CO	64	0	0	0	0	6
2016	Fall	2-Sep-16	Downstream	2	CT	0	0	0	5	2	0
2016	Fall	2-Sep-16	Downstream	2	DV	0	6	0	1	0	0
2016	Fall	2-Sep-16	Downstream	2	RB	87	72	29	16	0	0
2016	Fall	2-Sep-16	Downstream	3	CO	146	0	0	0	0	0
2016	Fall	2-Sep-16	Downstream	3	CT	0	0	1	1	0	0
2016	Fall	2-Sep-16	Downstream	3	DV	0	1	0	0	0	0
2016	Fall	2-Sep-16	Downstream	3	RB	105	49	27	10	0	0
2016	Fall	2-Sep-16	Downstream	4	CO	105	0	0	0	0	0
2016	Fall	2-Sep-16	Downstream	4	CT	0	0	0	3	6	0
2016	Fall	2-Sep-16	Downstream	4	DV	0	4	1	0	0	0
2016	Fall	2-Sep-16	Downstream	4	RB	6	52	14	8	6	0
2016	Fall	2-Sep-16	Tzoonie River	5	CO	0	0	0	0	0	5
2016	Fall	2-Sep-16	Tzoonie River	5	CT	0	0	0	2	10	0
2016	Fall	15-Sep-16	Lower Diversion	1	CO	465	0	0	0	0	0

[1] CO = Coho Salmon, SA = Salmon sp., CT = Cutthroat Trout, DV = Dolly Varden, RB = Rainbow Trout, ST = Steelhead, TR = Trout sp., L = Lamprey sp., UNK = Unknown sp., NFO = no fish observed.

Table 5. (Continued).

Year	Season	Date	Reach	Section	Species[1]	Fry (0-80 mm)	Parr (80-150 mm)	Adult 151-250 mm	Adult 251-350 mm	Adult 351-450 mm	Adult 450+ mm
2016	Fall	15-Sep-16	Lower Diversion	1	CT	0	10	9	12	10	0
2016	Fall	15-Sep-16	Lower Diversion	1	RB	220	405	161	9	0	0
2016	Fall	15-Sep-16	Downstream	2	CO	180	0	0	0	0	14
2016	Fall	15-Sep-16	Downstream	2	CT	0	0	0	11	4	8
2016	Fall	15-Sep-16	Downstream	2	RB	160	102	24	1	0	0
2016	Fall	15-Sep-16	Downstream	3	CO	377	0	0	0	0	0
2016	Fall	15-Sep-16	Downstream	3	CT	0	0	0	1	0	0
2016	Fall	15-Sep-16	Downstream	3	RB	210	72	43	0	0	0
2016	Fall	15-Sep-16	Downstream	4	CO	290	0	0	0	0	0
2016	Fall	15-Sep-16	Downstream	4	CT	2	3	0	0	0	0
2016	Fall	15-Sep-16	Downstream	4	RB	120	29	8	0	0	0
2016	Fall	15-Sep-16	Tzoonie River	5	CO	25	0	0	0	1	5
2016	Fall	15-Sep-16	Tzoonie River	5	CT	0	0	2	8	10	2
2016	Fall	15-Sep-16	Tzoonie River	5	RB	0	7	5	0	0	0
2016	Fall	29-Sep-16	Lower Diversion	1	CO	15	0	0	0	0	2
2016	Fall	29-Sep-16	Lower Diversion	1	CT	0	0	4	4	1	0
2016	Fall	29-Sep-16	Lower Diversion	1	RB	97	127	49	9	0	0
2016	Fall	29-Sep-16	Downstream	2	CO	74	0	0	0	0	0
2016	Fall	29-Sep-16	Downstream	2	CT	0	3	2	2	0	0
2016	Fall	29-Sep-16	Downstream	2	RB	153	69	28	5	0	0
2016	Fall	29-Sep-16	Downstream	3	CO	46	0	0	0	0	0
2016	Fall	29-Sep-16	Downstream	3	CT	0	0	4	1	0	0
2016	Fall	29-Sep-16	Downstream	3	RB	102	65	20	6	0	0
2016	Fall	29-Sep-16	Downstream	4	CO	171	0	0	0	0	0
2016	Fall	29-Sep-16	Downstream	4	RB	50	8	0	0	0	0
2016	Fall	29-Sep-16	Tzoonie River	5	CO	0	0	0	0	6	20
2016	Fall	29-Sep-16	Tzoonie River	5	CT	0	0	0	0	7	8
2016	Fall	30-Sep-16	Lower Diversion	1	CO	314	0	0	0	2	1
2016	Fall	30-Sep-16	Lower Diversion	1	CT	35	47	20	13	7	0
2016	Fall	30-Sep-16	Lower Diversion	1	RB	45	31	5	4	0	0
2016	Fall	30-Sep-16	Downstream	2	CO	0	0	0	0	14	26
2016	Fall	30-Sep-16	Downstream	2	CT	0	0	1	4	2	0
2016	Fall	12-Oct-16	Lower Diversion	1	CO	235	0	0	0	0	1
2016	Fall	12-Oct-16	Lower Diversion	1	CT	15	33	23	6	5	6
2016	Fall	12-Oct-16	Lower Diversion	1	RB	28	67	20	4	0	0
2016	Fall	12-Oct-16	Downstream	2	CO	1	0	0	0	5	37
2016	Fall	12-Oct-16	Downstream	2	CT	0	0	0	0	5	5
2016	Fall	12-Oct-16	Downstream	2	RB	15	9	5	1	0	0
2016	Fall	12-Oct-16	Downstream	3	CO	23	0	0	0	0	0
2016	Fall	12-Oct-16	Downstream	3	CT	0	0	1	1	0	0
2016	Fall	12-Oct-16	Downstream	3	RB	30	14	3	3	0	0
2016	Fall	12-Oct-16	Downstream	4	CO	22	0	0	0	0	0
2016	Fall	12-Oct-16	Downstream	4	RB	17	2	3	0	0	0
2016	Fall	12-Oct-16	Tzoonie River	5	CO	0	0	0	0	4	12
2016	Fall	12-Oct-16	Tzoonie River	5	CT	0	0	0	0	11	9
2016	Fall	26-Oct-16	Lower Diversion	1	CO	4	0	0	0	0	9
2016	Fall	26-Oct-16	Lower Diversion	1	CT	0	6	9	9	4	1
2016	Fall	26-Oct-16	Lower Diversion	1	RB	64	63	43	17	0	0

[1] CO = Coho Salmon, SA = Salmon sp., CT = Cutthroat Trout, DV = Dolly Varden, RB = Rainbow Trout, ST = Steelhead, TR = Trout sp., L = Lamprey sp., UNK = Unknown sp., NFO = no fish observed.

Table 5. (Continued).

Year	Season	Date	Reach	Section	Species[1]	Fry (0-80 mm)	Parr (80-150 mm)	Adult 151-250 mm	Adult 251-350 mm	Adult 351-450 mm	Adult 450+ mm
2016	Fall	26-Oct-16	Downstream	2	CO	0	0	0	0	0	45
2016	Fall	26-Oct-16	Downstream	2	CT	0	3	4	4	3	2
2016	Fall	26-Oct-16	Downstream	2	DV	0	0	1	0	0	0
2016	Fall	26-Oct-16	Downstream	2	RB	34	36	19	2	0	0
2016	Fall	26-Oct-16	Downstream	3	CT	0	0	0	1	1	0
2016	Fall	26-Oct-16	Downstream	3	RB	5	13	11	5	0	0
2016	Fall	26-Oct-16	Downstream	4	CO	0	0	0	0	1	3
2016	Fall	26-Oct-16	Downstream	4	CT	0	2	1	0	4	1
2016	Fall	26-Oct-16	Downstream	4	RB	0	5	2	0	0	0
2016	Fall	26-Oct-16	Tzoonie River	5	CO	0	0	0	0	4	23
2016	Fall	26-Oct-16	Tzoonie River	5	CT	0	0	0	0	7	8
2016	Fall	18-Nov-16	Lower Diversion	1	CO	97	0	0	0	0	28
2016	Fall	18-Nov-16	Lower Diversion	1	CT	0	3	6	4	7	4
2016	Fall	18-Nov-16	Lower Diversion	1	DV	0	1	0	0	0	0
2016	Fall	18-Nov-16	Lower Diversion	1	RB	4	25	26	5	0	0
2016	Fall	18-Nov-16	Downstream	2	RB	2	5	6	0	0	0
2016	Fall	18-Nov-16	Downstream	3	CT	0	0	0	0	1	0
2016	Fall	18-Nov-16	Downstream	3	RB	2	0	1	0	0	0
2016	Fall	18-Nov-16	Downstream	4	CO	0	0	0	0	0	2
2016	Fall	18-Nov-16	Downstream	4	CT	0	0	0	5	0	0
2016	Fall	18-Nov-16	Tzoonie River	5	CO	0	0	0	0	0	20
2016	Fall	18-Nov-16	Tzoonie River	5	CT	0	0	0	0	3	17
2016	Fall	30-Nov-16	Lower Diversion	1	RB	1	8	8	0	0	0
2016	Fall	30-Nov-16	Downstream	2	RB	1	1	1	1	0	0
2016	Fall	30-Nov-16	Downstream	3	RB	0	3	3	0	0	0
2016	Fall	30-Nov-16	Downstream	4	CO	0	0	0	0	0	1
2016	Fall	30-Nov-16	Downstream	4	CT	0	0	0	2	0	0
2016	Fall	30-Nov-16	Downstream	4	RB	0	2	0	0	0	0
2016	Fall	30-Nov-16	Tzoonie River	5	CO	0	0	0	0	0	1
2016	Fall	30-Nov-16	Tzoonie River	5	CT	0	0	0	2	5	2
2016	Fall	1-Dec-16	Lower Diversion	1	CO	10	0	0	0	0	14
2016	Fall	1-Dec-16	Lower Diversion	1	CT	0	4	8	16	4	0
2016	Fall	1-Dec-16	Lower Diversion	1	RB	5	5	0	2	0	0
2016	Fall	1-Dec-16	Downstream	2	CO	0	0	0	0	0	4
2016	Fall	1-Dec-16	Downstream	2	CT	0	0	1	0	2	1
2016	Fall	1-Dec-16	Downstream	2	RB	0	2	0	0	0	0
2016	Fall	20-Dec-16	Lower Diversion	1	CO	0	0	0	0	0	1
2016	Fall	20-Dec-16	Lower Diversion	1	CT	0	0	8	3	24	1
2016	Fall	20-Dec-16	Lower Diversion	1	NFO	0	0	0	0	0	0
2016	Fall	20-Dec-16	Downstream	2	CO	0	0	0	0	0	5
2016	Fall	20-Dec-16	Downstream	2	CT	0	0	0	0	4	0
2016	Fall	20-Dec-16	Downstream	2	NFO	0	0	0	0	0	0
2016	Fall	20-Dec-16	Downstream	3	RB	0	1	0	0	0	0
2016	Fall	20-Dec-16	Downstream	4	NFO	0	0	0	0	0	0
2016	Fall	20-Dec-16	Tzoonie River	5	CT	0	0	0	0	8	2

[1] CO = Coho Salmon, SA = Salmon sp., CT = Cutthroat Trout, DV = Dolly Varden, RB = Rainbow Trout, ST = Steelhead, TR = Trout sp., L = Lamprey sp., UNK = Unknown sp., NFO = no fish observed.

Appendix K. Representation invertebrate site photographs

LIST OF FIGURES

Figure 1. Looking upstream at nets at CHK-USIV on Chickwat Creek on September 16, 2014.

Figure 2. Looking from river right bank to river left bank (a) and left to right bank on CHK-USIV on Chickwat Creek on September 16, 2014.

a)

b)

Figure 3. **Looking upstream at nets at CHK-USIV on Chickwat Creek on November 02, 2014.**

Figure 4. **Looking from river right bank to river left bank (a) and left to right bank on CHK-USIV on Chickwat Creek on November 2, 2014.**

a) **b)**

Figure 5. Looking upstream at nets at CHK-USIV on Chickwat Creek on September 28, 2015.

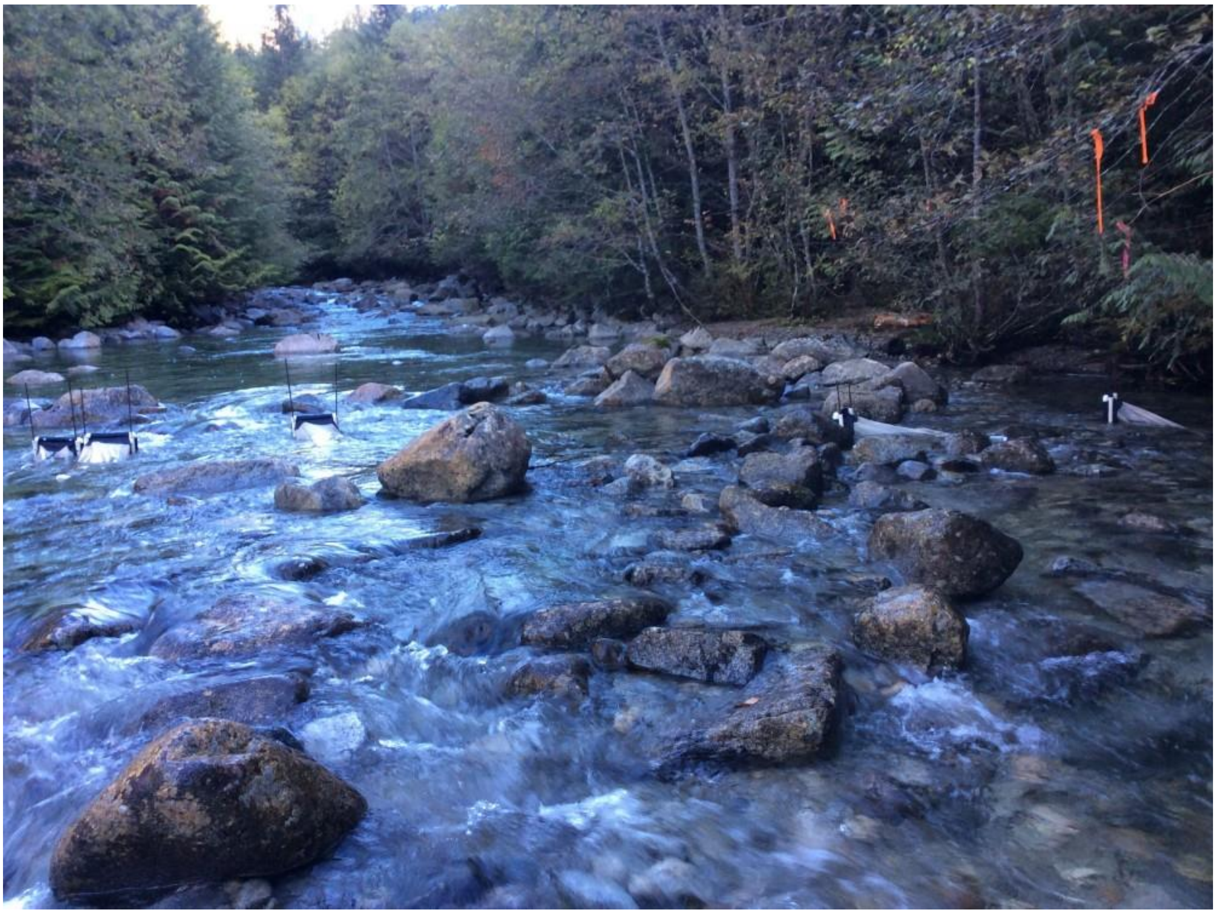

Figure 6. Looking from river right bank to river left bank (a) and left to right bank on CHK-USIV on Chickwat Creek on September 28, 2015.

a) b)

Figure 7. Looking upstream at nets at CHK-USIV on Chickwat Creek on November 11, 2015.

Figure 8. Looking from river right bank to river left bank (a) and left to right bank on CHK-USIV on Chickwat Creek on November 11, 2015.

a)

b)

Figure 9. Looking upstream at nets at CHK-DVIV on Chickwat Creek on September 16, 2014.

Figure 10. Looking from river right bank to river left bank (a) and left to right bank on CHK-DVIV on Chickwat Creek on September 16, 2014.

a) **b)**

Figure 11. Looking upstream at nets at CHK-DVIV on Chickwat Creek on November 2, 2014.

Figure 12. Looking from river right bank to river left bank (a) and left to right bank on CHK-DVIV on Chickwat Creek on November 2, 2014.

a) **b)**

Figure 13. Looking upstream at nets at CHK-DVIV on Chickwat Creek on September 28, 2015.

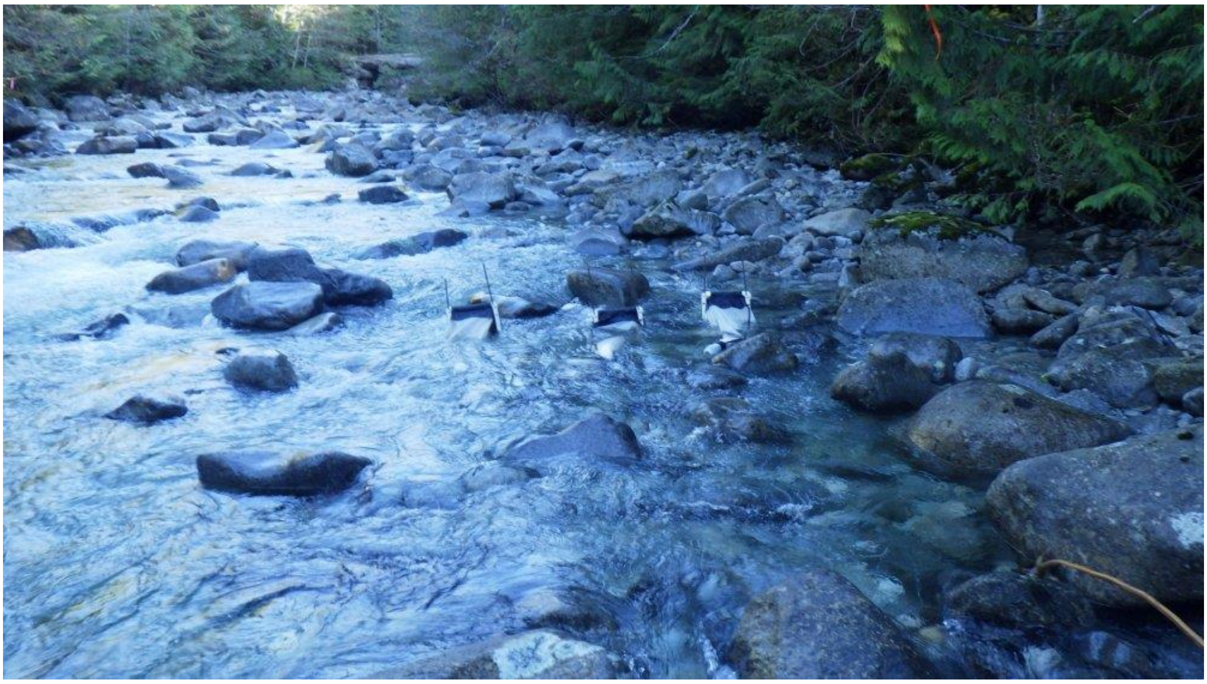

Figure 14. Looking from river right bank to river left bank (a) and left to right bank on CHK-DVIV on Chickwat Creek on September 28, 2015.

a)

b)

Figure 15. Looking upstream at nets at CHK-DVIV on Chickwat Creek on November 11, 2015.

Figure 16. Looking from river right bank to river left bank (a) and left to right bank on CHK-DVIV on Chickwat Creek on November 11, 2015.

a) b)

Figure 17. Looking upstream at nets at CHK-DSIV on Chickwat Creek on September 16, 2014.

Figure 18. Looking from river right bank to river left bank (a) and left to right bank on CHK-DSIV on Chickwat Creek on September 16, 2014.

a) **b)** **n/a**

Figure 19. **Looking upstream at nets at CHK-DSIV on Chickwat Creek on November 2, 2014.**

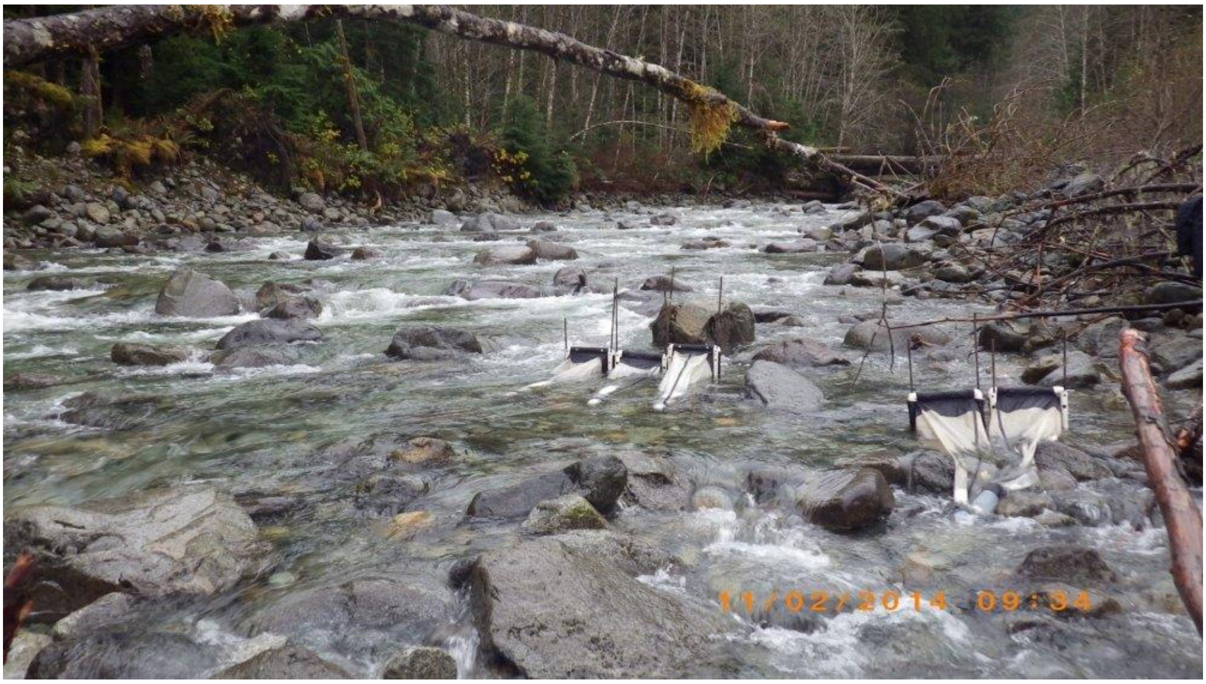

Figure 20. **Looking from river right bank to river left bank (a) and left to right bank on CHK-DSIV on Chickwat Creek on November 2, 2014.**

a)

b)

Figure 21. Looking upstream at nets at CHK-DSIV on Chickwat Creek on September 28, 2015.

Figure 22. Looking from river right bank to river left bank (a) and left to right bank on CHK-DSIV on Chickwat Creek on September 28, 2015.

a)

b)

Figure 23. Looking upstream at nets at CHK-DSIV on Chickwat Creek on November 11, 2015.

Figure 24. Looking from river right bank to river left bank (a) and left to right bank on CHK-DSIV on Chickwat Creek on November 11, 2015.

a) n/a

b) n/a

Appendix L. Geomorphology Headpond Oblique Photographs

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Figure 1. Chickwat Creek at CHK-GMPP1, Overview Photos taken on 2016-08-05.

a) Looking upstream.

c) Looking downstream.

b) Looking towards river left.

d) Looking towards river right.

Figure 2. Chickwat Creek at CHK-GMPP2, Overview Photos taken on 2016-08-05.

a) Looking upstream.

c) Looking downstream.

b) Looking towards river left.

d) Looking towards river right.

Figure 3. Chickwat Creek at CHK-GMPP3, Overview Photos taken on 2016-08-05.

a) Looking upstream.

c) Looking downstream.

b) Looking towards river left.

d) Looking towards river right.

Figure 4. Chickwat Creek at CHK-GMPP4, Overview Photos taken on 2016-08-05.

a) Looking upstream.

c) Looking downstream.

b) Looking towards river left.

d) Looking towards river right.

Figure 5. Chickwat Creek at CHK-GMPP4, Ground Photos taken on 2016-08-05.

a) Looking upstream.

c) Looking downstream.

b) Looking towards river left.

d) Looking towards river right.

Figure 6. Chickwat Creek at CHK-GMPP5, Overview Photos taken on 2016-08-05.

a) Looking upstream.

c) Looking downstream.

b) Looking towards river left.

d) Looking towards river right.

Appendix M. Geomorphology Rapid Assessment Photos

LIST OF FIGURES

1. CHICKWAT CREEK RAPID ASSESSMENT PHOTOGRAPHS

The photograph order below are ordered to roughly progress in an upstream direction. Figure 1 to Figure 20 are in the downstream reach, and Figure 21 to Figure 26 are in the lower diversion reach.

Figure 1. Mainstem channel in downstream fan reach. Banks are composed of poorly sorted cobble, gravel, and small boulder deposits. Floodplain trees have been knocked down or killed by sediment deposits.

Figure 2. Location of side channel in downstream reach that is currently only active at higher flows.

Figure 3. Looking downstream from current fan apex. Channel gradient is lower than upstream and side channels develop. A large quantity of cobble and small boulders cover the historical floodplain.

Figure 4. RR bank approximately 40 m downstream of the bridge crossing. Floodplain with mature forest overlying alluvial material has eroded, possibly during one high flow event. Channel consists of large boulder cascade section near current fan apex.

Figure 5. Looking downstream from ~20 m downstream of bridge crossing. Large wood jams have formed on RR against mature trees on low lying floodplain.

Figure 6. **Looking downstream from bridge crossing. Bank vegetation is mature on river right and young on river left where saplings are colonizing the cobble banks that were likely placed as part of the bridge protection work.**

Figure 7. **Evidence of bridge damage on RL downstream abutment caused by recent high flow events. Bridge opening is likely undersized for extreme flows.**

Figure 8. **Downstream RR bridge abutment where channel is scouring around abutment possibly due to large boulders and a log on RL forcing flows to RR. Deepest pools in the reach are formed by scour at base of bridge abutments.**

Figure 9. **Looking at RL upstream bridge abutment. Channel is beginning to form a pool and outflank abutment, indicating a more sinuous form may be imposing on the previously straightened channel.**

Figure 10. **Looking upstream from existing bridge crossing. Banks are composed of cobbles with moderate vegetation coverage. Gravel deposits are visible in the channel centre where a point bar is beginning to form. Channel progresses from cascade to plain-bed.**

Figure 11. **Gravel and sand deposits just upstream of bridge crossing. Channel is partially migrating toward RL, however vegetated banks with large boulder component resist erosion.**

Figure 12. RL bank just upstream of bridge crossing. Exposed roots in cobble matrix indicate partial erosion.

Figure 13. Gravel and sand deposit on river right side upstream of bridge crossing where a point bar is beginning to form.

Figure 14. **Looking downstream towards bridge crossing. Incised bankfull indicators are present on both channel banks indicating a recovering bankfull level within the trenched channel, or a lower bankfull level forced by backwatering from the downstream bridge.**

Figure 15. **Looking downstream from approximate proposed tailrace location. Cobble bank protection is progressively eroding on RL resulting in modest channel migration. RR channel bank has higher percentage of boulders and more mature trees.**

Figure 16. RR bank in downstream reach where inset cobble bank protection is progressively eroding towards historical bank. Moss covered terrace may indicate level of formative discharge that is causing a recovery channel within the trenched channel.

Figure 17. Steepest cascade section of the downstream reach followed by a medium sized pool.

Figure 18. Gravel patch with cobble subpavement near proposed tailrace location.

Figure 19. Perspective photo of gravel patch from previous photo. Gravel deposits occur where boulders congregate.

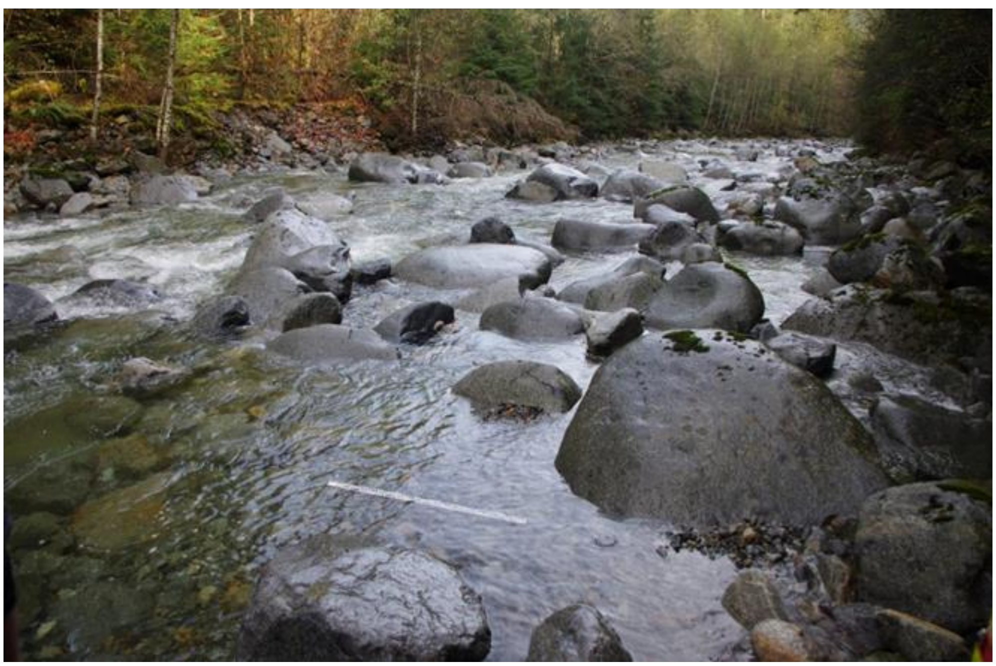

Figure 20. **Gravel deposits at downstream extent of a pool formed at foot of a cascade. Trees have established near water line near RL bank in cobble banks indicating the channel is entrenched.**

Figure 21. **Large wood piece in lower diversion partially embedded and heavily weathered. Banks are dominated by large boulders likely deposited by glaciofluvial processes.**

Figure 22. **Large boulders in lower diversion reach show signs of imbrication, which along with low moss coverage suggests some may have been transported in recent decades.**

Figure 23. **Large wood isolated step on river left side in lower diversion. Plunge pool depth below step is limited by large boulder base and lack of backwatering features downstream.**

Figure 24. **Looking upstream at cascade reach just downstream of canyon reach of lower diversion. Partial step-pools have formed with large boulder controls. Pools contain some gravel-cobble sized material at downstream extents.**

Figure 25. **Looking downstream from approximate downstream extent of canyon section. Channel morphology consists of large boulder cascade. Banks also consist of large boulder material overlain by thin floodplain soil.**

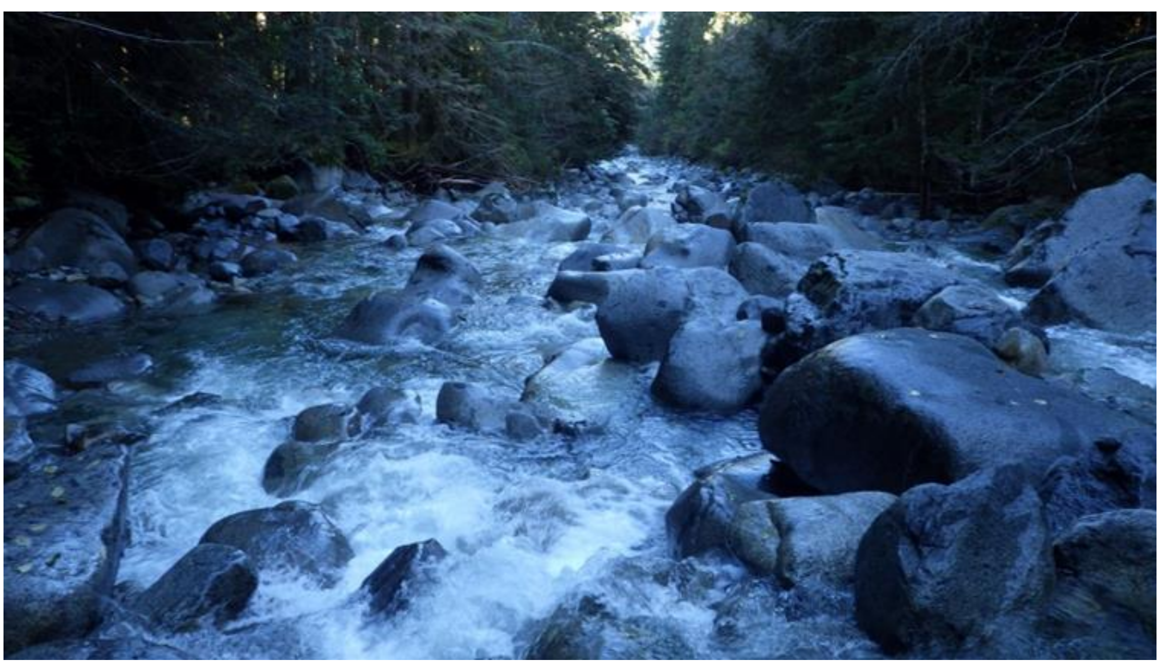

Figure 26. Looking upstream into canyon section. Channel morphology consists of large boulder and bedrock forced chutes. Large wood pieces are often non-functional in terms of morphology.

Appendix N. Geomorphology Cross-section Photographs

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Figure 1 Transect photographs taken at CHK-DSGM01 on October 15, 2015.

(a) Looking upstream at CHK-DSGM01

(b) Looking downstream at CHK-DSGM01

(c) Looking river right to river left at CHK-DSGM01

(d) Looking river left to river right at CHK-DSGM01

Figure 2. Transect photographs taken at CHK-DSGM02 on October 15, 2015

(a) Looking upstream at CHK-DSGM02

(b) Looking downstream at CHK-DSGM02

(c) Looking river right to river left at CHK-DSGM02

(d) Looking river left to river right at CHK-DSGM02

Figure 3 Transect photographs taken at CHK-DVGM01 on October 15, 2015.

(a) Looking upstream at CHK-DVGM01

(b) Looking downstream at CHK-DVGM01

(c) Looking river right to river left at CHK-DVGM01

(d) Looking river left to river right at CHK-DVGM01

Figure 4 Transect photographs taken at CHK-DVGM02 on October 15, 2015.

(a) Looking upstream at CHK-DVGM02

(b) Looking downstream at CHK-DVGM02

(c) Looking river right to river left at CHK-DVGM02

(d) Looking river left to river right at CHK-DVGM02

Figure 5 Transect photographs taken at CHK-DVGM03 on October 15, 2015.

(a) Looking upstream at CHK-DVGM03

(b) Looking downstream at CHK-DVGM03

(c) Looking river right to river left at CHK-DVGM03

(d) Looking river left to river right at CHK-DVGM03

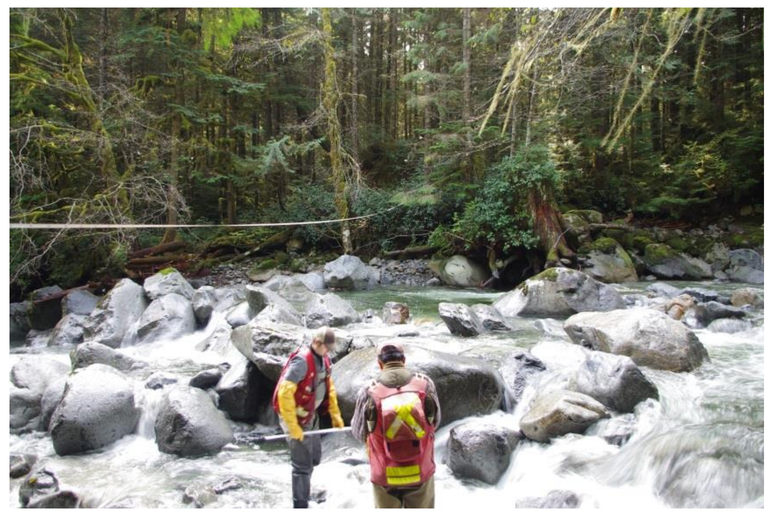


Figure 6 Transect photographs taken at CHK-DVGM04 on October 15, 2015.

(a) Looking upstream at CHK-DVGM04

(b) Looking downstream at CHK-DVGM04

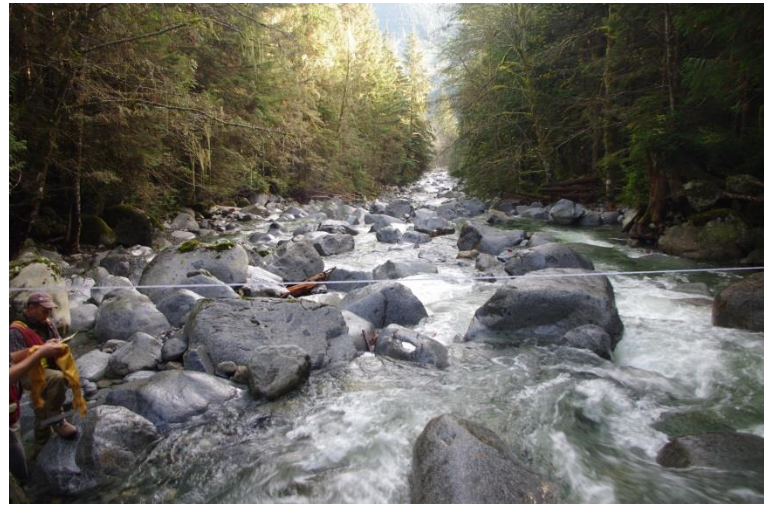
(c) Looking river right to river left at CHK-DVGM04

(d) Looking river left to river right at CHK-DVGM04

Figure 7. Transect photographs taken at CHK-DVGM05 on October 15, 2015.

(a) Looking upstream at CHK-DVGM05

(b) Looking downstream at CHK-DVGM05



(c) Looking river right to river left at CHK-DVGM05

(d) Looking river left to river right at CHK-DVGM05

Appendix O. Geomorphology Substrate Photographs.

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Figure 3. Substrate photograph of gravel patch at 4.5 m from river left pin and 2.0 m downstream.

Figure 4. Perspective photograph of gravel patch at 4.5 m from river left pin and 2.0 m downstream.

Figure 5. Substrate photograph of channel bed at 16.0 m from river left pin.

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2. SUBSTRATE PHOTOGRAPHS TAKEN AT CHK-DSGM02 ON OCTOBER 15, 2015.

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Figure 10. Perspective photograph of gravel patch at 2.4 m from river left pin.

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Figure 12. Perspective photograph of gravel patch at 5.6 m from river left pin and 1.0 m upstream

Figure 13. **Substrate photograph of gravel patch at 4.6 m from river left pin and 2.0 m downstream.**

Figure 14. **Perspective photograph of gravel patch at 4.6 m from river left pin and 2.0 m downstream.**

Figure 15. Substrate photograph of gravel patch at 20.2 m from river left pin.

Figure 16. Perspective photograph of gravel patch at 20.2 m from river left pin.

3. SUBSTRATE PHOTOGRAPHS TAKEN AT CHK-DVGM01 ON OCTOBER 15, 2015.

Figure 17. Substrate photograph of gravel patch at 2.9 m from river left pin.

Figure 18. Perspective photograph of gravel patch at 2.9 m from river left pin.

Figure 19. Substrate photograph of gravel patch at 4.2 m from river left pin and 1.5 m downstream.

Figure 20. Perspective photograph of gravel patch at 4.2 m from river left pin and 1.5 m downstream.

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Figure 21. Substrate photograph of gravel patch at 14.0 m from river left pin.

Figure 22. Perspective photograph of gravel patch at 14.0 m from river left pin.

4. SUBSTRATE PHOTOGRAPHS TAKEN AT CHK-DVGM02 ON OCTOBER 15, 2015.

Figure 23. Substrate photograph of gravel patch at 19.3 m from river left pin.

Figure 24. Perspective photograph of gravel patch at 19.3 m from river left pin.

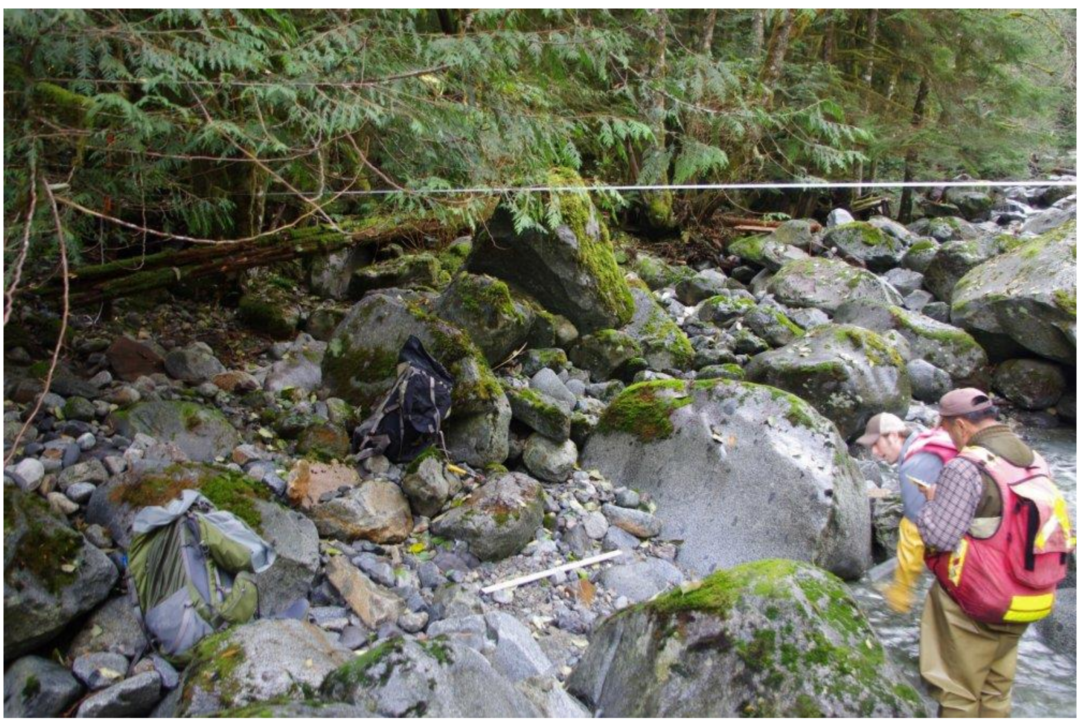

Figure 25. Substrate photograph of gravel patch at 10.2 m from river left pin.

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Figure 27. Substrate photograph of gravel patch at 9.0 m from river left pin and 1.0 m downstream.

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5. SUBSTRATE PHOTOGRAPHS TAKEN AT CHK-DVGM03 ON OCTOBER 15, 2015.

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Figure 33. Substrate photograph of gravel patch at 25.4 m from river left pin.

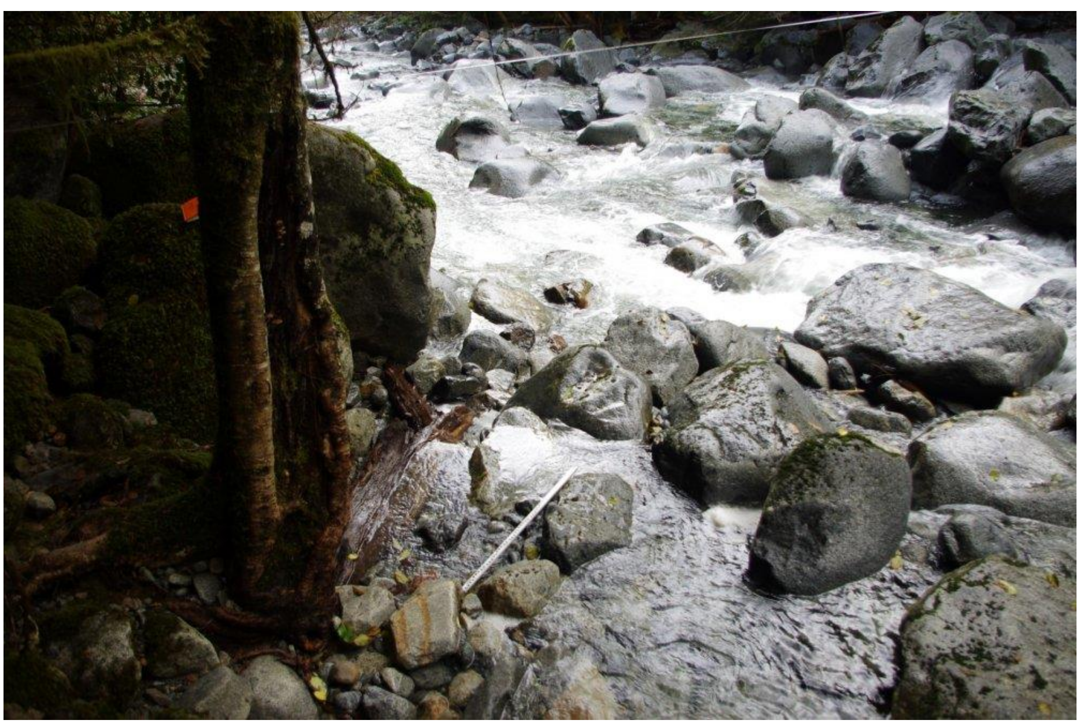
Figure 34. Perspective photograph of gravel patch 25.4 m from river left pin.

Figure 35. Substrate photograph of gravel patch at 18.5 m from river left pin.

Figure 36. Perspective photograph of gravel patch at 18.5 m from river left pin.

Figure 37. Substrate photograph of channel bed at 2.0 m from river left pin and 2.0 m upstream.

Figure 38. Perspective photograph of channel bed at 2.0 m from river left pin and 2.0 m upstream.



6. SUBSTRATE PHOTOGRAPHS TAKEN AT CHK-DVGM04 ON OCTOBER 15, 2015.

Figure 39. Substrate photograph of gravel patch at 9.6 m from river left pin.

Figure 40. Perspective photograph of gravel patch at 9.6 m from river left pin.

Figure 41. Substrate photograph of gravel patch at 21.5 m from river left pin.

Figure 42. Perspective photograph of gravel patch at 21.5 m from river left pin.

Figure 43. Substrate photograph of gravel patch at 27.5 m from river left pin and 4.0 m upstream.

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7. SUBSTRATE PHOTOGRAPHS TAKEN AT CHK-DVGM05 ON OCTOBER 15, 2015.

Figure 45. Substrate photograph of gravel patch at 2.3 m from river left pin.

Figure 46. Perspective photograph of gravel patch at 2.3 m from river left pin.

Figure 47. **Substrate photograph of gravel patch at 10.4 m from river left pin and 5.0 m upstream.**

Figure 48. **Perspective photograph of gravel patch at 10.4 m from river left pin and 5.0 m upstream.**

Figure 49. **Substrate photograph of gravel patch at 15.2 m from river left pin.**

Figure 50. **Perspective photograph of gravel patch at 15.2 m upstream of river left pin.**

Figure 51. Substrate photograph of gravel patch at 30.4 m from river left pin.

Figure 52. Perspective photograph of gravel patch at 30.4 m from river left pin.

Appendix P. Minnow trap habitat and set data

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Table 1. Habitat and set data for minnow trap sampling in the upper diversion of Chickwat Creek in the fall of 2014.

Location	Site	Trap	Mesh Size (mm)	Time In	Time Out	Soak Time (hrs)	Depth (m)	Mesohabitat	Cover[1]
Upper Diversion	CHK-UDVMT01	1	3	16:28	18:15	25.8	0.4	Riffle	BO
		2	6	16:28	18:15	25.8	0.4	Riffle	BO
		3	3	16:28	18:15	25.8	0.5	Riffle	BO
		4	3	16:28	18:15	25.8	0.5	Riffle	BO
		5	6	16:28	18:15	25.8	0.5	Riffle	BO
	CHK-UDVMT02	1	6	16:15	18:30	26.3	0.8	Riffle	BO
		2	3	16:15	18:30	26.3	0.6	Riffle	BO
		3	6	16:15	18:30	26.3	0.4	Riffle	BO
		4	6	16:15	18:30	26.3	0.4	Riffle	BO
		5	3	16:15	18:30	26.3	0.4	Riffle	BO
	CHK-UDVMT03	1	3	16:45	00:00	0.0	0.0	0	0
		2	3	16:45	00:00	0.0	0.0	0	0
		3	6	16:45	00:00	0.0	0.0	0	0
		4	3	16:45	00:00	0.0	0.0	0	0
		5	6	16:45	00:00	0.0	0.0	0	0
	CHK-UDVMT04	1	6	17:10	18:45	25.6	0.4	Pool	BO
		2	6	17:10	18:45	25.6	0.7	Pool	BO
		3	3	17:10	18:45	25.6	0.4	Pool	BO
		4	3	17:10	18:45	25.6	0.4	Pool	BO
		5	3	17:10	18:45	25.6	0.8	Pool	BO
	CHK-UDVMT05	1	3	17:18	18:55	25.6	0.5	Pool	BO
		2	3	17:18	18:55	25.6	0.9	Pool	BO
		3	6	17:18	18:55	25.6	0.5	Pool	BO
		4	3	17:18	18:55	25.6	0.7	Pool	BO
		5	6	17:18	18:55	25.6	0.5	Pool	BO

[1] BO = Boulder, CO = Cobble, DP = Deep pool, UC = Undercut, IV = Instream vegetation, OV = Overhanging vegetation, LWD = Large woody debris, and SWD = Small woody debris.

Table 2. Habitat and set data for minnow trap sampling in the upstream of Chickwat Creek in the fall of 2014.

Location	Site	Trap	Mesh Size (mm)	Time In	Time Out	Soak Time (hrs)	Depth (m)	Mesohabitat	Cover[1]
Upstream	CHK-USMT01	1	6	19:15	17:35	22.3	0.3	Riffle	BO
		2	6	19:15	17:35	22.3	0.3	Riffle	OV
		3	3	19:15	17:35	22.3	0.4	Riffle	OV
		4	3	19:15	17:35	22.3	0.4	Riffle	OV
		5	6	19:15	17:35	22.3	0.7	Riffle	OV
	CHK-USMT02	1	3	19:05	17:45	22.7	0.3	Riffle	BO
		2	6	19:05	17:45	22.7	0.4	Riffle	BO
		3	6	19:05	17:45	22.7	0.4	Riffle	BO
		4	3	19:05	17:45	22.7	0.4	Riffle	BO
		5	6	19:05	17:45	22.7	0.4	Riffle	BO
	CHK-USMT03	1	6	18:51	17:57	23.1	0.4	Riffle	BO
		2	6	18:51	17:57	23.1	1.0	Pool	DP
		3	3	18:51	17:57	23.1	0.8	Pool	DP
		4	3	18:51	17:57	23.1	0.3	Riffle	BO
		5	6	18:51	17:57	23.1	0.2	Riffle	BO
	CHK-USMT04	1	6	18:25	18:08	23.7	0.5	Riffle	BO
		2	6	18:25	18:08	23.7	0.7	Riffle	BO
		3	3	18:25	18:08	23.7	0.5	Riffle	BO
		4	6	18:25	18:08	23.7	0.4	Riffle	BO
		5	3	18:25	18:08	23.7	0.3	Riffle	BO
	CHK-USMT05	1	3	18:40	18:25	23.8	0.6	Cascade	BO
		2	6	18:40	18:25	23.8	0.8	Cascade	BO
		3	6	18:40	18:25	23.8	0.5	Cascade	BO
		4	6	18:40	18:25	23.8	0.5	Cascade	BO
		5	3	18:40	18:25	23.8	0.5	Cascade	BO

[1] BO = Boulder, CO = Cobble, DP = Deep pool, UC = Undercut, IV = Instream vegetation, OV = Overhanging vegetation, LWD = Large woody debris, and SWD = Small woody debris.

Table 3. Habitat and set data for minnow trap sampling in the upper diversion of Chickwat Creek in the fall of 2015.

Location	Site	Trap	Mesh Size (mm)	Time In	Time Out	Soak Time (hrs)	Depth (m)	Mesohabitat	Cover[1]
Upper Diversion	CHK-UDVMT01	1	3	15:02	13:43	22.7	0.7	Pool	BO, DP
		2	6	15:12	13:44	22.5	0.7	Pool	BO, DP
		3	6	15:13	13:45	22.5	0.4	Pool	BO
		4	6	15:06	13:46	22.7	0.4	Riffle	BO
		5	3	15:04	13:48	22.7	0.4	Pool	BO
	CHK-UDVMT02	1	6	15:26	13:55	22.5	0.4	Pool	BO, LWD
		2	6	15:28	13:57	22.5	0.4	Pool	BO
		3	3	15:33	13:58	22.4	0.6	Pool	BO
		4	3	15:34	14:00	22.4	0.5	Pool	BO, DP
		5	3	15:36	14:02	22.4	0.8	Pool	BO, DP
	CHK-UDVMT03	1	3	15:48	14:25	22.6	0.5	Riffle	BO, CO
		2	3	15:52	14:26	22.6	0.8	Riffle	BO, CO
		3	6	15:55	14:28	22.6	0.4	Riffle	BO, CO
		4	6	15:59	14:30	22.5	0.4	Riffle	BO, CO
		5	6	16:02	14:33	22.5	0.6	Riffle	BO, CO
	CHK-UDVMT04	1	3	15:48	14:40	22.9	0.5	Pool	BO, LWD
		2	3	15:52	14:41	22.8	0.3	Cascade	BO
		3	6	15:55	14:42	22.8	0.6	Cascade	BO
		4	6	15:59	14:44	22.8	0.4	Cascade	BO
		5	6	16:02	14:45	22.7	0.4	Riffle	BO
	CHK-UDVMT05	1	6	16:30	16:55	24.4	0.6	Pool	BO, DP, LWD
		2	3	16:35	14:56	22.4	0.5	Glide	BO
		3	6	16:38	14:57	22.3	1.5	Pool	BO, DP, LWD
		4	6	16:44	14:56	22.2	0.9	Pool	BO, DP
		5	6	16:45	14:56	22.2	0.9	Pool	BO, DP

[1] BO = Boulder, CO = Cobble, DP = Deep pool, UC = Undercut, IV = Instream vegetation, OV = Overhanging vegitation, LWD = Large woody debris, and SWD = Small woody debris.

Table 4. Habitat and set data for minnow trap sampling in the upstream of Chickwat Creek in the fall of 2015.

Location	Site	Trap	Mesh Size	Time In	Time Out	Soak Time	Depth (m)	Mesohabitat	Cover[1]
Upstream	CHK-USMT01	1	6	16:31	15:20	22.82	0.40	Riffle	BO, LWD
		2	3	16:29	15:23	22.90	0.45	Riffle	BO
		3	3	16:27	15:24	22.95	0.30	Riffle	BO
		4	6	16:24	15:27	23.05	0.40	Riffle	BO
		5	6	16:24	15:28	23.07	0.45	Riffle	BO, SWD
	CHK-USMT02	1	3	16:48	15:01	22.22	0.30	Cascade	BO
		2	3	16:45	15:02	22.28	0.45	Cascade	BO
		3	6	16:43	15:04	22.35	0.55	Cascade	BO
		4	6	16:41	15:05	22.40	0.48	Cascade	BO, LWD
		5	6	16:38	15:06	22.47	0.25	Cascade	BO, LWD
	CHK-USMT03	1	3	16:59	14:36	21.62	0.35	Riffle	BO
		2	6	17:01	14:37	21.60	0.45	Riffle	BO
		3	6	17:03	14:38	21.58	0.60	Riffle	BO, DP
		4	6	17:05	14:41	21.60	0.35	Pool	BO, OV
		5	3	17:07	14:42	21.58	0.32	Cascade	BO
	CHK-USMT04	1	6	17:15	14:17	21.03	0.35	Pool	OV, SWD
		2	6	17:18	14:16	20.97	0.43	Cascade	BO
		3	3	17:20	14:14	20.90	0.50	Riffle	BO
		4	3	17:23	14:12	20.82	0.25	Falls	BO
		5	3	17:25	14:11	20.77	0.55	Riffle	BO, DP
	CHK-USMT05	1	3	17:35	13:58	20.38	0.30	Cascade	BO, LWD, OV, SWD
		2	3	17:37	13:57	20.33	0.38	Cascade	BO
		3	6	17:39	13:54	20.25	0.60	Cascade	BO, DP
		4	6	17:41	13:53	20.20	0.35	Cascade	BO
		5	6	17:43	13:52	20.15	1.00	Cascade	BO, DP
	CHK-USMT06	1	6	17:52	13:32	19.67	0.40	Riffle	BO
		2	3	17:52	13:30	19.63	0.30	Riffle	BO
		3	3	17:54	13:27	19.55	0.40	Riffle	BO
		4	6	17:59	13:26	19.45	0.45	Riffle	BO
		5	6	18:05	13:25	19.33	0.50	Riffle	BO

[1] BO = Boulder, CO = Cobble, DP = Deep pool, UC = Undercut, IV = Instream vegetation, OV = Overhanging vegetation, LWD = Large woody debris, and SWD = Small woody debris.

Appendix Q. Mark Recapture Individual Fish Data 2014-2016

LIST OF TABLES

Table 1. Individual fish data for Chickwat Creek resident fish density mark-recapture in 2014.

Year	Waypoint/Site Name	Date	Sampling Objective	Capture Method[1]	Species[2]	Estimated Length (mm)	Measured Length (mm)	Weight (g)	Tag Number
2014	CHK-UDVSN01	7-Oct-14	Mark	SN	DV		62	2.4	
2014	CHK-UDVSN01	7-Oct-14	Mark	SN	DV		63	2.6	
2014	CHK-UDVSN01	7-Oct-14	Mark	SN	DV		67	2.9	
2014	CHK-UDVSN01	7-Oct-14	Mark	SN	DV		67	3.1	
2014	CHK-UDVSN01	7-Oct-14	Mark	SN	DV		68	3.2	
2014	CHK-UDVSN01	7-Oct-14	Mark	SN	DV		73	4.1	
2014	CHK-UDVSN01	7-Oct-14	Mark	SN	DV		75	4.2	
2014	CHK-UDVSN01	7-Oct-14	Mark	SN	DV		76	5.3	
2014	CHK-UDVSN01	7-Oct-14	Mark	SN	DV		104	13.1	989001003764939
2014	CHK-UDVSN01	7-Oct-14	Mark	SN	DV		114	16.5	989001003764985
2014	CHK-UDVSN01	7-Oct-14	Mark	SN	DV		115	17.8	989001003764940
2014	CHK-UDVSN01	7-Oct-14	Mark	SN	DV		122	20.1	989001003764999
2014	CHK-UDVSN01	7-Oct-14	Mark	SN	DV		125	23.5	989001003764993
2014	CHK-UDVSN01	7-Oct-14	Mark	SN	DV		127	23	989001003764978
2014	CHK-UDVSN01	7-Oct-14	Mark	SN	DV		135	28.1	989001003764968
2014	CHK-UDVSN01	7-Oct-14	Mark	SN	DV		179	59.6	989001003764972
2014	CHK-UDVSN01	7-Oct-14	Mark	SN	DV				
2014	CHK-UDVSN02	7-Oct-14	Mark	SN	DV		67	3.2	
2014	CHK-UDVSN02	7-Oct-14	Mark	SN	DV		102	11.3	989001003765004
2014	CHK-UDVSN02	7-Oct-14	Mark	SN	DV		104	13.5	989001003765000
2014	CHK-UDVSN02	7-Oct-14	Mark	SN	DV		105	12.4	989001003764943
2014	CHK-UDVSN02	7-Oct-14	Mark	SN	DV		105	12.7	989001003765009
2014	CHK-UDVSN02	7-Oct-14	Mark	SN	DV		115	15.9	989001003765007
2014	CHK-UDVSN02	7-Oct-14	Mark	SN	DV		115	18.1	989001003764970
2014	CHK-UDVSN02	7-Oct-14	Mark	SN	DV		118	17	989001003764930
2014	CHK-UDVSN02	7-Oct-14	Mark	SN	DV		121	19.1	989001003764982
2014	CHK-UDVSN02	7-Oct-14	Mark	SN	DV		124	19.8	989001003764987
2014	CHK-UDVSN02	7-Oct-14	Mark	SN	DV		127	21.3	989001003765011
2014	CHK-UDVSN02	7-Oct-14	Mark	SN	DV		183	70.6	989001003765001
2014	CHK-UDVSN02	7-Oct-14	Mark	SN	DV				
2014	CHK-UDVSN03	7-Oct-14	Mark	SN	DV	100			
2014	CHK-UDVSN03	7-Oct-14	Mark	SN	DV		110	14	989001003764933
2014	CHK-UDVSN03	7-Oct-14	Mark	SN	DV		113	15.5	989001003764997
2014	CHK-UDVSN03	7-Oct-14	Mark	SN	DV		148	34.3	989001003764998
2014	CHK-UDVSN03	7-Oct-14	Mark	SN	DV		152	35.3	989001003764963
2014	CHK-UDVSN03	7-Oct-14	Mark	SN	DV		161	42.6	989001003764973
2014	CHK-UDVSN03	7-Oct-14	Mark	SN	DV		161	44.5	989001003764996
2014	CHK-UDVSN03	7-Oct-14	Mark	SN	DV		173	54.5	989001003764971
2014	CHK-UDVSN03	7-Oct-14	Mark	SN	DV		175	54.7	989001003764995
2014	CHK-UDVSN03	7-Oct-14	Mark	SN	DV		177	60.4	989001003764976
2014	CHK-UDVSN03	7-Oct-14	Mark	SN	DV		180	60.4	989001003765003
2014	CHK-UDVSN03	7-Oct-14	Mark	SN	DV		185	63.9	989001003764992
2014	CHK-UDVSN03	7-Oct-14	Mark	SN	DV		193	72.2	989001003764990
2014	CHK-UDVSN03	7-Oct-14	Mark	SN	DV		193	74.8	989001003764957
2014	CHK-UDVSN04	8-Oct-14	Mark	SN	DV		68	3.3	
2014	CHK-UDVSN04	8-Oct-14	Mark	SN	DV		77	4.8	
2014	CHK-UDVSN04	8-Oct-14	Mark	SN	DV		118	16.4	989001003764937
2014	CHK-UDVSN04	8-Oct-14	Mark	SN	DV		124	19.5	989001003764931
2014	CHK-UDVSN04	8-Oct-14	Mark	SN	DV		129	21.7	989001003764932
2014	CHK-UDVSN04	8-Oct-14	Mark	SN	DV		167	48.7	989001003764941

[1] SN = snorkelling, MT = minnow trapping.
[2] DV = Dolly Varden.

Table 1. (Continued).

Year	Waypoint/Site Name	Date	Sampling Objective	Capture Method[1]	Species[2]	Estimated Length (mm)	Measured Length (mm)	Weight (g)	Tag Number
2014	CHK-UDVSN04	8-Oct-14	Mark	SN	DV		171	51.1	989001003764986
2014	CHK-UDVSN04	8-Oct-14	Mark	SN	DV		173	60.9	989001003764947
2014	CHK-UDVSN04	8-Oct-14	Mark	SN	DV		180	61.4	989001003764949
2014	CHK-UDVSN04	8-Oct-14	Mark	SN	DV		213	96.2	989001003764954
2014	CHK-UDVSN04	8-Oct-14	Mark	SN	DV				
2014	CHK-UDVSN05	8-Oct-14	Mark	SN	DV	170			
2014	CHK-UDVSN05	8-Oct-14	Mark	SN	DV		71	4.2	
2014	CHK-UDVSN05	8-Oct-14	Mark	SN	DV		73	4.1	
2014	CHK-UDVSN05	8-Oct-14	Mark	SN	DV		77	4.6	
2014	CHK-UDVSN05	8-Oct-14	Mark	SN	DV		118	17.1	989001003764946
2014	CHK-UDVSN05	8-Oct-14	Mark	SN	DV		119	17.5	989001003764977
2014	CHK-UDVSN05	8-Oct-14	Mark	SN	DV		121	17.8	989001003764925
2014	CHK-UDVSN05	8-Oct-14	Mark	SN	DV		131	23.9	989001003764965
2014	CHK-UDVSN05	8-Oct-14	Mark	SN	DV		143	24.5	989001003764980
2014	CHK-UDVSN05	8-Oct-14	Mark	SN	DV		155	37.4	989001003764948
2014	CHK-UDVSN05	8-Oct-14	Mark	SN	DV		180	59.9	989001003764994
2014	CHK-UDVSN05	8-Oct-14	Mark	SN	DV		200	79.2	989001003764934
2014	CHK-UDVSN05	8-Oct-14	Mark	SN	DV		214	90.9	989001003764950
2014	CHK-UDVSN05	8-Oct-14	Mark	SN	DV				
2014	CHK-USSN01	8-Oct-14	Mark	SN	DV	170			
2014	CHK-USSN01	8-Oct-14	Mark	SN	DV		68	3	
2014	CHK-USSN01	8-Oct-14	Mark	SN	DV		68	3.7	
2014	CHK-USSN01	8-Oct-14	Mark	SN	DV		70	3.6	
2014	CHK-USSN01	8-Oct-14	Mark	SN	DV		73	4.1	
2014	CHK-USSN01	8-Oct-14	Mark	SN	DV		76	4.7	
2014	CHK-USSN01	8-Oct-14	Mark	SN	DV		104	12.4	989001003764956
2014	CHK-USSN01	8-Oct-14	Mark	SN	DV		113	14.1	989001003764921
2014	CHK-USSN01	8-Oct-14	Mark	SN	DV		117	18.4	989001003764928
2014	CHK-USSN01	8-Oct-14	Mark	SN	DV		118	16.3	989001003764923
2014	CHK-USSN01	8-Oct-14	Mark	SN	DV		119	16.5	989001003764958
2014	CHK-USSN01	8-Oct-14	Mark	SN	DV		119	17	989001003764962
2014	CHK-USSN01	8-Oct-14	Mark	SN	DV		119	18.8	989001003764953
2014	CHK-USSN01	8-Oct-14	Mark	SN	DV		120	18.1	989001003764936
2014	CHK-USSN01	8-Oct-14	Mark	SN	DV		123	19.2	989001003765006
2014	CHK-USSN01	8-Oct-14	Mark	SN	DV		124	20	989001003764917
2014	CHK-USSN01	8-Oct-14	Mark	SN	DV		124	20.1	989001003764951
2014	CHK-USSN01	8-Oct-14	Mark	SN	DV		153	37.7	989001003764920
2014	CHK-USSN01	8-Oct-14	Mark	SN	DV		155	37.6	989001003764989
2014	CHK-USSN01	8-Oct-14	Mark	SN	DV		179	58	989001003764926
2014	CHK-USSN01	8-Oct-14	Mark	SN	DV		184	69.3	989001003764959
2014	CHK-USSN01	8-Oct-14	Mark	SN	DV				
2014	CHK-USSN02	8-Oct-14	Mark	SN	DV		66	2.7	
2014	CHK-USSN02	8-Oct-14	Mark	SN	DV		104	11.3	989001003764918
2014	CHK-USSN02	8-Oct-14	Mark	SN	DV		105	12.2	989001003764945
2014	CHK-USSN02	8-Oct-14	Mark	SN	DV		134	24	989001003764916
2014	CHK-USSN02	8-Oct-14	Mark	SN	DV		137	32.5	989001003764922
2014	CHK-USSN02	8-Oct-14	Mark	SN	DV		189	64.2	989001003764912
2014	CHK-USSN02	8-Oct-14	Mark	SN	DV				
2014	CHK-USSN03	9-Oct-14	Mark	SN	DV		69	3.2	

[1] SN = snorkelling, MT = minnow trapping.
[2] DV = Dolly Varden.

Table 1. (Continued).

Year	Waypoint/Site Name	Date	Sampling Objective	Capture Method[1]	Species[2]	Estimated Length (mm)	Measured Length (mm)	Weight (g)	Tag Number
2014	CHK-USSN03	9-Oct-14	Mark	SN	DV		104	10.9	989001003764966
2014	CHK-USSN03	9-Oct-14	Mark	SN	DV		113	15.1	989001003764984
2014	CHK-USSN03	9-Oct-14	Mark	SN	DV		114	14.4	989001003764974
2014	CHK-USSN03	9-Oct-14	Mark	SN	DV		114	15.5	989001003764967
2014	CHK-USSN03	9-Oct-14	Mark	SN	DV		115	15.3	989001003764935
2014	CHK-USSN03	9-Oct-14	Mark	SN	DV		147	30.4	989001003764991
2014	CHK-USSN03	9-Oct-14	Mark	SN	DV		156	38.2	989001003764924
2014	CHK-USSN03	9-Oct-14	Mark	SN	DV		170	51.4	989001003764983
2014	CHK-USSN03	9-Oct-14	Mark	SN	DV		176	54.8	989001003764964
2014	CHK-USSN03	9-Oct-14	Mark	SN	DV		180	57.4	989001003764960
2014	CHK-USSN03	9-Oct-14	Mark	SN	DV		187	77.5	989001003764969
2014	CHK-USSN03	9-Oct-14	Mark	SN	DV		208	85.7	989001003764914
2014	CHK-USSN03	9-Oct-14	Mark	SN	DV		213	92.8	989001003765002
2014	CHK-USSN03	9-Oct-14	Mark	SN	DV				
2014	CHK-USSN04	9-Oct-14	Mark	SN	DV		62	2.8	
2014	CHK-USSN04	9-Oct-14	Mark	SN	DV		64	2.7	
2014	CHK-USSN04	9-Oct-14	Mark	SN	DV		65	2.7	
2014	CHK-USSN04	9-Oct-14	Mark	SN	DV		68	3.3	
2014	CHK-USSN04	9-Oct-14	Mark	SN	DV		71	3.7	
2014	CHK-USSN04	9-Oct-14	Mark	SN	DV		115	15.2	989001003764919
2014	CHK-USSN04	9-Oct-14	Mark	SN	DV		148	33.5	989001003764927
2014	CHK-USSN04	9-Oct-14	Mark	SN	DV		176	56.3	989001003764942
2014	CHK-USSN04	9-Oct-14	Mark	SN	DV		178	56.5	989001003765010
2014	CHK-USSN04	9-Oct-14	Mark	SN	DV		207	80.3	989001003764961
2014	CHK-USSN04	9-Oct-14	Mark	SN	DV		219	97.4	989001003764929
2014	CHK-USSN04	9-Oct-14	Mark	SN	DV				
2014	CHK-USSN05	9-Oct-14	Mark	SN	DV		108	13.1	989001003764952
2014	CHK-USSN05	9-Oct-14	Mark	SN	DV		118	17.4	989001003765005
2014	CHK-USSN05	9-Oct-14	Mark	SN	DV		119	16	989001003764988
2014	CHK-USSN05	9-Oct-14	Mark	SN	DV		145	31.6	989001002925484
2014	CHK-USSN05	9-Oct-14	Mark	SN	DV		150	37.5	989001003764944
2014	CHK-USSN05	9-Oct-14	Mark	SN	DV		152	35.3	989001003764955
2014	CHK-USSN05	9-Oct-14	Mark	SN	DV		158	43	989001003764938
2014	CHK-USSN05	9-Oct-14	Mark	SN	DV		162	46.4	989001003764913
2014	CHK-USSN05	9-Oct-14	Mark	SN	DV		188	72.3	989001002925355
2014	CHK-USSN05	9-Oct-14	Mark	SN	DV		190	67	989001002925510
2014	CHK-USSN05	9-Oct-14	Mark	SN	DV		204	76.7	989001003765008
2014	CHK-USSN05	9-Oct-14	Mark	SN	DV		217	97.1	989001003764915
2014	CHK-USSN05	9-Oct-14	Mark	SN	DV				
2014	CHK-UDVMT02	15-Oct-14	Recapture	MT	DV		68	3.5	
2014	CHK-UDVMT02	15-Oct-14	Recapture	MT	DV		120	16.9	
2014	CHK-UDVSN01	15-Oct-14	Recapture	SN	DV	75			
2014	CHK-UDVSN01	15-Oct-14	Recapture	SN	DV		61	2.3	
2014	CHK-UDVSN01	15-Oct-14	Recapture	SN	DV		63	2.4	
2014	CHK-UDVSN01	15-Oct-14	Recapture	SN	DV		67	3	
2014	CHK-UDVSN01	15-Oct-14	Recapture	SN	DV		71	3.7	
2014	CHK-UDVSN01	15-Oct-14	Recapture	SN	DV		74	3.9	
2014	CHK-UDVSN01	15-Oct-14	Recapture	SN	DV		76	4.3	
2014	CHK-UDVSN01	15-Oct-14	Recapture	SN	DV		102	16.1	989001003764367
2014	CHK-UDVSN01	15-Oct-14	Recapture	SN	DV		114	16.5	989001003764985

[1] SN = snorkelling, MT = minnow trapping.

[2] DV = Dolly Varden.

Table 1. (Continued).

Year	Waypoint/Site Name	Date	Sampling Objective	Capture Method[1]	Species[2]	Estimated Length (mm)	Measured Length (mm)	Weight (g)	Tag Number
2014	CHK-UDVSN01	15-Oct-14	Recapture	SN	DV		115	17.8	989001003764940
2014	CHK-UDVSN01	15-Oct-14	Recapture	SN	DV		127	23	989001003764978
2014	CHK-UDVSN01	15-Oct-14	Recapture	SN	DV		135	28.1	989001003764968
2014	CHK-UDVSN02	15-Oct-14	Recapture	SN	DV	55	66	3.3	
2014	CHK-UDVSN02	15-Oct-14	Recapture	SN	DV	60	66	3.2	
2014	CHK-UDVSN02	15-Oct-14	Recapture	SN	DV	65	64	3.5	
2014	CHK-UDVSN02	15-Oct-14	Recapture	SN	DV	110	104	12.2	989001003764405
2014	CHK-UDVSN02	15-Oct-14	Recapture	SN	DV	110	105	12.6	989001003764377
2014	CHK-UDVSN02	15-Oct-14	Recapture	SN	DV	110	105	12.6	989001003764392
2014	CHK-UDVSN02	15-Oct-14	Recapture	SN	DV	110	105	13.5	989001003764388
2014	CHK-UDVSN02	15-Oct-14	Recapture	SN	DV	110			989001003765009
2014	CHK-UDVSN02	15-Oct-14	Recapture	SN	DV	115	105	12.7	989001003764378
2014	CHK-UDVSN02	15-Oct-14	Recapture	SN	DV	120	114	14.2	989001003764358
2014	CHK-UDVSN02	15-Oct-14	Recapture	SN	DV	120	114	15.5	989001003764396
2014	CHK-UDVSN02	15-Oct-14	Recapture	SN	DV	120			989001003765007
2014	CHK-UDVSN02	15-Oct-14	Recapture	SN	DV	120			
2014	CHK-UDVSN02	15-Oct-14	Recapture	SN	DV	140			989001003764932
2014	CHK-UDVSN02	15-Oct-14	Recapture	SN	DV	165	164	46.6	989001003764996
2014	CHK-UDVSN02	15-Oct-14	Recapture	SN	DV	185	184		989001003765001
2014	CHK-UDVSN03	15-Oct-14	Recapture	SN	DV	55	59	2	
2014	CHK-UDVSN03	15-Oct-14	Recapture	SN	DV	60	61	3.2	
2014	CHK-UDVSN03	15-Oct-14	Recapture	SN	DV	60	67	3	
2014	CHK-UDVSN03	15-Oct-14	Recapture	SN	DV	65	71	4.1	
2014	CHK-UDVSN03	15-Oct-14	Recapture	SN	DV	110			989001003764997
2014	CHK-UDVSN03	15-Oct-14	Recapture	SN	DV	120	128	21	989001003764316
2014	CHK-UDVSN03	15-Oct-14	Recapture	SN	DV	140	130	21.8	989001003764342
2014	CHK-UDVSN03	15-Oct-14	Recapture	SN	DV	140			989001003764987
2014	CHK-UDVSN03	15-Oct-14	Recapture	SN	DV	140			
2014	CHK-UDVSN03	15-Oct-14	Recapture	SN	DV	150			989001003764998
2014	CHK-UDVSN03	15-Oct-14	Recapture	SN	DV	160	162	42.6	989001003764402
2014	CHK-UDVSN03	15-Oct-14	Recapture	SN	DV	160			989001003764973
2014	CHK-UDVSN03	15-Oct-14	Recapture	SN	DV	165			
2014	CHK-UDVSN03	15-Oct-14	Recapture	SN	DV	170	178	51.7	989001003764376
2014	CHK-UDVSN03	15-Oct-14	Recapture	SN	DV	170	181		989001003765003
2014	CHK-UDVSN03	15-Oct-14	Recapture	SN	DV	180	182		989001003764992
2014	CHK-UDVSN03	15-Oct-14	Recapture	SN	DV	180			989001003764976
2014	CHK-UDVSN03	15-Oct-14	Recapture	SN	DV	190	193		989001003764957
2014	CHK-UDVSN04	15-Oct-14	Recapture	SN	DV	75	69	3.3	
2014	CHK-UDVSN04	15-Oct-14	Recapture	SN	DV	120	118		989001003764937
2014	CHK-UDVSN04	15-Oct-14	Recapture	SN	DV	140	199		989001003764932
2014	CHK-UDVSN04	15-Oct-14	Recapture	SN	DV	170	167		989001003764941
2014	CHK-UDVSN04	15-Oct-14	Recapture	SN	DV	180	162	45.8	989001003764369
2014	CHK-UDVSN04	15-Oct-14	Recapture	SN	DV	180	172	57.7	989001003764357
2014	CHK-UDVSN04	15-Oct-14	Recapture	SN	DV	195	199	76.4	989001003764411
2014	CHK-UDVSN04	15-Oct-14	Recapture	SN	DV	200	211		989001003764954
2014	CHK-UDVSN05	15-Oct-14	Recapture	SN	DV	60			
2014	CHK-UDVSN05	15-Oct-14	Recapture	SN	DV	65	73	3.9	
2014	CHK-UDVSN05	15-Oct-14	Recapture	SN	DV	70			
2014	CHK-UDVSN05	15-Oct-14	Recapture	SN	DV	100			
2014	CHK-UDVSN05	15-Oct-14	Recapture	SN	DV	115	115	15.5	989001003764368

[1] SN = snorkelling, MT = minnow trapping.
[2] DV = Dolly Varden.

Table 1. (Continued).

Year	Waypoint/Site Name	Date	Sampling Objective	Capture Method[1]	Species[2]	Estimated Length (mm)	Measured Length (mm)	Weight (g)	Tag Number
2014	CHK-UDVSN05	15-Oct-14	Recapture	SN	DV	140			
2014	CHK-UDVSN05	15-Oct-14	Recapture	SN	DV	180			
2014	CHK-UDVSN05	15-Oct-14	Recapture	SN	DV	200	197	74	989001003764324
2014	CHK-UDVSN05	15-Oct-14	Recapture	SN	DV	200	200	77.8	989001003764328
2014	CHK-UDVSN05	15-Oct-14	Recapture	SN	DV	210	214		989001003764950
2014	CHK-UDVSN05	15-Oct-14	Recapture	SN	DV	210			
2014	CHK-USMT01	14-Oct-14	Recapture	MT	DV		61	2	
2014	CHK-USMT01	14-Oct-14	Recapture	MT	DV		64	2.5	
2014	CHK-USMT03	14-Oct-14	Recapture	MT	DV		104		
2014	CHK-USMT04	14-Oct-14	Recapture	MT	DV		107	12.2	
2014	CHK-USSN01	16-Oct-14	Recapture	SN	DV	60	63	2.2	
2014	CHK-USSN01	16-Oct-14	Recapture	SN	DV	60	65	2.9	
2014	CHK-USSN01	16-Oct-14	Recapture	SN	DV	70	68	3	
2014	CHK-USSN01	16-Oct-14	Recapture	SN	DV	70	76		
2014	CHK-USSN01	16-Oct-14	Recapture	SN	DV	100			
2014	CHK-USSN01	16-Oct-14	Recapture	SN	DV	110	105	12	989001003764406
2014	CHK-USSN01	16-Oct-14	Recapture	SN	DV	110			989001003764936
2014	CHK-USSN01	16-Oct-14	Recapture	SN	DV	120	113		989001003764921
2014	CHK-USSN01	16-Oct-14	Recapture	SN	DV	120			989001003764953
2014	CHK-USSN01	16-Oct-14	Recapture	SN	DV	120			
2014	CHK-USSN01	16-Oct-14	Recapture	SN	DV	130	117	17.9	989001003764391
2014	CHK-USSN01	16-Oct-14	Recapture	SN	DV	130	132	23.1	989001003764343
2014	CHK-USSN01	16-Oct-14	Recapture	SN	DV	130			989001003764363
2014	CHK-USSN01	16-Oct-14	Recapture	SN	DV	130			989001003764917
2014	CHK-USSN01	16-Oct-14	Recapture	SN	DV	130			989001003764928
2014	CHK-USSN01	16-Oct-14	Recapture	SN	DV	130			989001003765006
2014	CHK-USSN01	16-Oct-14	Recapture	SN	DV	140			989001003764951
2014	CHK-USSN01	16-Oct-14	Recapture	SN	DV	170	179		989001003764926
2014	CHK-USSN01	16-Oct-14	Recapture	SN	DV	190	181	70.1	989001003764959
2014	CHK-USSN01	16-Oct-14	Recapture	SN	DV	190	187	63.3	989001003764335
2014	CHK-USSN02	16-Oct-14	Recapture	SN	DV	65	63	2.7	
2014	CHK-USSN02	16-Oct-14	Recapture	SN	DV	110	105	10.7	989001003764401
2014	CHK-USSN02	16-Oct-14	Recapture	SN	DV	110	106	12.3	989001003764315
2014	CHK-USSN02	16-Oct-14	Recapture	SN	DV	110	107	12.2	989001003764379
2014	CHK-USSN02	16-Oct-14	Recapture	SN	DV	110	109	13.2	989001003764373
2014	CHK-USSN02	16-Oct-14	Recapture	SN	DV	110			989001003764918
2014	CHK-USSN02	16-Oct-14	Recapture	SN	DV	120			
2014	CHK-USSN02	16-Oct-14	Recapture	SN	DV	130	113	15.8	989001003764349
2014	CHK-USSN02	16-Oct-14	Recapture	SN	DV	140	136	24.8	989001003764399
2014	CHK-USSN02	16-Oct-14	Recapture	SN	DV	140	150	36.1	989001003764372
2014	CHK-USSN02	16-Oct-14	Recapture	SN	DV	140			
2014	CHK-USSN02	16-Oct-14	Recapture	SN	DV	160	151	35.1	989001003764364
2014	CHK-USSN02	16-Oct-14	Recapture	SN	DV	180	221	93.2	989001003764333
2014	CHK-USSN03	16-Oct-14	Recapture	SN	DV	60			
2014	CHK-USSN03	16-Oct-14	Recapture	SN	DV	65	68	3.7	
2014	CHK-USSN03	16-Oct-14	Recapture	SN	DV	110			989001003764984
2014	CHK-USSN03	16-Oct-14	Recapture	SN	DV	115	113	14.2	989001003764313
2014	CHK-USSN03	16-Oct-14	Recapture	SN	DV	120	114	14.5	989001003764380
2014	CHK-USSN03	16-Oct-14	Recapture	SN	DV	130	127	21.2	989001003764334
2014	CHK-USSN03	16-Oct-14	Recapture	SN	DV	130			989001003764974

[1] SN = snorkelling, MT = minnow trapping.
[2] DV = Dolly Varden.

Table 1. (Continued).

Year	Waypoint/Site Name	Date	Sampling Objective	Capture Method[1]	Species[2]	Estimated Length (mm)	Measured Length (mm)	Weight (g)	Tag Number
2014	CHK-USSN03	16-Oct-14	Recapture	SN	DV	140	147	29.9	989001003764317
2014	CHK-USSN03	16-Oct-14	Recapture	SN	DV	150	142	30	989001003764371
2014	CHK-USSN03	16-Oct-14	Recapture	SN	DV	150	143	35.7	989001003764408
2014	CHK-USSN03	16-Oct-14	Recapture	SN	DV	150			989001003764991
2014	CHK-USSN03	16-Oct-14	Recapture	SN	DV	160	165	48.9	989001003764352
2014	CHK-USSN03	16-Oct-14	Recapture	SN	DV	170	173	56.1	989001003764353
2014	CHK-USSN03	16-Oct-14	Recapture	SN	DV	170			989001003764960
2014	CHK-USSN03	16-Oct-14	Recapture	SN	DV	200			989001003764969
2014	CHK-USSN03	16-Oct-14	Recapture	SN	DV	210	211	88.1	989001003764312
2014	CHK-USSN03	16-Oct-14	Recapture	SN	DV	250			989001003765002
2014	CHK-USSN04	16-Oct-14	Recapture	SN	DV	75	106	12	989001003764365
2014	CHK-USSN04	16-Oct-14	Recapture	SN	DV	100	109	13.1	989001003764400
2014	CHK-USSN04	16-Oct-14	Recapture	SN	DV	140			989001003764351
2014	CHK-USSN04	16-Oct-14	Recapture	SN	DV	150	159	46.2	989001003764348
2014	CHK-USSN04	16-Oct-14	Recapture	SN	DV	190	177	54.7	989001003764340
2014	CHK-USSN04	16-Oct-14	Recapture	SN	DV	200			989001003764961
2014	CHK-USSN04	16-Oct-14	Recapture	SN	DV	235	219	98.3	989001003764929
2014	CHK-USSN05	16-Oct-14	Recapture	SN	DV	60	64	2.7	
2014	CHK-USSN05	16-Oct-14	Recapture	SN	DV	60	65	2.8	
2014	CHK-USSN05	16-Oct-14	Recapture	SN	DV	60	69	3.3	
2014	CHK-USSN05	16-Oct-14	Recapture	SN	DV	100	108	13.3	989001003764332
2014	CHK-USSN05	16-Oct-14	Recapture	SN	DV	120	112	13.7	989001003764329
2014	CHK-USSN05	16-Oct-14	Recapture	SN	DV	120			989001003764952
2014	CHK-USSN05	16-Oct-14	Recapture	SN	DV	120			
2014	CHK-USSN05	16-Oct-14	Recapture	SN	DV	130	112	14	989001003764355
2014	CHK-USSN05	16-Oct-14	Recapture	SN	DV	130			989001003764955
2014	CHK-USSN05	16-Oct-14	Recapture	SN	DV	150			
2014	CHK-USSN05	16-Oct-14	Recapture	SN	DV	155	170	49.9	989001003764331
2014	CHK-USSN05	16-Oct-14	Recapture	SN	DV	160			
2014	CHK-USSN05	16-Oct-14	Recapture	SN	DV	170	197	76	989001003764337
2014	CHK-USSN05	16-Oct-14	Recapture	SN	DV	170			989001003764913
2014	CHK-USSN05	16-Oct-14	Recapture	SN	DV	170			989001003765008

[1] SN = snorkelling, MT = minnow trapping.
[2] DV = Dolly Varden.

Table 2. Individual fish data for Chickwat Creek resident fish density mark-recapture in 2015.

Year	Waypoint/Site Name	Date	Sampling Objective	Capture Method[1]	Species[2]	Estimated Length (mm)	Measured Length (mm)	Weight (g)	Tag Number
2015	CHK-UDVMT02	6-Oct-15	Abundance	MT	DV		104	11.1	989001004690444
2015	CHK-UDVMT02	6-Oct-15	Abundance	MT	DV		105	11.2	989001004690442
2015	CHK-UDVMT02	6-Oct-15	Abundance	MT	DV		128	20.8	989001003764379
2015	CHK-UDVMT05	7-Oct-15	Abundance	MT	DV		104		989001004690427
2015	CHK-UDVMT05	7-Oct-15	Abundance	MT	DV		113		989001004690409
2015	CHK-UDVMT05	7-Oct-15	Abundance	MT	DV		113		989001004690443
2015	CHK-UDVMT05	7-Oct-15	Abundance	MT	DV		127		989001004690412
2015	CHK-UDVMT05	7-Oct-15	Abundance	MT	DV		131		989001004690416
2015	CHK-UDVMT05	7-Oct-15	Abundance	MT	DV		161		989001004690426
2015	CHK-UDVMT05	7-Oct-15	Abundance	MT	DV		169		989001004690422
2015	CHK-USMT01	7-Oct-15	Abundance	MT	DV		100	9.9	9.8900100469051E_pls
2015	CHK-USMT01	7-Oct-15	Abundance	MT	DV		104	10.9	9.8900100469048E_pls
2015	CHK-USMT01	7-Oct-15	Abundance	MT	DV		136	25.6	9.8900100376439E_pls
2015	CHK-USMT02	7-Oct-15	Abundance	MT	DV		114	14.1	9.8900100469055E+14
2015	CHK-USMT03	7-Oct-15	Abundance	MT	DV		128	21.7	9.890010037644E_plsc
2015	CHK-USMT03	7-Oct-15	Abundance	MT	DV		136	24.7	9.8900100469052E_pls
2015	CHK-USMT04	7-Oct-15	Abundance	MT	DV		134	22.7	9.8900100376431E_pls
2015	CHK-USMT06	7-Oct-15	Abundance	MT	DV		102	11	9.890010046905E_plsc
2015	CHK-UDVSN01	6-Oct-15	Mark	SN	DV	100	99	9.5	989001004690460
2015	CHK-UDVSN01	6-Oct-15	Mark	SN	DV	120	107	12.1	989001004690450
2015	CHK-UDVSN01	6-Oct-15	Mark	SN	DV	120	113	14.2	989001004690455
2015	CHK-UDVSN01	6-Oct-15	Mark	SN	DV	140	151	38.3	989001003764978
2015	CHK-UDVSN01	6-Oct-15	Mark	SN	DV	150	149	34.4	989001003764968
2015	CHK-UDVSN02	6-Oct-15	Mark	SN	DV	70	98	9.1	989001004690386
2015	CHK-UDVSN02	6-Oct-15	Mark	SN	DV	70			
2015	CHK-UDVSN02	6-Oct-15	Mark	SN	DV	110	104	10.9	989001004690438
2015	CHK-UDVSN02	6-Oct-15	Mark	SN	DV	110	112	13.7	989001004690392
2015	CHK-UDVSN02	6-Oct-15	Mark	SN	DV	120	108	11.4	989001004690405
2015	CHK-UDVSN02	6-Oct-15	Mark	SN	DV	120	114	14.2	989001004690397
2015	CHK-UDVSN02	6-Oct-15	Mark	SN	DV	120	145	31	989001003764338
2015	CHK-UDVSN02	6-Oct-15	Mark	SN	DV	140	128	22.4	989001003764405
2015	CHK-UDVSN02	6-Oct-15	Mark	SN	DV	155	148	36.5	989001004690440
2015	CHK-UDVSN02	6-Oct-15	Mark	SN	DV	170	141	29.4	989001003764999
2015	CHK-UDVSN02	6-Oct-15	Mark	SN	DV	175	182	58.1	989001004690419
2015	CHK-UDVSN02	6-Oct-15	Mark	SN	DV	190	199	74.1	989001004690428
2015	CHK-UDVSN03	6-Oct-15	Mark	SN	DV	90	115	15.5	989001004690382
2015	CHK-UDVSN03	6-Oct-15	Mark	SN	DV	120	111	13.6	989001004690456
2015	CHK-UDVSN03	6-Oct-15	Mark	SN	DV	125	113	15.6	989001004690384
2015	CHK-UDVSN03	6-Oct-15	Mark	SN	DV	130	122	18.3	989001004690431
2015	CHK-UDVSN03	6-Oct-15	Mark	SN	DV	130	133	25.6	989001004690439
2015	CHK-UDVSN03	6-Oct-15	Mark	SN	DV	135	132	24.8	989001003765000
2015	CHK-UDVSN03	6-Oct-15	Mark	SN	DV	140	138	29.3	989001004690465
2015	CHK-UDVSN03	6-Oct-15	Mark	SN	DV	140	139	29.5	989001003765011
2015	CHK-UDVSN03	6-Oct-15	Mark	SN	DV	140			
2015	CHK-UDVSN03	6-Oct-15	Mark	SN	DV	150	137	26.1	989001004690433
2015	CHK-UDVSN03	6-Oct-15	Mark	SN	DV	150	169	50.9	989001003764973
2015	CHK-UDVSN03	6-Oct-15	Mark	SN	DV	165	182	57.2	989001003764376
2015	CHK-UDVSN03	6-Oct-15	Mark	SN	DV	180	182	62.6	989001004690458
2015	CHK-UDVSN03	6-Oct-15	Mark	SN	DV		106	11.6	989001004690436
2015	CHK-UDVSN04	6-Oct-15	Mark	SN	DV	140	139	24.4	989001003764342
2015	CHK-UDVSN04	6-Oct-15	Mark	SN	DV	145	137	26.5	989001003764932
2015	CHK-UDVSN04	6-Oct-15	Mark	SN	DV	150	141	28.4	989001003764987
2015	CHK-UDVSN04	6-Oct-15	Mark	SN	DV	155	166	47.8	989001004690387

[1] SN = snorkelling, MT = minnow trapping.

[2] DV = Dolly Varden.

Table 2. (Continued).

Year	Waypoint/Site Name	Date	Sampling Objective	Capture Method[1]	Species[2]	Estimated Length (mm)	Measured Length (mm)	Weight (g)	Tag Number
2015	CHK-UDVSN04	6-Oct-15	Mark	SN	DV	165	164	45.5	989001003764877
2015	CHK-UDVSN04	6-Oct-15	Mark	SN	DV	165	171	48.2	989001003764986
2015	CHK-UDVSN04	6-Oct-15	Mark	SN	DV	170	178	56.8	989001004690446
2015	CHK-UDVSN04	6-Oct-15	Mark	SN	DV	175	196	70.2	989001003764411
2015	CHK-UDVSN05	6-Oct-15	Mark	SN	DV	120	111	14.3	989001004690399
2015	CHK-UDVSN05	6-Oct-15	Mark	SN	DV	130			
2015	CHK-UDVSN05	6-Oct-15	Mark	SN	DV	140	141	28.6	989001003764988
2015	CHK-UDVSN05	6-Oct-15	Mark	SN	DV	140	163	45	989001004690374
2015	CHK-UDVSN05	6-Oct-15	Mark	SN	DV	150			
2015	CHK-UDVSN05	6-Oct-15	Mark	SN	DV	180	198	65.4	989001004690420
2015	CHK-USSN01	7-Oct-15	Mark	SN	DV	90	92	8	989001004690459
2015	CHK-USSN01	7-Oct-15	Mark	SN	DV	90	103	10.8	989001004690425
2015	CHK-USSN01	7-Oct-15	Mark	SN	DV	90	106		989001004690467
2015	CHK-USSN01	7-Oct-15	Mark	SN	DV	100	86	6.7	989001004690391
2015	CHK-USSN01	7-Oct-15	Mark	SN	DV	100	94	9	989001004690411
2015	CHK-USSN01	7-Oct-15	Mark	SN	DV	100	97	9.3	989001004690451
2015	CHK-USSN01	7-Oct-15	Mark	SN	DV	100	105	11.6	989001004690408
2015	CHK-USSN01	7-Oct-15	Mark	SN	DV	110	103	10.4	989001004690407
2015	CHK-USSN01	7-Oct-15	Mark	SN	DV	120	103	9.5	989001004690380
2015	CHK-USSN01	7-Oct-15	Mark	SN	DV	120	105	11.5	989001004690377
2015	CHK-USSN01	7-Oct-15	Mark	SN	DV	120	105	11.7	989001004690468
2015	CHK-USSN01	7-Oct-15	Mark	SN	DV	120	108	12.9	989001004690376
2015	CHK-USSN01	7-Oct-15	Mark	SN	DV	130	107	11.7	987001004690375
2015	CHK-USSN01	7-Oct-15	Mark	SN	DV	130	121	18.9	989001004690949
2015	CHK-USSN01	7-Oct-15	Mark	SN	DV	130	132	23.2	989001004690378
2015	CHK-USSN01	7-Oct-15	Mark	SN	DV	140	135	22.7	989001003764958
2015	CHK-USSN01	7-Oct-15	Mark	SN	DV	150	143	30.6	989001004690423
2015	CHK-USSN01	7-Oct-15	Mark	SN	DV	160	146	32.6	989001003764951
2015	CHK-USSN01	7-Oct-15	Mark	SN	DV	160			
2015	CHK-USSN02	7-Oct-15	Mark	SN	DV	100	101	10.8	989001004690379
2015	CHK-USSN02	7-Oct-15	Mark	SN	DV	100	102	9.9	989001004690414
2015	CHK-USSN02	7-Oct-15	Mark	SN	DV	100	105	11.7	989001004690393
2015	CHK-USSN02	7-Oct-15	Mark	SN	DV	105	109	13.3	989001004690462
2015	CHK-USSN02	7-Oct-15	Mark	SN	DV	110	98	9.1	989001004690394
2015	CHK-USSN02	7-Oct-15	Mark	SN	DV	110	100	9.6	989001004690466
2015	CHK-USSN02	7-Oct-15	Mark	SN	DV	110	123	17.5	989001003764918
2015	CHK-USSN02	7-Oct-15	Mark	SN	DV	120	125	19.3	989001004690452
2015	CHK-USSN02	7-Oct-15	Mark	SN	DV	120	134	23	989001003764386
2015	CHK-USSN02	7-Oct-15	Mark	SN	DV	130	130	23	989001003764379
2015	CHK-USSN02	7-Oct-15	Mark	SN	DV	140	148	33.4	989001003764916
2015	CHK-USSN02	7-Oct-15	Mark	SN	DV	160	163	47	989001003764624
2015	CHK-USSN02	7-Oct-15	Mark	SN	DV	180	198	75.5	989001004690415
2015	CHK-USSN03	7-Oct-15	Mark	SN	DV	100	103	10.4	989001004890413
2015	CHK-USSN03	7-Oct-15	Mark	SN	DV	105	101	9	989001004690388
2015	CHK-USSN03	7-Oct-15	Mark	SN	DV	110	105	8.8	989001004690471
2015	CHK-USSN03	7-Oct-15	Mark	SN	DV	110	109	9.9	989001004690417
2015	CHK-USSN03	7-Oct-15	Mark	SN	DV	110	118	17.7	989001004690463
2015	CHK-USSN03	7-Oct-15	Mark	SN	DV	120	101	7.6	989001004690457
2015	CHK-USSN03	7-Oct-15	Mark	SN	DV	120	113	11.9	989001004690402
2015	CHK-USSN03	7-Oct-15	Mark	SN	DV	120	114	12.2	989001004690404
2015	CHK-USSN03	7-Oct-15	Mark	SN	DV	120	115	11	989001004690390
2015	CHK-USSN03	7-Oct-15	Mark	SN	DV	120	127	21.3	989001004690398
2015	CHK-USSN03	7-Oct-15	Mark	SN	DV	135	122	14.6	989001003764966
2015	CHK-USSN03	7-Oct-15	Mark	SN	DV	140	133	19	989001004690421

[1] SN = snorkelling, MT = minnow trapping.
[2] DV = Dolly Varden.

Table 2. (Continued).

Year	Waypoint/Site Name	Date	Sampling Objective	Capture Method[1]	Species[2]	Estimated Length (mm)	Measured Length (mm)	Weight (g)	Tag Number
2015	CHK-USSN03	7-Oct-15	Mark	SN	DV	140	136	22	989001004690447
2015	CHK-USSN03	7-Oct-15	Mark	SN	DV	155	163	34.3	989001003764317
2015	CHK-USSN03	7-Oct-15	Mark	SN	DV	190	180	60.3	989001004690429
2015	CHK-USSN03	7-Oct-15	Mark	SN	DV	210	222	63.5	989001003764688
2015	CHK-USSN03	7-Oct-15	Mark	SN	DV	250	203	62.2	989001004690403
2015	CHK-USSN04	7-Oct-15	Mark	SN	DV	100	105	11.6	989001004690441
2015	CHK-USSN04	7-Oct-15	Mark	SN	DV	100	116	15.3	989001004690469
2015	CHK-USSN04	7-Oct-15	Mark	SN	DV	105	97	8.4	989001004690401
2015	CHK-USSN04	7-Oct-15	Mark	SN	DV	110	111	13.2	989001004690434
2015	CHK-USSN04	7-Oct-15	Mark	SN	DV	115	115	15.6	989001004690437
2015	CHK-USSN04	7-Oct-15	Mark	SN	DV	125	134	25.4	989001003764400
2015	CHK-USSN04	7-Oct-15	Mark	SN	DV	160	188	67.5	989001004690435
2015	CHK-USSN05	7-Oct-15	Mark	SN	DV	100	133	23.9	989001003764952
2015	CHK-USSN05	7-Oct-15	Mark	SN	DV	120	116	15.6	989001004690418
2015	CHK-USSN05	7-Oct-15	Mark	SN	DV	120	117	14.9	989001004690395
2015	CHK-USSN05	7-Oct-15	Mark	SN	DV	120	117	15.8	989001004690424
2015	CHK-USSN05	7-Oct-15	Mark	SN	DV	120	118	16.4	989001004690396
2015	CHK-USSN05	7-Oct-15	Mark	SN	DV	120	143	29	989001004690435
2015	CHK-USSN05	7-Oct-15	Mark	SN	DV	130	138	28.6	989001004690464
2015	CHK-USSN05	7-Oct-15	Mark	SN	DV	160	166	47	989001003764955
2015	CHK-USSN05	7-Oct-15	Mark	SN	DV	170	175	54.4	989001004690470
2015	CHK-USSN06	7-Oct-15	Mark	SN	DV	110	112	13.9	989001004690448
2015	CHK-USSN06	7-Oct-15	Mark	SN	DV	115	112	12.2	989001004690410
2015	CHK-USSN06	7-Oct-15	Mark	SN	DV	125	118	17.2	989001004890383
2015	CHK-USSN06	7-Oct-15	Mark	SN	DV	140	145	26.5	989001004690445
2015	CHK-USSN06	7-Oct-15	Mark	SN	DV	140	148	34	989001004690432
2015	CHK-USSN06	7-Oct-15	Mark	SN	DV	150	142	29	989001003764334
2015	CHK-USSN06	7-Oct-15	Mark	SN	DV	190	211	90.1	989001004690472
2015	CHK-USSN06	7-Oct-15	Mark	SN	DV		102	10.3	989001004690543
2015	CHK-USSN06	7-Oct-15	Mark	SN	DV		110	12.6	989001004690559
2015	CHK-USSN06	7-Oct-15	Mark	SN	DV		112	13.3	989001004690483
2015	CHK-USSN06	7-Oct-15	Mark	SN	DV		112	15.2	989001004690496
2015	CHK-USSN06	7-Oct-15	Mark	SN	DV		115	15.2	989001004690568
2015	CHK-USSN06	7-Oct-15	Mark	SN	DV		124	18.7	989001004690554
2015	CHK-USSN06	7-Oct-15	Mark	SN	DV		125	19	989001004690545
2015	CHK-USSN06	7-Oct-15	Mark	SN	DV		125	19.8	989001004690540
2015	CHK-USSN06	7-Oct-15	Mark	SN	DV		135	25.1	989001004690566
2015	CHK-USSN06	7-Oct-15	Mark	SN	DV		151	32	989001004690563
2015	CHK-USSN06	7-Oct-15	Mark	SN	DV		174	47.3	989001004690461
2015	CHK-USSN06	7-Oct-15	Mark	SN	DV		182	64.3	989001004690406
2015	CHK-USSN06	7-Oct-15	Mark	SN	DV		193	72.4	989001004690389
2015	CHK-UDVSN01	14-Oct-15	Recapture	SN	DV	110			989001004690444
2015	CHK-UDVSN01	14-Oct-15	Recapture	SN	DV	120	98	9.6	989001004690460
2015	CHK-UDVSN01	14-Oct-15	Recapture	SN	DV	120	106	11.8	989001004690442
2015	CHK-UDVSN01	14-Oct-15	Recapture	SN	DV	120	113	14.4	989001004690455
2015	CHK-UDVSN01	14-Oct-15	Recapture	SN	DV	120			
2015	CHK-UDVSN01	14-Oct-15	Recapture	SN	DV	140			989001003764378
2015	CHK-UDVSN01	14-Oct-15	Recapture	SN	DV	150			
2015	CHK-UDVSN01	14-Oct-15	Recapture	SN	DV	160	150	33.8	989001003764968
2015	CHK-UDVSN02	14-Oct-15	Recapture	SN	DV	110	101	10.1	989001004690522
2015	CHK-UDVSN02	14-Oct-15	Recapture	SN	DV	110			989001004690438
2015	CHK-UDVSN02	14-Oct-15	Recapture	SN	DV	115			
2015	CHK-UDVSN02	14-Oct-15	Recapture	SN	DV	120	111	13.6	989001004690529
2015	CHK-UDVSN02	14-Oct-15	Recapture	SN	DV	120	119	18.7	989001004690513

[1] SN = snorkelling, MT = minnow trapping.

[2] DV = Dolly Varden.

Table 2. (Continued).

Year	Waypoint/Site Name	Date	Sampling Objective	Capture Method[1]	Species[2]	Estimated Length (mm)	Measured Length (mm)	Weight (g)	Tag Number
2015	CHK-UDVSN02	14-Oct-15	Recapture	SN	DV	120			989001004690397
2015	CHK-UDVSN02	14-Oct-15	Recapture	SN	DV	120			989001004690405
2015	CHK-UDVSN02	14-Oct-15	Recapture	SN	DV	130	127	22.3	989001004690539
2015	CHK-UDVSN02	14-Oct-15	Recapture	SN	DV	130	129	21.9	989001004690498
2015	CHK-UDVSN02	14-Oct-15	Recapture	SN	DV	130	133	23.8	989001003764396
2015	CHK-UDVSN02	14-Oct-15	Recapture	SN	DV	135			989001003764358
2015	CHK-UDVSN02	14-Oct-15	Recapture	SN	DV	200	198	71.4	989001004690428
2015	CHK-UDVSN03	8-Apr-15	Recapture	SN	DV	120	119	15.7	989001003764930
2015	CHK-UDVSN03	8-Apr-15	Recapture	SN	DV	150	121	16.2	989001003764632
2015	CHK-UDVSN03	8-Apr-15	Recapture	SN	DV	160			
2015	CHK-UDVSN03	8-Apr-15	Recapture	SN	DV	180	156	35.5	989001003764963
2015	CHK-UDVSN03	8-Apr-15	Recapture	SN	DV	180			
2015	CHK-UDVSN03	14-Oct-15	Recapture	SN	DV	100	106	10.9	989001004690506
2015	CHK-UDVSN03	14-Oct-15	Recapture	SN	DV	110	109	12.3	989001004690488
2015	CHK-UDVSN03	14-Oct-15	Recapture	SN	DV	110			989001004690436
2015	CHK-UDVSN03	14-Oct-15	Recapture	SN	DV	115			989001004690456
2015	CHK-UDVSN03	14-Oct-15	Recapture	SN	DV	120			989001004690431
2015	CHK-UDVSN03	14-Oct-15	Recapture	SN	DV	125	126	21.3	989001003764388
2015	CHK-UDVSN03	14-Oct-15	Recapture	SN	DV	125			989001004690433
2015	CHK-UDVSN03	14-Oct-15	Recapture	SN	DV	130	130	20.4	989001004690530
2015	CHK-UDVSN03	14-Oct-15	Recapture	SN	DV	135			989001003765011
2015	CHK-UDVSN03	14-Oct-15	Recapture	SN	DV	140			989001004690465
2015	CHK-UDVSN03	14-Oct-15	Recapture	SN	DV	160			989001003764376
2015	CHK-UDVSN04	8-Apr-15	Recapture	SN	DV	80			
2015	CHK-UDVSN04	8-Apr-15	Recapture	SN	DV	120	161	39.1	989001003764877
2015	CHK-UDVSN04	8-Apr-15	Recapture	SN	DV	120			
2015	CHK-UDVSN04	8-Apr-15	Recapture	SN	DV	150	163	40.8	989001003764661
2015	CHK-UDVSN04	8-Apr-15	Recapture	SN	DV	160	167	46.1	989001003764941
2015	CHK-UDVSN04	8-Apr-15	Recapture	SN	DV	170	190	59	989001003764826
2015	CHK-UDVSN04	8-Apr-15	Recapture	SN	DV	200	208	80.8	989001003764954
2015	CHK-UDVSN04	8-Apr-15	Recapture	SN	DV	200	210	70.5	989001003764706
2015	CHK-UDVSN04	14-Oct-15	Recapture	SN	DV	100			
2015	CHK-UDVSN04	14-Oct-15	Recapture	SN	DV	105			
2015	CHK-UDVSN04	14-Oct-15	Recapture	SN	DV	120			989001003764342
2015	CHK-UDVSN04	14-Oct-15	Recapture	SN	DV	120			989001004690416
2015	CHK-UDVSN04	14-Oct-15	Recapture	SN	DV	120			
2015	CHK-UDVSN04	14-Oct-15	Recapture	SN	DV	125	127	22.2	989001003764928
2015	CHK-UDVSN04	14-Oct-15	Recapture	SN	DV	125	139	28.7	989001004690572
2015	CHK-UDVSN04	14-Oct-15	Recapture	SN	DV	130	143	32.1	989001004690547
2015	CHK-UDVSN04	14-Oct-15	Recapture	SN	DV	130			
2015	CHK-UDVSN04	14-Oct-15	Recapture	SN	DV	135			989001004690426
2015	CHK-UDVSN04	14-Oct-15	Recapture	SN	DV	140	173	55.1	989001004690504
2015	CHK-UDVSN04	14-Oct-15	Recapture	SN	DV	145			989001003764932
2015	CHK-UDVSN04	14-Oct-15	Recapture	SN	DV	145			989001003764987
2015	CHK-UDVSN04	14-Oct-15	Recapture	SN	DV	180			
2015	CHK-UDVSN04	14-Oct-15	Recapture	SN	DV	195	211	85.1	989001003764954
2015	CHK-UDVSN05	8-Apr-15	Recapture	SN	DV	75	77	4.6	
2015	CHK-UDVSN05	8-Apr-15	Recapture	SN	DV	100	122	17.3	989001003764925
2015	CHK-UDVSN05	8-Apr-15	Recapture	SN	DV	120			
2015	CHK-UDVSN05	8-Apr-15	Recapture	SN	DV	150	118	14.1	989001003764988
2015	CHK-UDVSN05	8-Apr-15	Recapture	SN	DV	180			
2015	CHK-UDVSN05	14-Oct-15	Recapture	SN	DV	120			
2015	CHK-UDVSN05	14-Oct-15	Recapture	SN	DV	130	134	24.7	989001004690491
2015	CHK-UDVSN05	14-Oct-15	Recapture	SN	DV	180	198	65.9	989001004690420

[1] SN = snorkelling, MT = minnow trapping.
[2] DV = Dolly Varden.

Table 2. (Continued).

Year	Waypoint/Site Name	Date	Sampling Objective	Capture Method[1]	Species[2]	Estimated Length (mm)	Measured Length (mm)	Weight (g)	Tag Number
2015	CHK-USSN01	9-Apr-15	Recapture	SN	DV	75	70	3.7	
2015	CHK-USSN01	9-Apr-15	Recapture	SN	DV	75	80	5	
2015	CHK-USSN01	9-Apr-15	Recapture	SN	DV		75	4	
2015	CHK-USSN01	9-Apr-15	Recapture	SN	DV		79	4.4	
2015	CHK-USSN01	9-Apr-15	Recapture	SN	DV		115	15	989001003764898
2015	CHK-USSN01	9-Apr-15	Recapture	SN	DV		116	15.7	989001003764953
2015	CHK-USSN01	9-Apr-15	Recapture	SN	DV		123	17.7	989001003764936
2015	CHK-USSN01	9-Apr-15	Recapture	SN	DV		124	18.6	989001003765006
2015	CHK-USSN01	9-Apr-15	Recapture	SN	DV		150	33.1	989001003764624
2015	CHK-USSN01	9-Apr-15	Recapture	SN	DV		153	36.2	989001003764857
2015	CHK-USSN01	9-Apr-15	Recapture	SN	DV		155	37.1	989001003764989
2015	CHK-USSN01	9-Apr-15	Recapture	SN	DV		175	46.3	989001003764926
2015	CHK-USSN01	9-Apr-15	Recapture	SN	DV		180	54.4	989001003764959
2015	CHK-USSN01	15-Oct-15	Recapture	SN	DV	90			989001004690459
2015	CHK-USSN01	15-Oct-15	Recapture	SN	DV	95			989001004690391
2015	CHK-USSN01	15-Oct-15	Recapture	SN	DV	100			989001004690411
2015	CHK-USSN01	15-Oct-15	Recapture	SN	DV	100			989001004690467
2015	CHK-USSN01	15-Oct-15	Recapture	SN	DV	100			989001004690484
2015	CHK-USSN01	15-Oct-15	Recapture	SN	DV	105			989001004690425
2015	CHK-USSN01	15-Oct-15	Recapture	SN	DV	110			989001004690408
2015	CHK-USSN01	15-Oct-15	Recapture	SN	DV	110			989001004690468
2015	CHK-USSN01	15-Oct-15	Recapture	SN	DV	115			989001004690376
2015	CHK-USSN01	15-Oct-15	Recapture	SN	DV	115			989001004690451
2015	CHK-USSN01	15-Oct-15	Recapture	SN	DV	120			989001004690375
2015	CHK-USSN01	15-Oct-15	Recapture	SN	DV	120			989001004690449
2015	CHK-USSN01	15-Oct-15	Recapture	SN	DV	130			989001003764391
2015	CHK-USSN01	15-Oct-15	Recapture	SN	DV	130			989001003764898
2015	CHK-USSN01	15-Oct-15	Recapture	SN	DV	135	142	25.9	989001003764363
2015	CHK-USSN01	15-Oct-15	Recapture	SN	DV	145			989001003764951
2015	CHK-USSN01	15-Oct-15	Recapture	SN	DV	175	184	57.6	989001003764926
2015	CHK-USSN02	9-Apr-15	Recapture	SN	DV	75	75	3.9	
2015	CHK-USSN02	9-Apr-15	Recapture	SN	DV	100	105	11.3	989001003764315
2015	CHK-USSN02	9-Apr-15	Recapture	SN	DV	100	106	11	989001003764407
2015	CHK-USSN02	9-Apr-15	Recapture	SN	DV	110	105	10.2	989001003764918
2015	CHK-USSN02	9-Apr-15	Recapture	SN	DV	110	115	13.1	989001003764386
2015	CHK-USSN02	9-Apr-15	Recapture	SN	DV	130	137	28.5	989001003764922
2015	CHK-USSN02	9-Apr-15	Recapture	SN	DV	140	136	24.1	989001003764820
2015	CHK-USSN02	9-Apr-15	Recapture	SN	DV	150	148	30.5	989001003764372
2015	CHK-USSN02	9-Apr-15	Recapture	SN	DV	170	161	41.5	989001003764827
2015	CHK-USSN02	15-Oct-15	Recapture	SN	DV	90			989001004690373
2015	CHK-USSN02	15-Oct-15	Recapture	SN	DV	90			989001004690414
2015	CHK-USSN02	15-Oct-15	Recapture	SN	DV	90			989001004690466
2015	CHK-USSN02	15-Oct-15	Recapture	SN	DV	100	106	11.8	989001004690508
2015	CHK-USSN02	15-Oct-15	Recapture	SN	DV	105			989001004690379
2015	CHK-USSN02	15-Oct-15	Recapture	SN	DV	110	107	11.4	989001004690518
2015	CHK-USSN02	15-Oct-15	Recapture	SN	DV	110			989001004690462
2015	CHK-USSN02	15-Oct-15	Recapture	SN	DV	110			989001004690552
2015	CHK-USSN02	15-Oct-15	Recapture	SN	DV	110			
2015	CHK-USSN02	15-Oct-15	Recapture	SN	DV	130			989001003764379
2015	CHK-USSN02	15-Oct-15	Recapture	SN	DV	130			989001003764918
2015	CHK-USSN02	15-Oct-15	Recapture	SN	DV	130			989001004690452
2015	CHK-USSN02	15-Oct-15	Recapture	SN	DV	135			989001003764386
2015	CHK-USSN02	15-Oct-15	Recapture	SN	DV	135			
2015	CHK-USSN02	15-Oct-15	Recapture	SN	DV	150			989001003764916

[1] SN = snorkelling, MT = minnow trapping.
[2] DV = Dolly Varden.

Table 2. (Continued).

Year	Waypoint/Site Name	Date	Sampling Objective	Capture Method[1]	Species[2]	Estimated Length (mm)	Measured Length (mm)	Weight (g)	Tag Number
2015	CHK-USSN02	15-Oct-15	Recapture	SN	DV	170	164		989001003764624
2015	CHK-USSN02	15-Oct-15	Recapture	SN	DV	170	199		989001004690415
2015	CHK-USSN02	15-Oct-15	Recapture	SN	DV	175	180	61.4	989001004690486
2015	CHK-USSN03	9-Apr-15	Recapture	SN	DV	75			
2015	CHK-USSN03	9-Apr-15	Recapture	SN	DV	76			
2015	CHK-USSN03	9-Apr-15	Recapture	SN	DV	120	115	13.8	989001003764974
2015	CHK-USSN03	9-Apr-15	Recapture	SN	DV	120			
2015	CHK-USSN03	9-Apr-15	Recapture	SN	DV	150	149	30.7	989001003764364
2015	CHK-USSN03	9-Apr-15	Recapture	SN	DV	170			
2015	CHK-USSN03	9-Apr-15	Recapture	SN	DV	190			
2015	CHK-USSN03	9-Apr-15	Recapture	SN	DV	210			
2015	CHK-USSN03	9-Apr-15	Recapture	SN	DV		74	4.1	
2015	CHK-USSN03	9-Apr-15	Recapture	SN	DV		114	13.6	989001003764313
2015	CHK-USSN03	9-Apr-15	Recapture	SN	DV		114	14.7	989001003764380
2015	CHK-USSN03	9-Apr-15	Recapture	SN	DV		130	20.8	989001003764334
2015	CHK-USSN03	9-Apr-15	Recapture	SN	DV		141	32.8	989001003764408
2015	CHK-USSN03	9-Apr-15	Recapture	SN	DV		148	29.2	989001003764317
2015	CHK-USSN03	9-Apr-15	Recapture	SN	DV		171	44.2	989001003764885
2015	CHK-USSN03	9-Apr-15	Recapture	SN	DV		196	62.1	989001003764688
2015	CHK-USSN03	9-Apr-15	Recapture	SN	DV		209	72.6	989001003765002
2015	CHK-USSN03	15-Oct-15	Recapture	SN	DV	110	108	12.1	989001004690564
2015	CHK-USSN03	15-Oct-15	Recapture	SN	DV	110	109	14.8	989001004690557
2015	CHK-USSN03	15-Oct-15	Recapture	SN	DV	110			989001004690402
2015	CHK-USSN03	15-Oct-15	Recapture	SN	DV	110			989001004690457
2015	CHK-USSN03	15-Oct-15	Recapture	SN	DV	110			989001004690471
2015	CHK-USSN03	15-Oct-15	Recapture	SN	DV	120	126	22.1	989001003764315
2015	CHK-USSN03	15-Oct-15	Recapture	SN	DV	120			989001003764398
2015	CHK-USSN03	15-Oct-15	Recapture	SN	DV	120			989001004690398
2015	CHK-USSN03	15-Oct-15	Recapture	SN	DV	120			989001004690417
2015	CHK-USSN03	15-Oct-15	Recapture	SN	DV	120			989001004690463
2015	CHK-USSN03	15-Oct-15	Recapture	SN	DV	130	137	25.3	989001003764974
2015	CHK-USSN03	15-Oct-15	Recapture	SN	DV	130			989001003764313
2015	CHK-USSN03	15-Oct-15	Recapture	SN	DV	130			989001003764317
2015	CHK-USSN03	15-Oct-15	Recapture	SN	DV	130			989001004690447
2015	CHK-USSN03	15-Oct-15	Recapture	SN	DV	130			
2015	CHK-USSN03	15-Oct-15	Recapture	SN	DV	170			989001004690429
2015	CHK-USSN03	15-Oct-15	Recapture	SN	DV	210	236	113.6	989001004690536
2015	CHK-USSN04	15-Oct-15	Recapture	SN	DV	70	75	4.1	
2015	CHK-USSN04	15-Oct-15	Recapture	SN	DV	100			989001004690441
2015	CHK-USSN04	15-Oct-15	Recapture	SN	DV	120			989001004690437
2015	CHK-USSN04	15-Oct-15	Recapture	SN	DV	130			989001003764400
2015	CHK-USSN04	15-Oct-15	Recapture	SN	DV	140			
2015	CHK-USSN04	15-Oct-15	Recapture	SN	DV	180	189		989001004690435
2015	CHK-USSN04	15-Oct-15	Recapture	SN	DV	190	218	81.9	989001003764929
2015	CHK-USSN05	15-Oct-15	Recapture	SN	DV	110	109	12.6	989001004690558
2015	CHK-USSN05	15-Oct-15	Recapture	SN	DV	120	115		989001004690523
2015	CHK-USSN05	15-Oct-15	Recapture	SN	DV	125			989001003764952
2015	CHK-USSN05	15-Oct-15	Recapture	SN	DV	125			989001004690395
2015	CHK-USSN05	15-Oct-15	Recapture	SN	DV	125			989001004690424
2015	CHK-USSN05	15-Oct-15	Recapture	SN	DV	140	138		989001004690549
2015	CHK-USSN05	15-Oct-15	Recapture	SN	DV	140			
2015	CHK-USSN05	15-Oct-15	Recapture	SN	DV	160			989001004690393
2015	CHK-USSN06	15-Oct-15	Recapture	SN	DV	60	71	3.5	
2015	CHK-USSN06	15-Oct-15	Recapture	SN	DV	90	99	10.1	989001004690534

[1] SN = snorkelling, MT = minnow trapping.
[2] DV = Dolly Varden.

Table 2. (Continued).

Year	Waypoint/Site Name	Date	Sampling Objective	Capture Method[1]	Species[2]	Estimated Length (mm)	Measured Length (mm)	Weight (g)	Tag Number
2015	CHK-USSN06	15-Oct-15	Recapture	SN	DV	100	105	11.6	989001004690537
2015	CHK-USSN06	15-Oct-15	Recapture	SN	DV	110	105	11.3	989001004690526
2015	CHK-USSN06	15-Oct-15	Recapture	SN	DV	110	111	13.4	989001004690502
2015	CHK-USSN06	15-Oct-15	Recapture	SN	DV	110			989001004690410
2015	CHK-USSN06	15-Oct-15	Recapture	SN	DV	110			989001004690568
2015	CHK-USSN06	15-Oct-15	Recapture	SN	DV	110			
2015	CHK-USSN06	15-Oct-15	Recapture	SN	DV	120	104	10.9	989001004690497
2015	CHK-USSN06	15-Oct-15	Recapture	SN	DV	120	122	17.8	989001003764945
2015	CHK-USSN06	15-Oct-15	Recapture	SN	DV	120			989001004690496
2015	CHK-USSN06	15-Oct-15	Recapture	SN	DV	130	135	22.6	989001004690510
2015	CHK-USSN06	15-Oct-15	Recapture	SN	DV	130	137	25.3	989001004690490
2015	CHK-USSN06	15-Oct-15	Recapture	SN	DV	130			989001004690483
2015	CHK-USSN06	15-Oct-15	Recapture	SN	DV	130			989001004690540
2015	CHK-USSN06	15-Oct-15	Recapture	SN	DV	135	123	18.2	989001004690480
2015	CHK-USSN06	15-Oct-15	Recapture	SN	DV	135	126	20.5	989001004690531
2015	CHK-USSN06	15-Oct-15	Recapture	SN	DV	135	134	21.7	989001004690505
2015	CHK-USSN06	15-Oct-15	Recapture	SN	DV	135			989001004690554
2015	CHK-USSN06	15-Oct-15	Recapture	SN	DV	140	139	26.2	989001004690495
2015	CHK-USSN06	15-Oct-15	Recapture	SN	DV	145	151	33	989001004690500
2015	CHK-USSN06	15-Oct-15	Recapture	SN	DV	190	213		989001004690472
2015	CHK-USSN06	15-Oct-15	Recapture	SN	DV	190			
2015	CHK-UDVSN03	8-Apr-15	Re-Sight Index	SN	DV	100			
2015	CHK-UDVSN03	8-Apr-15	Re-Sight Index	SN	DV	120			
2015	CHK-UDVSN03	8-Apr-15	Re-Sight Index	SN	DV	160			
2015	CHK-UDVSN03	8-Apr-15	Re-Sight Index	SN	DV	180			
2015	CHK-UDVSN03	8-Apr-15	Re-Sight Index	SN	DV	220			
2015	CHK-UDVSN04	8-Apr-15	Re-Sight Index	SN	DV	80			
2015	CHK-UDVSN04	8-Apr-15	Re-Sight Index	SN	DV	120			
2015	CHK-UDVSN04	8-Apr-15	Re-Sight Index	SN	DV	150			
2015	CHK-UDVSN04	8-Apr-15	Re-Sight Index	SN	DV	160			
2015	CHK-UDVSN04	8-Apr-15	Re-Sight Index	SN	DV	200			
2015	CHK-UDVSN05	8-Apr-15	Re-Sight Index	SN	DV	120			
2015	CHK-UDVSN05	8-Apr-15	Re-Sight Index	SN	DV	150			
2015	CHK-UDVSN05	8-Apr-15	Re-Sight Index	SN	DV	180			
2015	CHK-USSN01	9-Apr-15	Re-Sight Index	SN	DV	75			
2015	CHK-USSN01	9-Apr-15	Re-Sight Index	SN	DV	120			
2015	CHK-USSN01	9-Apr-15	Re-Sight Index	SN	DV	140			
2015	CHK-USSN01	9-Apr-15	Re-Sight Index	SN	DV	150			
2015	CHK-USSN01	9-Apr-15	Re-Sight Index	SN	DV	160			
2015	CHK-USSN01	9-Apr-15	Re-Sight Index	SN	DV	170			
2015	CHK-USSN01	9-Apr-15	Re-Sight Index	SN	DV	180			
2015	CHK-USSN02	9-Apr-15	Re-Sight Index	SN	DV	70			
2015	CHK-USSN02	9-Apr-15	Re-Sight Index	SN	DV	100			
2015	CHK-USSN02	9-Apr-15	Re-Sight Index	SN	DV	110			
2015	CHK-USSN02	9-Apr-15	Re-Sight Index	SN	DV	120			
2015	CHK-USSN02	9-Apr-15	Re-Sight Index	SN	DV	130			
2015	CHK-USSN02	9-Apr-15	Re-Sight Index	SN	DV	150			
2015	CHK-USSN02	9-Apr-15	Re-Sight Index	SN	DV	210			
2015	CHK-USSN03	9-Apr-15	Re-Sight Index	SN	DV	70			
2015	CHK-USSN03	9-Apr-15	Re-Sight Index	SN	DV	80			
2015	CHK-USSN03	9-Apr-15	Re-Sight Index	SN	DV	110			
2015	CHK-USSN03	9-Apr-15	Re-Sight Index	SN	DV	120			
2015	CHK-USSN03	9-Apr-15	Re-Sight Index	SN	DV	140			
2015	CHK-USSN03	9-Apr-15	Re-Sight Index	SN	DV	150			
2015	CHK-USSN03	9-Apr-15	Re-Sight Index	SN	DV	170			
2015	CHK-USSN03	9-Apr-15	Re-Sight Index	SN	DV	190			

[1] SN = snorkelling, MT = minnow trapping.
[2] DV = Dolly Varden.

Table 3. Individual fish data for Chickwat Creek resident fish density mark-recapture in 2016.

Year	Waypoint/Site Name	Date	Sampling Objective	Capture Method[1]	Species[2]	Estimated Length (mm)	Measured Length (mm)	Weight (g)	Tag Number
2016	CHK-LDVEF01	2016-10-05	Index Index	EF	CC		73	5.1	
2016	CHK-LDVEF01	2016-10-05	Index Index	EF	CT		66	3	
2016	CHK-LDVEF01	2016-10-05	Index Index	EF	TR		50	1.5	
2016	CHK-LDVEF01	2016-10-05	Index Index	EF	TR		52	1.7	
2016	CHK-LDVEF01	2016-10-05	Index Index	EF	TR		52	1.8	
2016	CHK-LDVEF01	2016-10-05	Index Index	EF	TR		55	1.7	
2016	CHK-LDVEF02	2016-10-05	Index Index	EF	CO		64	3.6	
2016	CHK-LDVEF02	2016-10-05	Index Index	EF	CO		76	6	
2016	CHK-LDVEF02	2016-10-05	Index Index	EF	CO		79	6.9	
2016	CHK-LDVEF02	2016-10-05	Index Index	EF	CT		53	1.5	
2016	CHK-LDVEF02	2016-10-05	Index Index	EF	CT		53	1.7	
2016	CHK-LDVEF02	2016-10-05	Index Index	EF	CT		55	1.9	
2016	CHK-LDVEF02	2016-10-05	Index Index	EF	RB		95	8.2	
2016	CHK-LDVEF02	2016-10-05	Index Index	EF	TR		41	0.8	
2016	CHK-LDVEF02	2016-10-05	Index Index	EF	TR		64	3.2	
2016	CHK-LDVEF03	2016-10-05	Index Index	EF	CO		95	10	
2016	CHK-LDVEF03	2016-10-05	Index Index	EF	CT		93	7.5	989001006118438
2016	CHK-LDVEF03	2016-10-05	Index Index	EF	CT		101	10.4	989001006118418
2016	CHK-LDVEF03	2016-10-05	Index Index	EF	TR		45	1.2	
2016	CHK-LDVEF03	2016-10-05	Index Index	EF	TR		46	1.2	
2016	CHK-LDVEF03	2016-10-05	Index Index	EF	TR		49	1.3	
2016	CHK-LDVEF03	2016-10-05	Index Index	EF	TR		50	1.3	
2016	CHK-LDVEF03	2016-10-05	Index Index	EF	TR		50	1.5	
2016	CHK-LDVEF03	2016-10-05	Index Index	EF	TR		51	1.7	
2016	CHK-LDVEF03	2016-10-05	Index Index	EF	TR		52	1.9	
2016	CHK-LDVEF03	2016-10-05	Index Index	EF	TR		58	2.4	
2016	CHK-LDVEF04	2016-10-05	Index Index	EF	CT		63	2.6	
2016	CHK-LDVEF04	2016-10-05	Index Index	EF	CT		70	3.7	
2016	CHK-LDVEF04	2016-10-05	Index Index	EF	RB		58	2.9	
2016	CHK-LDVEF04	2016-10-05	Index Index	EF	RB		146	36.3	989001006118481
2016	CHK-LDVEF04	2016-10-05	Index Index	EF	RB		177	58.2	989001006118461
2016	CHK-LDVEF04	2016-10-05	Index Index	EF	TR		50	1.3	
2016	CHK-LDVEF04	2016-10-05	Index Index	EF	TR		50	1.6	
2016	CHK-LDVEF04	2016-10-05	Index Index	EF	TR		51	2	
2016	CHK-LDVEF04	2016-10-05	Index Index	EF	TR		53	1.6	
2016	CHK-LDVEF04	2016-10-05	Index Index	EF	TR		55	2	
2016	CHK-LDVEF05	2016-10-05	Index Index	EF	TR		48	1.4	
2016	CHK-LDVSN01	2016-09-27	Mark Mark	DN	CO		70	3.9	
2016	CHK-LDVSN01	2016-09-27	Mark Mark	DN	CO		74	4.2	
2016	CHK-LDVSN01	2016-09-27	Mark Mark	DN	CO		75	5	
2016	CHK-LDVSN01	2016-09-27	Mark Mark	DN	RB		52	1.3	
2016	CHK-LDVSN01	2016-09-27	Mark Mark	DN	RB		54	1.6	
2016	CHK-LDVSN01	2016-09-27	Mark Mark	DN	RB		57	2	
2016	CHK-LDVSN01	2016-09-27	Mark Mark	DN	RB		64	2.7	
2016	CHK-LDVSN01	2016-09-27	Mark Mark	DN	RB/CT		66	2.8	
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	CO		59	2.3	
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	CO		72	4.2	
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	CO		75	5.1	
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	CO		78	5.5	
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	CT		124	18.5	989001006118273
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	RB		55	2	
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	RB		102	10.6	989001006118295

[1] EF = electrofishing, SN = snorkelling, DN = dip netting, AG = angling.
[2] CC = Sculpin (General), CT = Cutthroat Trout, TR = Unidentifiable Trout, CO = Coho Salmon, RB = Rainbow Trout, DV = Dolly Varden, UNK = Unknown species.

Table 3. (Continued).

Year	Waypoint/Site Name	Date	Sampling Objective	Capture Method[1]	Species[2]	Estimated Length (mm)	Measured Length (mm)	Weight (g)	Tag Number
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	RB		104	11.2	989001006118303
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	RB		109	12.9	989001006118260
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	RB		109	13.4	989001006118279
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	RB		110	12.6	989001006118301
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	RB		116	14.7	989001006118300
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	RB		120	18	989001006118284
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	RB		122	18.3	989001006118246
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	RB		126	21	989001006118256
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	RB		126	21.6	989001006118245
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	RB		140	29.2	989001006118263
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	RB		147	34.5	989001006118297
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	RB		150	39.3	989001006118235
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	RB		156	40.1	989001006118257
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	RB		166	50.5	989001006118296
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	RB		171	54.1	989001006118255
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	RB		173	53.1	989001006118287
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	RB		177	58.7	989001006118275
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	RB		178	59.3	989001006118294
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	RB		189	72.3	989001006118258
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	RB		196	82.1	989001006118238
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	RB		199	89.9	989001006118281
2016	CHK-LDVSN01	2016-09-27	Mark Mark	SN	RB/CT		124	19.6	989001006118280
2016	CHK-LDVSN02	2016-09-27	Mark Mark	DN	CO		74	4.9	
2016	CHK-LDVSN02	2016-09-27	Mark Mark	DN	RB		44	1	
2016	CHK-LDVSN02	2016-09-27	Mark Mark	DN	RB		50	1.1	
2016	CHK-LDVSN02	2016-09-27	Mark Mark	DN	RB		51	1.5	
2016	CHK-LDVSN02	2016-09-27	Mark Mark	DN	RB		57	2	
2016	CHK-LDVSN02	2016-09-27	Mark Mark	DN	RB		59	2.1	
2016	CHK-LDVSN02	2016-09-27	Mark Mark	DN	RB		61	2.3	
2016	CHK-LDVSN02	2016-09-27	Mark Mark	DN	RB		69	3.8	
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	CO		80	5.4	
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	CO		94	9.1	
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	CT		127	19.7	989001006118274
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		54	1.5	
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		71	3.8	989001006118298
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		102	10.7	989001006118269
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		103	12.2	989001006118239
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		109	12.2	989001006118236
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		110	14.3	989001006118259
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		110	14.5	989001006118208
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		115	14.2	989001006118227
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		115	16.7	989001006118247
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		116	14	989001006118266
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		119	18.1	989001006118230
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		125	18.5	989001006118290
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		125	19.8	989001016118265
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		131	23.4	989001006118292
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		131	24.5	989001006118248
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		132	26	989001006118231
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		133	23.8	989001006118299
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		146	33.3	989001006118286
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		148	34.2	989001006118282
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		154	36.8	989001006118222
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		157	36.5	989001006118289

[1] EF = electrofishing, SN = snorkelling, DN = dip netting, AG = angling.
[2] CC = Sculpin (General), CT = Cutthroat Trout, TR = Unidentifiable Trout, CO = Coho Salmon, RB = Rainbow Trout, DV = Dolly Varden, UNK = Unknown species.

Table 3. (Continued).

Year	Waypoint/Site Name	Date	Sampling Objective	Capture Method[1]	Species[2]	Estimated Length (mm)	Measured Length (mm)	Weight (g)	Tag Number
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		165	54.7	989001006118293
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		167	48.9	989001006118261
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		168	49.9	989001006118242
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		170	51.6	989001006118264
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		170	53.3	989001006118241
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		192	74.2	989001006118302
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		193	81.5	989001006118277
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		208	94.4	989001006118283
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		211	96.8	989001006118250
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB		242	151	989001006118229
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB/CT		113	14.8	989001006118285
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	RB/CT		210	93.1	989001006118278
2016	CHK-LDVSN02	2016-09-27	Mark Mark	SN	TR		48	1.1	
2016	CHK-LDVSN03	2016-09-27	Mark Mark	DN	CT		143	29.1	989001006118288
2016	CHK-LDVSN03	2016-09-27	Mark Mark	DN	RB		56	1.9	
2016	CHK-LDVSN03	2016-09-27	Mark Mark	DN	RB		59	2.2	
2016	CHK-LDVSN03	2016-09-27	Mark Mark	DN	RB		61	2.4	
2016	CHK-LDVSN03	2016-09-27	Mark Mark	DN	RB		61	2.5	
2016	CHK-LDVSN03	2016-09-27	Mark Mark	DN	RB		64	2.7	
2016	CHK-LDVSN03	2016-09-27	Mark Mark	DN	RB		156	38	989001006118226
2016	CHK-LDVSN03	2016-09-27	Mark Mark	DN	TR		41	0.8	
2016	CHK-LDVSN03	2016-09-27	Mark Mark	DN	TR		48	1.3	
2016	CHK-LDVSN03	2016-09-27	Mark Mark	DN	TR		49	1.2	
2016	CHK-LDVSN03	2016-09-27	Mark Mark	DN	TR		51	1.4	
2016	CHK-LDVSN03	2016-09-27	Mark Mark	DN	TR		52	1.7	
2016	CHK-LDVSN03	2016-09-27	Mark Mark	DN	TR		54	1.5	
2016	CHK-LDVSN03	2016-09-27	Mark Mark	DN	TR		55	2	
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	CO		87	7.8	
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	CT		83	5.6	989001006118219
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	CT		106	10.7	989001006118224
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	CT		109	12.4	989001006118268
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	CT		154	36.4	989001006118212
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	CT		209	84.8	989001006118221
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	CT		216	92.2	989001006118205
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	CT		265	183	989001006118209
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	DV		123	21	989001006118244
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		61	2.5	
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		67	3.1	
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		69	3.4	
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		102	10	989001006118211
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		105	11.8	989001006118249
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		105	12.9	989001006118253
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		111	14.3	989001006118251
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		113	13.5	989001006118207
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		115	14.9	989001006118228
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		117	15.6	989001006118214
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		117	15.9	989001006118217
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		122	18.5	989001006118206
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		123	20	989001006118225
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		126	20.4	989001006118204
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		128	21	989001006118220
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		130	20.2	989001006118270
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		134	23.9	989001006118252
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		135	26.2	989001006118240
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		135	27.2	989001006118218
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		136	24.1	989001006118216

[1] EF = electrofishing, SN = snorkelling, DN = dip netting, AG = angling.

[2] CC = Sculpin (General), CT = Cutthroat Trout, TR = Unidentifiable Trout, CO = Coho Salmon, RB = Rainbow Trout, DV = Dolly Varden, UNK = Unknown species.

Table 3. (Continued).

Year	Waypoint/Site Name	Date	Sampling Objective	Capture Method[1]	Species[2]	Estimated Length (mm)	Measured Length (mm)	Weight (g)	Tag Number
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		138	25.4	989001006118233
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		141	25.5	989001006118267
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		147	30.3	989001006118272
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		155	35.3	989001006118276
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		161	35.9	989001006118291
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		166	49.4	989001006118223
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		167	45.5	989001006118213
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		167	47.3	989001006118234
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		176	62.6	989001006118254
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		181	61.3	989001006118215
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		198	83.5	989001006118271
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		200	73.2	989001006118262
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		234	133.8	989001006118232
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	RB		278	221	989001006118237
2016	CHK-LDVSN03	2016-09-27	Mark Mark	SN	TR		49	1.1	
2016	CHK-LDVSN04	2016-09-28	Mark Mark	DN	RB		54	1.7	
2016	CHK-LDVSN04	2016-09-28	Mark Mark	DN	RB		55	1.9	
2016	CHK-LDVSN04	2016-09-28	Mark Mark	DN	RB		64	2.8	
2016	CHK-LDVSN04	2016-09-28	Mark Mark	DN	TR		40	0.8	
2016	CHK-LDVSN04	2016-09-28	Mark Mark	DN	TR		45	0.9	
2016	CHK-LDVSN04	2016-09-28	Mark Mark	DN	TR		50	1.3	
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	CT		102	10.8	989001006118693
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	CT		126	18.8	989001006118701
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	CT		130	21	989001006118684
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	CT		133	21	989001006118699
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	CT		133	22.4	989001006118696
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	CT		136	24.2	989001006118687
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	CT		156	35	989001006118667
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	CT		159	43.9	989001006118677
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	CT		163	42	989001006118690
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	CT		164	39.2	989001006118670
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	CT		185	58.2	989001006118647
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	CT		237	132.9	989001006118689
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	RB		55	1.9	
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	RB		65	3	
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	RB		68	3.3	
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	RB		68	3.6	
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	RB		70	3.6	
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	RB		108	12.2	989001006118653
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	RB		110	14.7	989001006118688
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	RB		114	16	989001006118658
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	RB		117	16.3	989001006118665
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	RB		124	19.7	989001006118686
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	RB		125	20.3	989001006118697
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	RB		140	28.2	989001006118633
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	RB		157	41.7	989001006118679
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	RB		162	44.4	989001006118644
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	RB		169	55.1	989001006118643
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	RB		173	57.2	989001006118608
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	RB		182	62.7	989001006118702
2016	CHK-LDVSN04	2016-09-28	Mark Mark	SN	RB		198	79.9	989001006118700
2016	CHK-LDVSN05	2016-09-28	Mark Mark	DN	CT		119	15.8	989001006118621
2016	CHK-LDVSN05	2016-09-28	Mark Mark	DN	TR		50	1.2	
2016	CHK-LDVSN05	2016-09-28	Mark Mark	DN	TR		53	1.6	
2016	CHK-LDVSN05	2016-09-28	Mark Mark	DN	TR		60	2.6	
2016	CHK-LDVSN05	2016-09-28	Mark Mark	DN	TR		65	2.8	

[1] EF = electrofishing, SN = snorkelling, DN = dip netting, AG = angling.
[2] CC = Sculpin (General), CT = Cutthroat Trout, TR = Unidentifiable Trout, CO = Coho Salmon, RB = Rainbow Trout, DV = Dolly Varden, UNK = Unknown species.

Table 3. (Continued).

Year	Waypoint/Site Name	Date	Sampling Objective	Capture Method[1]	Species[2]	Estimated Length (mm)	Measured Length (mm)	Weight (g)	Tag Number
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	CO				
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	CT		119	15.5	989001006118646
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	CT		119	16.7	989001006118638
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	CT		120	17.5	989001006118619
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	CT		124	17.3	989001006118680
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	CT		130	20.5	989001006118681
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	CT		133	21	989001006118624
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	CT		138	23.7	989001006118656
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	CT		153	34.1	989001006118674
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	CT		164	41.1	989001006118627
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	CT		166	42.7	989001006118661
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	CT		187	64.7	989001006118645
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	CT		189	60.1	989001006118649
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	CT		215	95.9	989001006118611
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	CT		259	183.9	989001006118660
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	RB		50	1.4	
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	RB		115	14.6	989001006118635
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	RB		122	18.9	989001006118628
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	RB		122	19.5	989001006118630
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	RB		123	20.1	989001006118669
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	RB		127	21.3	989001006118664
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	RB		129	20.8	989001006118663
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	RB		138	25.1	989001006118606
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	RB		143	29.4	989001006118615
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	RB		152		989001006118698
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	RB		161	42.3	989001006118685
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	RB		163	45.2	989001006118625
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	RB		165	47.2	989001006118676
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	RB		169	50.2	989001006118614
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	RB		180	65.6	989001006118639
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	RB		185	65.3	989001006118673
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	RB		185	65.4	989001006118659
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	RB		190	72.8	989001006118668
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	RB		231	136.5	989001006118625
2016	CHK-LDVSN05	2016-09-28	Mark Mark	SN	TR		54	1.8	
2016	TZN-SN01	2016-09-29	Mark Mark	DN	CT		70	3.6	
2016	TZN-SN01	2016-09-29	Mark Mark	DN	TR		37	0.4	
2016	TZN-SN01	2016-09-29	Mark Mark	SN	CT		103	11.3	989001006118692
2016	TZN-SN01	2016-09-29	Mark Mark	SN	CT		106	12.5	989001006118637
2016	TZN-SN01	2016-09-29	Mark Mark	SN	CT		113	15.9	989001006118675
2016	TZN-SN01	2016-09-29	Mark Mark	SN	CT		116	16.9	989001006118678
2016	TZN-SN01	2016-09-29	Mark Mark	SN	CT		121	17.5	989001006118634
2016	TZN-SN01	2016-09-29	Mark Mark	SN	CT		133	22.3	989001006118623
2016	TZN-SN01	2016-09-29	Mark Mark	SN	CT		138	25.9	989001006118616
2016	TZN-SN01	2016-09-29	Mark Mark	SN	CT		141	27	989001006118641
2016	TZN-SN01	2016-09-29	Mark Mark	SN	CT		145	29.2	989001006118695
2016	TZN-SN01	2016-09-29	Mark Mark	SN	CT		146	32.6	989001006118657
2016	TZN-SN01	2016-09-29	Mark Mark	SN	CT		166	47.3	989001006118605
2016	TZN-SN01	2016-09-29	Mark Mark	SN	CT		168	47.2	989001006118671
2016	TZN-SN01	2016-09-29	Mark Mark	SN	CT		192	69.2	989001006118642
2016	TZN-SN01	2016-09-29	Mark Mark	SN	CT		196	77.3	989001006118655
2016	TZN-SN01	2016-09-29	Mark Mark	SN	CT		240	131.1	989001006118626
2016	TZN-SN01	2016-09-29	Mark Mark	SN	CT		255	160.7	989001006118636
2016	TZN-SN01	2016-09-29	Mark Mark	SN	CT		293	227	989001006118703
2016	TZN-SN02	2016-09-29	Mark Mark	SN	CT		96	9.2	989001006118582
2016	TZN-SN02	2016-09-29	Mark Mark	SN	CT		102	11	989001006118593

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Table 3. (Continued).

Year	Waypoint/Site Name	Date	Sampling Objective	Capture Method[1]	Species[2]	Estimated Length (mm)	Measured Length (mm)	Weight (g)	Tag Number
2016	TZN-SN02	2016-09-29	Mark Mark	SN	CT		124	19	989001006118601
2016	TZN-SN02	2016-09-29	Mark Mark	SN	CT		126	17.7	989001006118567
2016	TZN-SN02	2016-09-29	Mark Mark	SN	CT		141	30	989001006118571
2016	TZN-SN02	2016-09-29	Mark Mark	SN	CT		143	30	989001006118565
2016	TZN-SN02	2016-09-29	Mark Mark	SN	CT		145	29.2	989001006118537
2016	TZN-SN02	2016-09-29	Mark Mark	SN	CT		147	29.7	989001006118574
2016	TZN-SN02	2016-09-29	Mark Mark	SN	CT		155	35.3	989001006118550
2016	TZN-SN02	2016-09-29	Mark Mark	SN	CT		188	66.8	989001006118522
2016	TZN-SN02	2016-09-29	Mark Mark	SN	CT		198	73.4	989001006118504
2016	TZN-SN02	2016-09-29	Mark Mark	SN	CT		226	117.7	989001006118527
2016	TZN-SN02	2016-09-29	Mark Mark	SN	CT		230	120.9	989001006118581
2016	TZN-SN02	2016-09-29	Mark Mark	SN	CT		260	165.6	989001006118603
2016	TZN-SN03	2016-10-29	Mark Mark	DN	CT		69	3.8	
2016	TZN-SN03	2016-10-29	Mark Mark	SN	CT		99	10.5	989001006118556
2016	TZN-SN03	2016-10-29	Mark Mark	SN	CT		116	14.2	989001006118520
2016	TZN-SN03	2016-10-29	Mark Mark	SN	CT		121	18.2	989001006118577
2016	TZN-SN03	2016-10-29	Mark Mark	SN	CT		123	18.9	989001006118543
2016	TZN-SN03	2016-10-29	Mark Mark	SN	CT		126	21.2	989001006118632
2016	TZN-SN03	2016-10-29	Mark Mark	SN	CT		127	20.2	989001006118569
2016	TZN-SN03	2016-10-29	Mark Mark	SN	CT		130	20.1	989001006118546
2016	TZN-SN03	2016-10-29	Mark Mark	SN	CT		139	27.1	989001006118640
2016	TZN-SN03	2016-10-29	Mark Mark	SN	CT		139	27.4	989001006118617
2016	TZN-SN03	2016-10-29	Mark Mark	SN	CT		141	27.3	989001006118609
2016	TZN-SN03	2016-10-29	Mark Mark	SN	CT		142	31.6	989001006118589
2016	TZN-SN03	2016-10-29	Mark Mark	SN	CT		154	35.5	989001006118384
2016	TZN-SN03	2016-10-29	Mark Mark	SN	CT		173	51	989001006118509
2016	TZN-SN03	2016-10-29	Mark Mark	SN	CT		180	55.6	989001006118599
2016	TZN-SN03	2016-10-29	Mark Mark	SN	CT		189	71.5	989001006118560
2016	TZN-SN03	2016-10-29	Mark Mark	SN	CT		199	78.2	989001006118513
2016	TZN-SN03	2016-10-29	Mark Mark	SN	CT		200	82.9	989001006118542
2016	TZN-SN03	2016-10-29	Mark Mark	SN	CT		202	81.3	989001006118545
2016	TZN-SN03	2016-10-29	Mark Mark	SN	CT		225	114.6	989001006118541
2016	TZN-SN03	2016-10-29	Mark Mark	SN	CT		263	167.4	989001006118518
2016	TZN-SN03	2016-10-29	Mark Mark	SN	DV		118	16.4	989001006118597
2016	TZN-SN04	2016-10-29	Mark Mark	DN	CT		138	25.2	989001006118570
2016	TZN-SN04	2016-10-29	Mark Mark	SN	CT		113	13.6	989001006118530
2016	TZN-SN04	2016-10-29	Mark Mark	SN	CT		118	16.8	989001006118555
2016	TZN-SN04	2016-10-29	Mark Mark	SN	CT		124	19.4	989001006118528
2016	TZN-SN04	2016-10-29	Mark Mark	SN	CT		125	20.3	989001006118580
2016	TZN-SN04	2016-10-29	Mark Mark	SN	CT		138	25.8	989001006118526
2016	TZN-SN04	2016-10-29	Mark Mark	SN	CT		143	29.3	989001006118519
2016	TZN-SN04	2016-10-29	Mark Mark	SN	CT		149	32.2	989001006118516
2016	TZN-SN04	2016-10-29	Mark Mark	SN	CT		150	39.2	989001006118559
2016	TZN-SN04	2016-10-29	Mark Mark	SN	CT		153	33.1	989001006118525
2016	TZN-SN04	2016-10-29	Mark Mark	SN	CT		173	50.1	989001006118591
2016	TZN-SN04	2016-10-29	Mark Mark	SN	CT		173	50.6	989001006118539
2016	TZN-SN04	2016-10-29	Mark Mark	SN	CT		173	53.4	989001006118648
2016	TZN-SN04	2016-10-29	Mark Mark	SN	CT		190	70.3	989001006118515
2016	TZN-SN04	2016-10-29	Mark Mark	SN	CT		209	89.8	989001006118529
2016	TZN-SN04	2016-10-29	Mark Mark	SN	CT		230	122.2	989001006118578
2016	TZN-SN05	2016-10-28	Mark Mark	SN	CT		96	8.8	989001006118694
2016	TZN-SN05	2016-10-28	Mark Mark	SN	CT		114	15.5	989001006118683
2016	TZN-SN05	2016-10-28	Mark Mark	SN	CT		117	16	989001006118612
2016	TZN-SN05	2016-10-28	Mark Mark	SN	CT		125	18.9	989001006118604
2016	TZN-SN05	2016-10-28	Mark Mark	SN	CT		129	22.3	989001006118618
2016	TZN-SN05	2016-10-28	Mark Mark	SN	CT		132	23.4	989001006118610

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Table 3. (Continued).

Year	Waypoint/Site Name	Date	Sampling Objective	Capture Method[1]	Species[2]	Estimated Length (mm)	Measured Length (mm)	Weight (g)	Tag Number
2016	TZN-SN05	2016-10-28	Mark Mark	SN	CT		164	41	989001006118662
2016	TZN-SN05	2016-10-28	Mark Mark	SN	CT		178	54.8	989001006118648
2016	TZN-SN05	2016-10-28	Mark Mark	SN	CT		184	58.8	989001006118620
2016	TZN-SN05	2016-10-28	Mark Mark	SN	CT		202	83.6	989001006118631
2016	TZN-SN05	2016-10-28	Mark Mark	SN	CT		205	92	989001006118629
2016	TZN-SN05	2016-10-28	Mark Mark	SN	CT		217	105.5	989001006118654
2016	TZN-SN05	2016-10-28	Mark Mark	SN	CT		255	164.4	989001006118651
2016	TZN-SN05	2016-10-28	Mark Mark	SN	DV		131	20	989001006118666
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	DN	CO		74	4.6	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	DN	CO		81	6	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	DN	CT		63	2.6	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	DN	CT		65	2.9	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	DN	RB		64	2.5	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	DN	RB		66	2.8	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	DN	RB		199	86.9	989001006118281
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	DN	TR		47	1	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	DN	TR		51	1.1	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	DN	TR		51	1.3	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	DN	TR		51	1.4	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	DN	TR		56	1.9	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	DN	TR		57	1.9	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	DN	TR		57	2	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	CO		71	3.9	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	CO		75	4.7	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	CO		76	5.1	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	CO		80	6	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	CO		83	6.3	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	CO		90	8.1	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	CT		60	2.1	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	CT		64	2.7	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	CT		65	2.8	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	CT		67	3.1	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	CT		76	4.3	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	CT		108	11.7	989001006118510
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	CT		116	14.4	989001006118551
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	CT		124	18.3	989001006118273
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	CT		124	19.9	989001006118280
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	CT		147	28.8	989001006118552
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	CT		156	35	989001006118572
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	RB		65	2.8	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	RB		70	3.5	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	RB		102	10.3	989001006118295
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	RB		104	11.7	989001006118303
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	RB		112	13.4	989001006118467
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	RB		115	14.8	989001006118458
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	RB		118	15.2	989001006118464
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	RB		118	16.9	989001006118466
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	RB		122	17.8	989001006118246
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	RB		123	19.4	989001006118455
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	RB		125	19.1	989001006118290
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	RB		126	19.8	989001006118256
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	RB		131	23.5	989001006118514
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	RB		132	24.9	989001006118231
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	RB		134	23.5	989001006118579
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	RB		140	28.1	989001006118263
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	RB		147	35.9	989001006118590

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Table 3. (Continued).

Year	Waypoint/Site Name	Date	Sampling Objective	Capture Method[1]	Species[2]	Estimated Length (mm)	Measured Length (mm)	Weight (g)	Tag Number
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	RB		149	38.4	989001006118235
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	RB		150		989001006118300
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	RB		156	35.1	989001006118257
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	RB		165	47.1	989001006118558
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	RB		167	47.1	989001006118482
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	RB		172	51.5	989001006118287
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	RB		178	57.7	989001006118294
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	RB		190	72.1	989001006118258
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	TR		54	1.8	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	TR		55	1.7	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	TR		57	1.9	
2016	CHK-LDVSN01	2016-10-04	Recap Recapture	SN	TR		59	2.3	
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	DN	CO		74	4.7	
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	DN	CT		123	19.3	989001006118491
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	DN	RB		65	2.9	
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	DN	RB		119	15.7	989001006118503
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	DN	TR		47	1.1	
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	DN	TR		52	1.4	
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	CO		77	5	
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	CO		79	5.2	
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	CO		82	6.1	
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	CO		82	7.2	
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	CO		85	7.8	
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	CO		89	7.9	
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	CO		90	8.7	
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	CO		93	9.1	
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	CO		98	10.4	
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	CT		114	13.5	989001006118487
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	CT		123	17.7	989001006118494
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	CT		128	19.3	989001006118274
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	CT		128	20.7	989001006118475
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	CT		146	35	989001006118468
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	CT		176	54.3	989001006118451
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	CT		199	77.7	989001006118492
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	CT		208	92.1	989001006118278
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	RB		65	2.8	
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	RB		68	3.4	
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	RB		70	3.2	
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	RB		93	8	989001006118499
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	RB		113	14.6	989001006118285
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	RB		114	14.8	989001006118493
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	RB		116	13.9	989001006118266
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	RB		122	16.3	989001006118456
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	RB		126	19.7	989001006118265
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	RB		127	20.3	989001006118475
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	RB		128	20.2	989001006118500
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	RB		128	21.4	989001006118498
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	RB		128	21.5	989001006118484
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	RB		132	24.4	989001006118248
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	RB		133	23.1	989001006118299
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	RB		138	26.4	989001006118473
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	RB		147	32.4	989001006118286
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	RB		154	35.5	989001006118222
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	RB		157	35.6	989001006118289
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	RB		166	44.6	989001006118293
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	RB		169	50.4	989001006118264
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	RB		177	55.3	989001006118502
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	RB		193	78.9	989001006118277

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[2] CC = Sculpin (General), CT = Cutthroat Trout, TR = Unidentifiable Trout, CO = Coho Salmon, RB = Rainbow Trout, DV = Dolly Varden, UNK = Unknown species.

Table 3. (Continued).

Year	Waypoint/Site Name	Date	Sampling Objective	Capture Method[1]	Species[2]	Estimated Length (mm)	Measured Length (mm)	Weight (g)	Tag Number
2016	CHK-LDVSN02	2016-10-04	Recap Recapture	SN	RB		206	89.5	989001006118489
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	DN	CO		80	5.9	
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	DN	CT		60	2.2	
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	DN	RB		63	2.6	
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	DN	RB		66	3.2	
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	DN	RB		129	20.8	989001006118441
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	DN	RB		131	23	989001006118419
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	DN	RB		142	31.7	989001006118442
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	DN	TR		49	1.1	
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	DN	TR		49	1.3	
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	DN	TR		50	1.2	
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	DN	TR		51	1.3	
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	DN	TR		52	1.5	
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	DN	TR		53	1.4	
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	DN	TR		54	1.6	
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	DN	TR		55	1.9	
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	DN	TR		57	2.7	
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	DN	TR		58	2.1	
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	CO		95	9.9	
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	CT		60	2.4	
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	CT		137	23.5	989001006118687
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	CT		139	25.7	989001006118486
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	CT		143	26.5	989001006118457
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	CT		166	40.4	989001006118690
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	CT		175	56.2	989001006118450
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	CT		209	84.3	989001006118221
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	CT		266	176.9	989001006118209
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		63	2.6	
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		97	8.8	989001006118490
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		102	9.5	989001006118409
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		102	10.6	989001006118211
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		105	11.5	989001006118447
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		110	12.9	989001006118443
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		110	13.7	989001006118424
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		111	14.2	989001006118251
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		112	13.1	989001006118483
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		112	14.8	989001006118445
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		114	13.3	989001006118410
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		115	14.7	989001006118452
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		116	18.2	989001006118436
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		117	16.3	989001006118449
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		122	17.3	989001006118421
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		123	18.5	989001006118404
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		123	18.5	989001006118412
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		125	19.5	989001006118488
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		126	19.6	989001006118432
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		128	19	989001006118453
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		128	22.3	989001006118428
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		131	20.1	989001006118270
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		133	22.4	989001006118446
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		137	24.8	989001006118471
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		138	26.2	989001006118233
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		146	32.7	989001006118422
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		155	39	989001006118496
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		155	39.8	989001006118463
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		155	40	989001006118416
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		166	49	989001006118223
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		167	44.5	989001006118478

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Table 3. (Continued).

Year	Waypoint/Site Name	Date	Sampling Objective	Capture Method[1]	Species[2]	Estimated Length (mm)	Measured Length (mm)	Weight (g)	Tag Number
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		167	46.7	989001006118234
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		176	61.3	989001006118254
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		182	62.1	989001006118495
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		185	65.2	989001006118472
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		198	82.7	989001006118271
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	RB		200	71.3	989001006118470
2016	CHK-LDVSN03	2016-10-04	Recap Recapture	SN	TR		57	2	
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	DN	RB		56	1.8	
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	DN	RB		59	2.3	
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	DN	RB		67	3.2	
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	DN	RB		108	11.3	989001006118653
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	DN	RB		140	28.7	989001006118633
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	DN	TR		50	1.4	
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	DN	TR		54	1.6	
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	CT		107	12.3	989001006118554
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	CT		121	17	989001006118549
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	CT		132	20.4	989001006118699
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	CT		164	38.7	989001006118670
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	CT		164	40.4	989001006118553
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	CT		183	55.6	989001006118647
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	CT		237	129.1	989001006118564
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	DV		104	11.3	989001006118521
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	RB		73	4.2	989001006118506
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	RB		107	11.2	989001006118563
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	RB		111	14.6	989001006118688
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	RB		114	13.5	989001006118588
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	RB		117	16.1	989001006118665
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	RB		119	16.7	989001006118523
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	RB		123	19.9	989001006118686
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	RB		124	19.5	989001006118575
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	RB		125	20.1	989001006118697
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	RB		149	35	989001006118540
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	RB		157	43	989001006118679
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	RB		162	45.7	989001006118507
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	RB		169	52.8	989001006118643
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	RB		170	49.8	989001006118585
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	RB		182	66.3	989001006118602
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	RB		197	75	989001006118700
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	RB		212	107.2	989001006118584
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	TR		47	1.2	
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	TR		55	1.7	
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	UNK	60			
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	UNK	135			
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	UNK	140			
2016	CHK-LDVSN04	2016-10-03	Recap Recapture	SN	UNK	160			
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	DN	CT		119	15.9	989001006118621
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	DN	CT		129	21.5	989001006118573
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	DN	RB		57	2.1	
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	DN	TR		50	1.4	
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	CT		109	11.5	989001006118544
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	CT		117	14.1	989001006118595
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	CT		117	15.2	989001006118535
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	CT		120	15.6	989001006118562
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	CT		123	16.6	989001006118680
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	CT		124	16.5	989001006118600
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	CT		130	20.1	989001006118681
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	CT		132	22	989001006118538
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	CT		133	21.1	989001006118624
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	CT		139	24.5	989001006118592

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Table 3. (Continued).

Year	Waypoint/Site Name	Date	Sampling Objective	Capture Method[1]	Species[2]	Estimated Length (mm)	Measured Length (mm)	Weight (g)	Tag Number
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	CT		143	29.1	989001006118568
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	CT		157	33.8	989001006118508
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	CT		158	34.4	989001006118586
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	CT		166	40.7	989001006118627
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	CT		179	47.6	989001006118557
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	CT		185	62	989001006118536
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	CT		191	59.2	989001006118649
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	CT		205	86.6	989001006118533
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	DV		169	51.6	989001006118561
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	RB		67	3.6	
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	RB		115	14.5	989001006118635
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	RB		126	22.1	989001006118532
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	RB		127	20.8	989001006118664
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	RB		129	21.8	989001006118576
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	RB		129	22	989001006118534
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	RB		129	22.5	989001006118531
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	RB		143	29	989001006118615
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	RB		145	30.5	989001006118566
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	RB		151	36.6	989001006118517
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	RB		152	35.7	989001006118698
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	RB		161	42	989001006118685
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	RB		164	45.9	989001006118512
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	RB		170	49.7	989001006118614
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	RB		176	55.2	989001006118591
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	RB		180	62.6	989001006118639
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	RB		184	64.1	989001006118659
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	RB		185	64.9	989001006118673
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	RB		189	73.1	989001006118587
2016	CHK-LDVSN05	2016-10-03	Recap Recapture	SN	RB		201	86.6	989001006118594
2016	TZN-EF01	2016-10-06	Recap Recapture	EF	CT		53	1.9	
2016	TZN-EF01	2016-10-06	Recap Recapture	EF	CT		54	1.6	
2016	TZN-EF01	2016-10-06	Recap Recapture	EF	CT		62	2.9	
2016	TZN-EF01	2016-10-06	Recap Recapture	EF	DV		122	17.4	989001006118334
2016	TZN-EF02	2016-10-06	Recap Recapture	EF	DV		96	8.3	989001006118339
2016	TZN-EF04	2016-10-06	Recap Recapture	EF	CT		62	2.6	
2016	TZN-EF04	2016-10-06	Recap Recapture	EF	CT		122	16.9	989001006118327
2016	TZN-EF04	2016-10-06	Recap Recapture	EF	DV		56	1.7	
2016	TZN-EF04	2016-10-06	Recap Recapture	EF	DV		122	18.1	989001006118408
2016	TZN-EF05	2016-10-06	Recap Recapture	EF	CT		102	12.7	989001006118398
2016	TZN-EF05	2016-10-06	Recap Recapture	EF	CT		105	14.1	989001006118329
2016	TZN-SN01	2016-10-05	Recap Recapture	DN	CT		114	16.6	989001006118675
2016	TZN-SN01	2016-10-05	Recap Recapture	DN	CT		141	26.6	989001006118641
2016	TZN-SN01	2016-10-05	Recap Recapture	DN	DV		109	11.8	989001006118411
2016	TZN-SN01	2016-10-05	Recap Recapture	SN	CT	350			
2016	TZN-SN01	2016-10-05	Recap Recapture	SN	CT		93	8.2	989001006118460
2016	TZN-SN01	2016-10-05	Recap Recapture	SN	CT		100	11	989001006118407
2016	TZN-SN01	2016-10-05	Recap Recapture	SN	CT		107	12.3	989001006118637
2016	TZN-SN01	2016-10-05	Recap Recapture	SN	CT		117	16.7	989001006118678
2016	TZN-SN01	2016-10-05	Recap Recapture	SN	CT		118	16.4	989001006118657
2016	TZN-SN01	2016-10-05	Recap Recapture	SN	CT		121	17.4	989001006118634
2016	TZN-SN01	2016-10-05	Recap Recapture	SN	CT		130	21	989001006118448
2016	TZN-SN01	2016-10-05	Recap Recapture	SN	CT		138	25.4	989001006118616
2016	TZN-SN01	2016-10-05	Recap Recapture	SN	CT		141	26.6	989001006118439
2016	TZN-SN01	2016-10-05	Recap Recapture	SN	CT		144	28.2	989001006118695
2016	TZN-SN01	2016-10-05	Recap Recapture	SN	CT		146	30.4	989001006118537
2016	TZN-SN01	2016-10-05	Recap Recapture	SN	CT		146	32.9	989001006118657
2016	TZN-SN01	2016-10-05	Recap Recapture	SN	CT		150	33.9	989001006118465
2016	TZN-SN01	2016-10-05	Recap Recapture	SN	CT		166	46.6	989001006118605
2016	TZN-SN01	2016-10-05	Recap Recapture	SN	CT		192	68.3	989001006118642

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Table 3. (Continued).

Year	Waypoint/Site Name	Date	Sampling Objective	Capture Method[1]	Species[2]	Estimated Length (mm)	Measured Length (mm)	Weight (g)	Tag Number
2016	TZN-SN01	2016-10-05	Recap Recapture	SN	CT		195	77.6	989001006118655
2016	TZN-SN01	2016-10-05	Recap Recapture	SN	CT		229	120	989001006118431
2016	TZN-SN01	2016-10-05	Recap Recapture	SN	CT		231	118.5	989001006118581
2016	TZN-SN01	2016-10-05	Index Recapture	SN	CO				
2016	TZN-SN01	2016-10-05	Index Recapture	SN	CT				
2016	TZN-SN02	2016-10-05	Index Recapture	SN	CT	90			
2016	TZN-SN02	2016-10-05	Index Recapture	SN	CT	140			
2016	TZN-SN02	2016-10-05	Recap Recapture	SN	CT	145			
2016	TZN-SN02	2016-10-05	Recap Recapture	SN	CT		102	10.4	989001006118593
2016	TZN-SN02	2016-10-05	Recap Recapture	SN	CT		103	9.8	989001006118469
2016	TZN-SN02	2016-10-05	Recap Recapture	SN	CT		111	11.8	989001006118414
2016	TZN-SN02	2016-10-05	Recap Recapture	SN	CT		112	13.7	989001006118444
2016	TZN-SN02	2016-10-05	Recap Recapture	SN	CT		120	15.4	989001006118417
2016	TZN-SN02	2016-10-05	Recap Recapture	SN	CT		124	16.5	989001006118429
2016	TZN-SN02	2016-10-05	Recap Recapture	SN	CT		143	29.5	989001006118565
2016	TZN-SN02	2016-10-05	Recap Recapture	SN	CT		148	27.1	989001006118571
2016	TZN-SN02	2016-10-05	Recap Recapture	SN	CT		148	28.4	989001006118406
2016	TZN-SN02	2016-10-05	Recap Recapture	SN	CT		169	43.1	989001006118413
2016	TZN-SN02	2016-10-05	Recap Recapture	SN	CT		227	107.3	989001006118527
2016	TZN-SN02	2016-10-05	Recap Recapture	SN	CT				989001006118603
2016	TZN-SN03	2016-10-05	Recap Recapture	SN	CT		100	10.5	989001006118556
2016	TZN-SN03	2016-10-05	Recap Recapture	SN	CT		110	13.4	989001006118470
2016	TZN-SN03	2016-10-05	Recap Recapture	SN	CT		130	22.3	989001006118546
2016	TZN-SN03	2016-10-05	Recap Recapture	SN	CT		144	27.1	989001006118425
2016	TZN-SN03	2016-10-05	Recap Recapture	SN	CT		147	26.9	989001006118609
2016	TZN-SN03	2016-10-05	Recap Recapture	SN	CT		154	34.6	989001006118524
2016	TZN-SN03	2016-10-05	Recap Recapture	SN	CT		160	40.6	989001006118433
2016	TZN-SN03	2016-10-05	Recap Recapture	SN	CT		173	50.3	989001006118485
2016	TZN-SN03	2016-10-05	Recap Recapture	SN	CT		175	52.9	989001006118462
2016	TZN-SN03	2016-10-05	Recap Recapture	SN	CT		176	50.2	989001006118474
2016	TZN-SN03	2016-10-05	Recap Recapture	SN	CT		181	57.7	989001006118599
2016	TZN-SN03	2016-10-05	Recap Recapture	SN	CT		207	80.5	989001006118545
2016	TZN-SN03	2016-10-05	Recap Recapture	SN	CT		257	155.1	989001006118636
2016	TZN-SN03	2016-10-05	Recap Recapture	SN	CT		263	166.9	989001006118515
2016	TZN-SN03	2016-10-05	Recap Recapture	SN	DV		118	16.5	989001006118597
2016	TZN-SN04	2016-10-05	Recap Recapture	DN	CT		63	2.5	
2016	TZN-SN04	2016-10-05	Recap Recapture	SN	CT	140			
2016	TZN-SN04	2016-10-05	Recap Recapture	SN	CT		105	11.8	989001006118420
2016	TZN-SN04	2016-10-05	Recap Recapture	SN	CT		107	12.2	989001006118459
2016	TZN-SN04	2016-10-05	Recap Recapture	SN	CT		110	12.5	989001006118405
2016	TZN-SN04	2016-10-05	Recap Recapture	SN	CT		126	19.9	989001006118580
2016	TZN-SN04	2016-10-05	Recap Recapture	SN	CT		136	27.6	989001006118423
2016	TZN-SN04	2016-10-05	Recap Recapture	SN	CT		141	25.1	989001006118480
2016	TZN-SN04	2016-10-05	Recap Recapture	SN	CT		151	38.2	989001006118559
2016	TZN-SN04	2016-10-05	Recap Recapture	SN	CT		152	35.2	989001006118497
2016	TZN-SN04	2016-10-05	Recap Recapture	SN	CT		155	38	989001006118437
2016	TZN-SN04	2016-10-05	Recap Recapture	SN	CT		172	50.1	989001006118434
2016	TZN-SN04	2016-10-05	Recap Recapture	SN	CT		230	118.3	989001006118578
2016	TZN-SN04	2016-10-05	Recap Recapture	SN	DV		122	18.1	989001006118408
2016	TZN-SN05	2016-10-05	Recap Recapture	DN	TR	50			
2016	TZN-SN05	2016-10-05	Recap Recapture	SN	CT		96	8.8	989001006118694
2016	TZN-SN05	2016-10-05	Recap Recapture	SN	CT		102	11.4	989001006118378
2016	TZN-SN05	2016-10-05	Recap Recapture	SN	CT		115	16.2	989001006118683
2016	TZN-SN05	2016-10-05	Recap Recapture	SN	CT		117	17.7	989001006118612
2016	TZN-SN05	2016-10-05	Recap Recapture	SN	CT		129	21.7	989001006118330
2016	TZN-SN05	2016-10-05	Recap Recapture	SN	CT		131	21.6	989001006118618
2016	TZN-SN05	2016-10-05	Recap Recapture	SN	CT		135	23.7	989001006118610
2016	TZN-SN05	2016-10-05	Recap Recapture	SN	CT		138	25.3	989001006118435

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Table 3. (Continued).

Year	Waypoint/Site Name	Date	Sampling Objective	Capture Method[1]	Species[2]	Estimated Length (mm)	Measured Length (mm)	Weight (g)	Tag Number
2016	TZN-SN05	2016-10-05	Recap Recapture	SN	CT		143	30.1	989001006118589
2016	TZN-SN05	2016-10-05	Recap Recapture	SN	CT		145	32.9	989001006118454
2016	TZN-SN05	2016-10-05	Recap Recapture	SN	CT		153	36.5	989001006118501
2016	TZN-SN05	2016-10-05	Recap Recapture	SN	CT		161	40.7	989001006118415
2016	TZN-SN05	2016-10-05	Recap Recapture	SN	CT		164	41	989001006118662
2016	TZN-SN05	2016-10-05	Recap Recapture	SN	CT		165	48.8	989001006118389
2016	TZN-SN05	2016-10-05	Recap Recapture	SN	CT		173	54.2	989001006118648
2016	TZN-SN05	2016-10-05	Recap Recapture	SN	CT		178	59.5	989001006118390
2016	TZN-SN05	2016-10-05	Recap Recapture	SN	CT		183	56.2	989001006118620
2016	TZN-SN05	2016-10-05	Recap Recapture	SN	CT		190	69.1	989001006118515
2016	TZN-SN05	2016-10-05	Recap Recapture	SN	CT		195	77.4	989001006118426
2016	TZN-SN05	2016-10-05	Recap Recapture	SN	CT		199	79.5	989001006118513
2016	TZN-SN05	2016-10-05	Recap Recapture	SN	CT		201	82.2	989001006118631
2016	TZN-SN05	2016-10-05	Recap Recapture	SN	CT		206	91.9	989001006118629
2016	TZN-SN05	2016-10-05	Recap Recapture	SN	CT		217	106.3	989001006118654
2016	TZN-SN05	2016-10-05	Recap Recapture	SN	CT		304	294	989001006118318
2016	TZN-SN05	2016-10-05	Recap Recapture	SN	CT				989001006118651
2016	TZN-SN05	2016-10-05	Recap Recapture	SN	DV		112	14.6	989001006118332
2016	CHK-DSAG01	2016-11-30	Reconnaissance	AG	CT		355		
2016	CHK-DSAG01	2016-11-30	Reconnaissance	AG	CT		422		
2016	CHK-DSAG01	2016-11-30	Reconnaissance	AG	CT		428		
2016	CHK-DSAG01	2016-11-30	Reconnaissance	AG	CT		440		

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