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Site C Clean Energy Project

Offset Effectiveness Monitoring for River Road Rock Spurs and Upper Site 109L – 2019

Peace River Fish Community Monitoring Program (Mon-2, Task 2d)
Peace River Physical Habitat Monitoring Program (Mon-3, Task 2c)

Construction Year 5 (2019)

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27 February 2020

REPORT

Site C Clean Energy Project Offset Effectiveness Monitoring

River Road Rock Spurs and Upper Sites 109L - 2019
Peace River Fish Community Monitoring Program (Mon-2, Task 2d)
Peace River Physical Habitat Monitoring Program (Mon-3, Task 2c)

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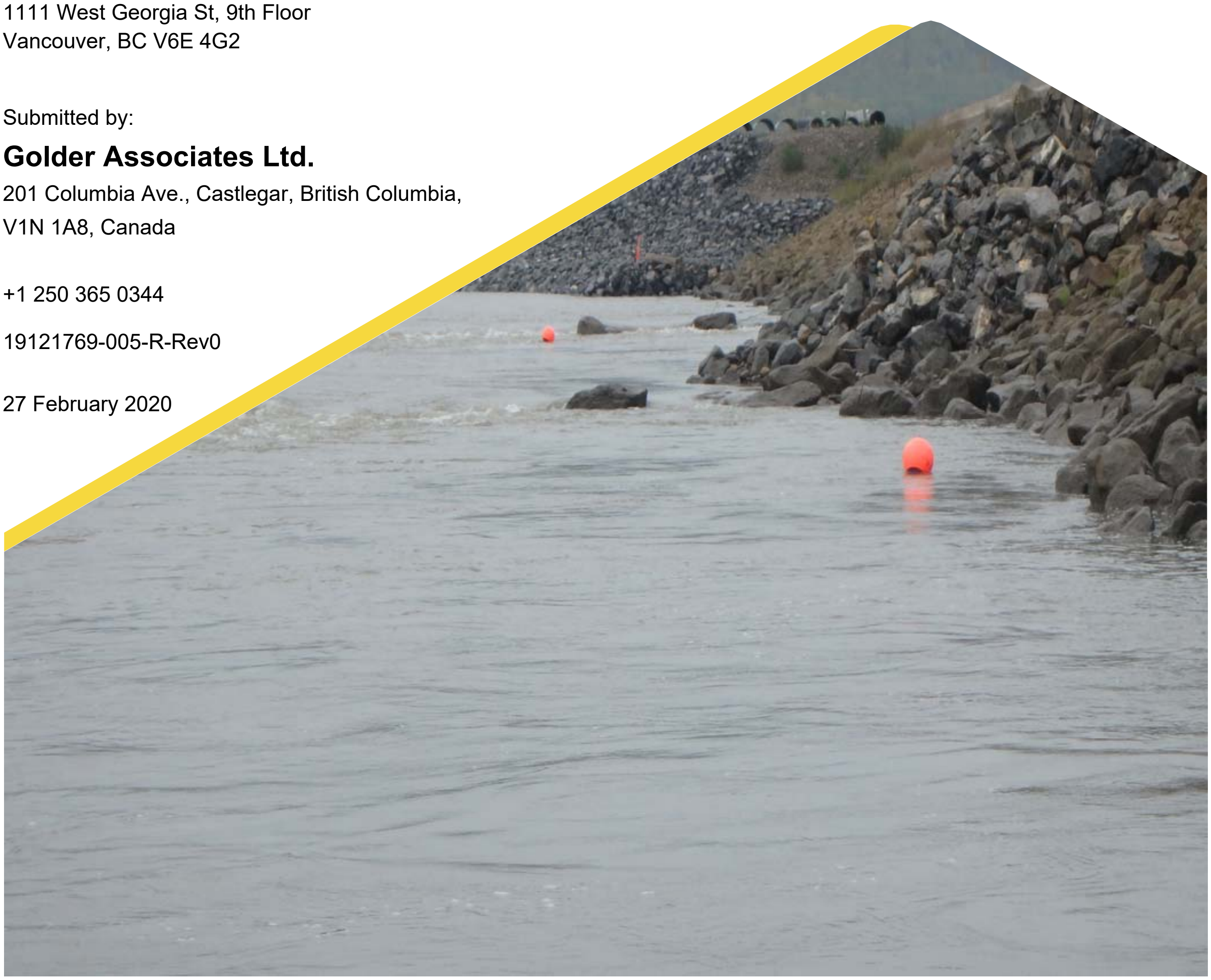

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Executive Summary

Fish and fish habitat are valued components of the Peace River that are considered important by BC Hydro, Aboriginal groups, the public, the scientific community, and government agencies. The Site C Clean Energy Project (the Project), including Project construction, reservoir filling, and operation, could affect fish and fish habitat via three key pathways: changes to fish habitat (including nutrient concentrations and lower trophic biota), changes to fish health and fish survival, and changes to fish movement.

BC Hydro submitted an application to Fisheries and Oceans Canada (DFO) for an authorization under Section 35(2)b of the *Fisheries Act* for several components of the Project associated with Site Preparation. The application included an Offsetting Plan, which proposed the creation of rock spurs along River Road, channel modifications at Upper Site 109L, and channel modifications at Side Channel Site 108R, which were designed to offset unavoidable serious harm to fish as a result of Site Preparation by providing the following (as detailed in the application; BC Hydro 2015):

- increase the quantity and quality of available, permanently wetted habitat to support primary and secondary production as food production for fish and provide rearing, feeding, overwintering, and potential spawning habitats for fish
- reduce fish stranding risk
- increase the complexity and variability of fish habitat to support a variety of life stages for local fish populations

DFO approved the Offsetting Plan and issued a *Fisheries Act* Authorization (FAA; No. 15-HPAC-00170) for site preparation works on 30 September 2015. The FAA requires BC Hydro undertake monitoring and reporting of the implementation of offsetting measures. The objectives of Site C Offset Effectiveness Monitoring are to identify the following (as detailed in the application; BC Hydro 2015):

- that the offsets have been implemented as designed and approved
- that the offsets maintain their design and purpose over time
- that the offsets are biologically effective (i.e., support ongoing productivity)

Construction of two habitat offset areas, the River Road rock spurs and channel modifications at Upper Site 109L, began in 2015 and were completed in 2016. Construction of the third habitat offset area (channel modifications at Side Channel Site 108R) began in October 2018 and was completed in 2019. Effectiveness monitoring at Side Channel Site 108R is scheduled to begin in 2020.

Monitoring the effectiveness of the River Road rock spurs and Upper Site 109L began in 2017 and was continued in 2018. In 2019, the third year of monitoring was completed. This report presents the results of the third and final year of proposed offset effectiveness monitoring for these two offsets.

In 2019, effectiveness monitoring of offset areas focused on the same three components as 2017 and 2018; physical habitat, general fish use, and Mountain Whitefish (*Prosopium williamsoni*) spawning.

Physical habitat was visually assessed to confirm that the rock spurs provided a diversity of hydraulic conditions that were unique to that reach of the Peace River. Water velocity patterns were also assessed using an Acoustic Doppler Profiler (ADP). Where possible, water depth data collected during boat-based and ground-based ADP surveys were compared to data that were similarly collected in 2015, 2017, and 2018. ADP surveys were conducted on 14 September 2019 at eight previously established transect locations. Five of these transects were previously assessed as part of BC Hydro's Site C Fisheries and Aquatic Habitat Monitoring and Follow-up Program (FAHMFP; Golder 2015), and three new transects were established in 2017 for the purposes of offset effectiveness monitoring at Upper Site 109L.

A visual assessment of the rock spur structures and associated bank armouring along River Road indicated that the near-channel area provides more turbulent and variable flow patterns with slower mean water column velocities when compared to the more laminar flows observed towards the mid-channel and along adjacent Peace River shorelines. Water vector assessments showed that flow directions were affected by the rock spurs, with velocity vectors pointing in different directions. At Upper Site 109L, ADP mean water column velocity data generally indicate higher velocities near the upstream and downstream ends of Upper Site 109L and lower velocities near the middle of the site. Water velocities were also higher along the mid-channel side (i.e., south side) of Upper Site 109L when compared to the north side. Locations of individual excavated depressions were visible in the ADP data and indicated variability in water depths and velocities throughout Upper Site 109L. The variability in water depths and velocities created by the excavated channel depressions is likely to increase habitat complexity and habitat suitability for the indicator species (i.e., Arctic Grayling [*Thymallus arcticus*], Bull Trout [*Salvelinus confluentus*], Mountain Whitefish, Rainbow Trout [*Oncorhynchus mykiss*], and Walleye [*Sander vitreus*]). In addition, the excavation of Upper Site 109L to an elevation of less than 407 metres above sea level (masl) ensures that the area remains permanently wetted under most operating flows for the Project (409 masl), increasing the quantity of permanently wetted habitat available for primary and secondary productivity while reducing fish stranding risk. Data collected indicate an increase in bed elevation between 2017 and 2019 at one location in Upper Site 109L that results in a cobble bar becoming exposed at low water levels. Substrate data collected in 2019 showed variable riverbed material throughout Upper Site 109L and most of the material surveyed was relatively clean (no collection of fines evident) gravel and cobble with suitable interstitial spaces for Mountain Whitefish egg incubation.

General fish use was assessed by conducting boat electroshocking sampling in each offset area. Sampling was conducted at three previously established sites that are also assessed as part of the Site C FAHMFP. Three additional sites were established within Upper Site 109L for the purposes of offset effectiveness monitoring. Boat electroshocking was conducted between mid-August and early October. These data were combined with data collected from 2016 to 2018 (i.e., a 4-year block of post offset construction data) and compared to data collected from 2012 to 2015 (i.e., a 4-year block of pre offset construction data).

In 2019, hoop traps and minnow traps were deployed in the eddies downstream of rock spurs to further document use of the River Road area by juvenile life stages of large-bodied fish species and use by small-bodied fish species.

Fish use data collected in 2019 showed similar trends to those identified in 2017 and 2018. There was increased use of the area by Bull Trout and Rainbow Trout, and decreased use of the area by Walleye, Northern Pike (*Esox lucius*), and the three sucker species (Largescale Sucker [*Catostomus macrocheilus*], Longnose Sucker [*Catostomus catostomus*], and White Sucker [*Catostomus commersonii*]). The number of Mountain Whitefish recorded in the rock spur area declined in the first two years after the construction of the offsets; however, Mountain Whitefish catches were lower throughout the Peace River during this same period. A total of eight Burbot (*Lota lota*) were recorded from 2017 to 2019 combined along the rock spurs. Prior to 2017, Burbot were not recorded in this area during 16 years of systematic sampling. Sparse data for all other species during all study years limit analysis and interpretation for these species.

Hoop nets and minnow traps were largely ineffective due to the dynamic flow conditions and high debris loads; however, Prickly Sculpin (*Cottus asper*), Slimy Sculpin (*Cottus cognatus*), and single young-of-the-Year Sucker species were recorded using these methods.

The use of Upper Site 109L for spawning by Mountain Whitefish was monitored using artificial substrate mats (egg mats) that rested on the river bottom to trap eggs that drifted downstream. These samplers were deployed continuously between 28 October 2019 and 10 February 2020 and were checked approximately once every two weeks. Over 32,000 hours of sampling were expended during the 15-week long Mountain Whitefish spawning monitoring survey. The sampling period covered a range of water temperatures from a high of 6.9°C to a low of -0.2°. Mountain Whitefish eggs were not recorded during this period. Mountain Whitefish eggs were not recorded during any of the three study years.

Overall, the survey documented the effectiveness of the offsets relative to monitoring objectives. First, the River Road rock spurs and channel modifications at Upper Site 109L were constructed as described in Section 6.2.1 (Mitigation Measures Downstream of Site C Dam Site) of the Project's Fisheries and Aquatic Habitat Management Plan[1] and the offsets maintained their design and function over the monitoring period. Second, physical habitat data collected in 2017, 2018, and 2019 showed that the offsets provide a variety of habitats unique to that reach of the Peace River that are suitable for use by a variety of fish species and life stages, while reducing stranding risk. Lastly, a variety of fish species and life stages were recorded in the offset areas after their construction.

[1] Available for download at: https://www.sitecproject.com/sites/default/files/Fisheries_and_Aquatic_Habitat_Management_Plan.pdf.

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1.0 INTRODUCTION AND BACKGROUND

Fish and fish habitat are valued components of the Peace River that are considered important by BC Hydro, Aboriginal groups, the public, the scientific community, and government agencies. The Site C Clean Energy Project (the Project), including Project construction, reservoir filling, and operation, could affect fish and fish habitat via three key pathways: changes to fish habitat (including nutrient concentrations and lower trophic biota), changes to fish health and fish survival, and changes to fish movement. These paths are examined in Volume 2 of the Project's Environmental Impact Statement (EIS)[2].

BC Hydro submitted an application to Fisheries and Oceans Canada (DFO) for an authorization under Section 35(2)b of the *Fisheries Act* for several components of the Project associated with Site Preparation (BC Hydro 2015). The application included an Offsetting Plan, which proposed the creation of rock spurs along the River Road, channel modifications at Upper Site 109L, and channel modifications at Side Channel Site 108R, which were designed to offset unavoidable serious harm to fish as a result of Site Preparation by providing the following (BC Hydro 2015):

- increasing the quantity and quality of available, permanently wetted habitat to support primary and secondary production as food production for fish and provide rearing, feeding, overwintering, and potential spawning habitats for fish
- reducing fish stranding risk
- increasing the complexity and variability of fish habitat to support a variety of life stages for local fish populations

The design of the offsets is described in the Project's Fisheries and Aquatic Habitat Management Plan[3], BC Hydro's *Fisheries Act* Authorization Application for Site Preparation (BC Hydro 2015) provides the following summary with regards to the construction of the River Road rock spurs:

> *Twenty rock spurs will be constructed along a 2.4 km length of River Road that extend from River Road into the river to enhance fish habitat by providing a diversity of water velocities, depths, and predation refuges. These spurs were proposed in the EIS for the Project and are a common enhancement method to induce eddies or shear zones, which are frequently used as resting and feeding areas by fish (Slaney and Zaldokas 1997). The rock spurs will be constructed either entirely of riprap from Wuthrich Quarry or a combination of river cobble/gravels and armoured with Wuthrich riprap as River Road construction progresses. The rock spurs will be 15 m long and 4 m wide at the crest. The spacing between the spurs will be 60 m, four times their length. The rock spurs will alter 0.19 ha of instream area beyond the River Road footprint. In addition to the rock spurs, this portion of River Road will be stabilized with large riprap and boulders, which will also provide more substrate variability and interstitial cover for rearing fish when compared to existing conditions.*

[2] Available for download at: http://www.ceaa-acee.gc.ca/050/document-eng.cfm?document=85328.

[3] Available for download at: https://www.sitecproject.com/sites/default/files/Fisheries_and_Aquatic_Habitat_Management_Plan.pdf.

Flow conditions associated with the rock spurs (i.e., flow streamlines, water levels, and depth averaged velocities) were modelled using River 2D. Modelling predicted that the spurs would be effective at moving the higher velocities away from the bank, and therefore provide a range of velocities between them that is more suitable for fish use. Substrata between the spurs will initially consist of gravel and cobble that is suitable for supporting benthos. At discharges below 1000 m³/s, the modelling predicted low velocity depositional areas will form between the spurs that will result in some sediment deposition. At higher flows, recirculation between the spurs is predicted, which will limit fine sediment deposition and potentially scour out previously deposited fines…

The rock spurs are expected to enhance fish productivity by diversifying water velocities and depths in the area, as well as providing predation refugia for juvenile large-bodied fish and all life stages of small-bodied fish. Current hydraulic conditions along this section of the river bank are homogenous due to a lack of physical habitat (such as log jams or depositional fans), limited undulations in the shoreline, and a consistent bank slope. The eddies that will form behind each rock spur will benefit most life stages of the cold-water target fish species. Migrating Bull Trout (Salvelinus confluentus) will use the slack water within the eddies for resting. Adult Arctic Grayling (Thymallus arcticus), Bull Trout, Mountain Whitefish (Prosopium williamsoni), and Rainbow Trout (Oncorhynchus mykiss) can hold in the eddies, dart into the adjacent main current to capture prey items drifting downstream, and quickly return to the eddy. Juvenile Rainbow Trout are known to prefer the interstitial areas created within the large riprap substrate (Tabor and Wurtsbaugh 1991; ONA et al. 2014).

Riprap substrate was placed between the rock spurs and adjacent to River Road to armour the newly constructed bank (BC Hydro 2015). The riprap substrate was larger than the substrate found in the area prior to construction (Golder 2016) and is expected to provide additional interstitial cover for small fish. Throughout this report, assessments of fish use consider the combined influence of the River Road rock spurs themselves and the associated bank armouring along the length of River Road.

With regards to Upper Site 109L, BC Hydro (2015) provides the following summary:

The approach is to use a 'cut and fill' excavation and deposition approach in shallow water habitats that are dewatered during Project operations. Areas will be excavated to below low flow levels, and this material will be used to 'fill' adjacent shallow areas to an elevation above high water. Alternatively, at some locations, excavated material from shallow water habitats can be moved and used as Project construction material. The area proposed for excavation during Site Preparation comprises 15.43 ha of instream area and 0.04 ha of riparian area…

The works are expected to increase the potential use of the area for Mountain Whitefish spawning by providing suitable depth and velocity characteristics. The excavation should provide clean gravels and cobbles that will increase interstitial spaces, thereby providing additional cover for eggs and larvae that in turn, may benefit survival of these life stages. The increased wetted surface area and wetted duration of the habitat at Upper Site 109L is also expected to result in an overall increase in primary and secondary productivity…

In addition, channel depressions will be excavated within Upper Site 109L. These depressions and their associated monitoring form part of BC Hydro's adaptive management strategy, and monitoring results on the physical and biological effectiveness of these depressions will guide future channel enhancements. There is substantial biological precedent for the use of structures that alter depth and velocity to increase habitat suitability in rivers, and this approach will be used to increase fish use at this site. These depressions will include both longitudinal (parallel to flow) and transverse (perpendicular to flow) types to *create a variety of hydraulic conditions. The depressions proposed are 5 to 25 m in length and width (at the top), and vary in depth from 1 m to 2 m deeper than the adjacent bed. The depressions will be spaced to maintain uniform hydraulics across the area. The depressions will be located and spaced across the area to optimize fish habitat features.*

These depressions will provide areas of greater depth (up to 3 m at minimum flows) and increase the habitat suitability and complexity in the area by providing more appropriate depths and velocities, as well as complex flow patterns and velocity refugia, while not interfering with the overall flow-through of the main current. The additional habitat complexity provided by the proposed depressions is expected to increase the number of fish that use the area for feeding and holding functions. Hydraulic modelling of 109L shows the velocities of up to [sic] *exceed preferences of Mountain Whitefish during peak operating flows over most of the 109L area. Under these conditions the proposed depressions will provide lower velocities across 109L, increasing habitat suitability over a range of flows for Mountain Whitefish. The depressions are also expected to provide shear zones at higher flows and deeper pool areas for cover and holding at lower flows. These features will provide additional habitat for species such as Walleye (Sander vitreus), Mountain Whitefish and Bull Trout, which make use of deeper habitats.*

Construction of the third offset area (i.e., Side Channel Site 108R) began in October 2018 and was completed in November 2019. Effectiveness monitoring for this offset is scheduled to begin in 2020.

DFO approved the Offsetting Plan and issued a *Fisheries Act* Authorization (FAA; No. 15-HPAC-00170) for site preparation works[4]. Condition 6.3 of the FAA states that the Proponent shall provide an annual effectiveness monitoring report to DFO. This report documents the results of monitoring in accordance with this condition.

The construction of the River Road rock spurs and the channel modifications at Upper Site 109L were completed in 2015 and 2016. Monitoring the effectiveness of these two offset areas began in 2017 (Golder 2018), the first year following the construction of the offsets, which was described in the monitoring plan. Offset effectiveness monitoring includes data collection that supplements existing monitoring of fish and fish habitat that has been ongoing. This report presents the results of the third year of three years of proposed offset effectiveness monitoring.

1.1 Objectives

The Site C Fisheries and Aquatic Habitat Monitoring and Follow-up Program (FAHMFP) states that the objective of Offset Effectiveness Monitoring is to determine the biological effectiveness of the offsets (i.e., to support ongoing productivity) by monitoring fish abundance and community composition at both a site- (i.e., 100's m) and reach-scale (i.e., 10's km). Data were specifically collected as part of this study to summarize the effectiveness of the offset areas at a site-scale. Reach-scale monitoring will be encompassed within the entirety of the Site C FAHMFP. The offset areas were not expected to have an immediate reach-scale effect; therefore, summaries of the reach-scale effectiveness of the offset areas will be provided during future study years under the Site C FAHMFP.

[4] Available for download at: https://www.sitecproject.com/sites/default/files/authorization-site-preparation-15-HPAC-00170_0.pdf.

Site-scale offset effectiveness monitoring as detailed in this report represents a summary of activities conducted under two different components of the Site C FAHMFP: the Peace River Physical Habitat Monitoring Program (Mon-3) and the Peace River Fish Community Monitoring Program (Mon-2).

The objective of Offset Effectiveness Monitoring (Task 2c) under Mon-3 is to determine if offset areas maintain their structure and function over time and to evaluate the suitability of habitat for fish. One of the uncertainties listed within Mon-3 is if the effectiveness of the offset components in terms of potential rates of sediment deposition and changes in physical configuration will change over time.

The application for authorizations states that there is relatively high confidence (low uncertainty) that the offset measures are likely to be effective. However, uncertainties remain regarding the effectiveness of these offsets in terms of fish use. As a result, fish use of offset areas by indicator species and Mountain Whitefish spawning at the offset areas will be monitored under Task 2d (Offset Effectiveness Monitoring) of Mon-2.

Monitoring techniques, as detailed in Section 2.0, were adapted based on the results of the 2017 and 2018 surveys (Golder 2018, 2019) while following the methods and requirements detailed in the FAA. Effectiveness monitoring is intended to provide answers to the following questions that are listed in the application:

- are the offsets implemented as designed and approved
- do the offsets maintain their design and purpose over time
- are the offsets biologically effective (i.e., support ongoing productivity)

The offsets were constructed as described in Section 6.2.1 (Mitigation Measures Downstream of Site C Dam Site) of the Project's Fisheries and Aquatic Habitat Management Plan[5].

Determining whether the offsets maintain their design and purpose over time will be tested by Hypothesis #3 of Mon-3, which is stated as follows:

> H_3: Site C offset habitat areas in the Peace River maintain their design and purpose over time.

The biological effectiveness of the offsets will be tested by Hypothesis #6 of Mon-2, which is stated as follows:

> H_6: Indicator fish species will use the Site C offset habitat areas in the Peace River between the Project and the Many Islands area in Alberta for rearing, feeding, and/or spawning as shown in Table [1].

The indicator fish species referenced in the Site C FAHMFP are Arctic Grayling, Bull Trout, Burbot (*Lota lota*), Goldeye (*Hiodon alosoides*), Mountain Whitefish, Rainbow Trout, and Walleye (BC Government 2011); however, the offset areas were not predicted to yield measurable improvements to habitats preferred by Burbot and Goldeye. As such, these two species are not presented in Table 1. Table 1 has been modified relative to the one presented in the Site C FAHMFP to only include offset areas that are applicable to the Project's Site Preparation FAA.

[5] Available for download at: https://www.sitecproject.com/sites/default/files/Fisheries_and_Aquatic_Habitat_Management_Plan.pdf#page=27.

Table 1: Expected use of proposed habitat offsets located in the Peace River between the Project and the Many Islands area in Alberta by indicator fish species. Modified from Table 2 of the Peace River Fish Community Monitoring Program (Mon-2) of the Site C FAHMFP.

Location	Species				
	Arctic Grayling	Bull Trout	Mountain Whitefish	Rainbow Trout	Walleye
River Road Rock	R[a], F	F	R, F	R, F	
Upper Site 109L	R	F	R, F, S	R, F	F
Side Channel Site	R, F		R, F	R, F	

[a] R = rearing; F = feeding; and S = habitat suitable for spawning.

Throughout this report, indicator species are classified as being members of either the coldwater or coolwater fish groups. Information regarding these classifications are summarized in the Project's EIS[6]. Arctic Grayling, Bull Trout, Mountain Whitefish, and Rainbow Trout belong to the coldwater fish group and Burbot, Goldeye, and Walleye belong to the coolwater fish group.

[6] Site C Clean Energy Project Environmental Impact Statement, Volume 2, Section 12.3.2.1.

2.0 METHODS

Effectiveness monitoring of offset areas at the site-scale has three components; physical habitat, general fish use, and Mountain Whitefish spawning. A site-scale overview map of the study area is provided in Appendix A, Figure A1.

Peace River discharge data presented in this report are from the Water Survey of Canada's Peace River at Pine River station (Station Number 07FA004)[7], which is located approximately 3 km downstream of Upper Site 109L. Unless stated otherwise, discharge values are daily average values presented in cubic metres per second (m^3/s).

2.1 Physical Habitat

The study design for physical habitat at the River Road rock spurs and Upper Site 109L included assessing water depths and velocities using an Acoustic Doppler Profiler (ADP) at channel cross section transects and visual assessments of the offsets and the hydraulic features around the offsets. ADP measurements were obtained by boat. Physical habitat was visually assessed at the rock spurs to determine if they provide a diversity of hydraulic conditions that are less common in that reach of the Peace River. Additional ADP surveys were conducted around four separate "typical" rock spurs to collect additional measurements of flows around individual rock spurs. The physical habitat survey was conducted on 14 September 2019.

ADP surveys were conducted at the same eight previously established transect locations surveyed in 2017 and 2018 (Golder 2018, 2019). Five transects were assessed as part of the Site C FAHMFP's Peace River Physical Habitat Monitoring Program (Mon-3), three transects were established for the purposes of offset effectiveness monitoring (Task 2c; Mon-3) (Table 2; Appendix A Figure A2). Where possible, water depth data from 2019 were compared to data collected in 2015 (Golder 2016), 2017 (Golder 2018), and 2018 (Golder 2019).

Table 2: Physical habitat transect locations surveyed on 14 September 2019 as part of Site C Offset Effectiveness Monitoring. All transects are located within UTM Zone 10.

Transect Identifier	Offset Location	Left Bank[a] (Transect Start)		Right Bank[a] (Transect End)	
		Easting (m)	Northing (m)	Easting (m)	Northing (m)
DS03	Rock Spurs	630856	6229716	630577	6228620
DS04	Rock Spurs	631314	6229624	631318	6228389
DS05	Rock Spurs	631894	6229580	632071	6228420
DS06a	Upper Site 109L	632275	6229669	632676	6228529
DS06	Upper Site 109L	632409	6229718	632843	6228578
DS06b	Upper Site 109L	632544	6229773	632996	6228659
DS07	Upper Site 109L	632669	6229861	633151	6228740
DS07b	Upper Site 109L	632830	6229854	633283	6228819

[a] As viewed facing downstream.

[7] https://wateroffice.ec.gc.ca/search/real_time_e.html.

Two methods were used to collect coordinates (X,Y,Z) of surveyed elevations (topography and bathymetry) within the active channel:

- GPS RTK Total Station Surveys. A Trimble R8 GPS RTK system was used to measure topography on shoreline areas above the water level at the time of survey and in some wadable areas of Peace River. The topographic elevations were measured along the established transects (Appendix A, Figure A1) and included areas of the active channel below the bankfull elevation. Survey data for the river banks towards the bankfull elevation and above were not collected.
- River Depth Surveys. A SonTek RiverSurveyor® M9 dual beam Acoustic Doppler Profiler (ADP) system (SonTek / Xylem Inc., San Diego, CA) was used to measure the river depth from a boat. These measurements of water depth were used to establish the riverbed surface elevation. The ADP transducer was mounted approximately 0.15 m below the water surface with a minimum measurable river depth of 0.35 m. Both water depth and water velocity data were collected.

During the river depth surveys the Trimble GPS system was attached to the ADP system and the local positional coordinates (X,Y) were transmitted to the ADP unit and incorporated into the raw data file collected by the ADP data software to provide X,Y,Z coordinates for surveyed locations. The two survey methods were referenced to the same datum, and at the end of the survey they were spliced together to produce a single dataset.

Where possible, the river cross section bathymetry profiles were compared to data collected during previous survey programs (Golder 2016, 2018, 2019).

In addition to the ADP data collected at established transects (Table 2), additional ADP data were also collected within the Upper Site 109L area to garner more information on water velocities and water depths in this area. These data were collected by conducting longitudinal transects (surveyed from upstream to downstream) across the area.

2.1.1 Substrate Characteristics

On 27 and 28 January and 10 February 2020, substrate characteristics for Upper Site 109L were assessed through underwater video surveys. Imagery collected by underwater video surveys were used to collect substrate characteristic data (i.e., particle size and embeddedness) at select locations within Upper Site 109L where water depths were less than 2.0 m. Nine video transects were conducted within Upper Site 109L starting at the upstream end of the site (Table 3). Underwater video footage was collected using a digital camera (GoPro Hero 2®) in a waterproof housing and recorded in H.264 video format. The camera was attached to an aluminium survey rod that was marked in 10 cm increments. For scale, a 30 cm bar integrated with 5 cm increment markings was attached to the base of the survey rod. The camera was lowered on the survey rod off the port side of the boat, to the river bottom. The initial starting depth was measured using the depth sounder on the boat. Video footage was collected as the boat drifted downstream with the current until water depths exceeded the depth of view of the camera, which typically occurred at water depths greater than 2.0 m. In addition to the substrate imagery, anecdotal observations of water clarity and the amount/type of substrate material collected on deployed egg mats were recorded throughout the Mountain Whitefish spawning monitoring survey (Section 2.3).

Substrate size was measured from select video frames where both the substrate and the markings on the wading rod were clearly visible. Individual substrate dimensions were then assigned a category (i.e., sand, gravel, cobble etc.) based on the Wentworth grain size classification system (Wentworth1922).

Table 3: Substrate characteristic underwater video locations surveyed on 27 and 28 January and 10 February 2020 as part of Site C Offset Effectiveness Monitoring. All video sites are located within UTM Zone 10.

Video Sites	Offset Location	Easting (m)	Northing (m)	Comments
Video-01	Upper Site 109L	632503	6229625	Near egg mat M502
Video-02		632633	6229576	Near egg mat M503
Video-03		632705	6229721	Near egg mat M504
Video-04		632832	6229737	Near confluence of L3 Stream
Video-05		632448	6229554	Near egg mat M501
Video-06		632459	6229545	Near egg mat M501
Video-07		632656	6229658	Near egg mat M504
Video-08		632776	6229620	Near egg mat M505
Video-09		632831	6229741	Near egg mat M508

2.2 General Fish Use

The study design for fish use consisted of monitoring each of the two offset areas (i.e., River Road rock spurs and Upper Site 109L) between late August and early October. This timing corresponded with the timing of historical surveys conducted by BC Hydro (e.g., Mainstream 2010, 2011, 2013, Mainstream and Gazey 2004–2014; Golder and Gazey 2015–2019). A more accurate comparison between the two datasets was possible by aligning the study period with historical datasets. The sampling conditions in the Peace River during the late summer to early fall period were the most suitable in terms of water clarity, water temperature, and discharge. In addition, the fish species and life stages that are expected to use the offset areas were expected to be present at this time. Timing for the third year of monitoring aligned with the first two years of monitoring. During the first year of monitoring (2017), sampling during other seasons was considered, but ultimately abandoned due to expected inefficiencies, largely associated with ice formation and cold weather in the winter and high water levels and high turbidity during the spring and early summer.

Sites 0505, 0506, and 0509 (Appendix A, Figure A3) were sampled from 2005 to 2006 (Mainstream and Gazey 2006–2007) and from 2008 to 2019 (Mainstream and Gazey 2008–2014; Golder and Gazey 2015–2019; Golder and Gazey in prep.) as part of various BC Hydro studies. These studies included the Large River Fish Indexing Program (2001 to 2007), the Peace Project Water Use Plan (2008 to 2014), and the Peace River Large Fish Indexing Survey (2015 to 2019; Mon-2, Task 2a). While sample collection methods employed each year were relatively consistent between 2005 and 2013, some changes were implemented in 2014 and 2015 that should be considered when drawing conclusions across study years.

In 2014, electroshocker settings were modified to reduce the likelihood of electroshocker-induced injuries to large-bodied fish. As a result of this change, catchability (i.e., the fraction of the population that is caught in a given unit of effort) was lower from 2014–2019 when compared to 2005–2013. A summary of these electroshocker setting changes is provided in Golder and Gazey (2015).

In 2015, the objectives of sampling were modified to ensure collected data met the needs of the Project. One of these changes included the size of fish targeted by the netters. Prior to 2015, netters focused effort on fish that had fork lengths (FL) greater than approximately 150 mm. From 2015 onward, netters targeted all size classes of fish. As a result of this change to the methods, small-bodied fish species (e.g., Redside Shiner [*Richardsonius balteatus*]) and younger age-classes of large-bodied fish species were inconsistently recorded prior to 2015.

During the 2019 survey, boat electroshocking, minnow traps, and hoop traps were used to asses fish use of the River Road rock spurs. In 2017 and 2018, only boat electroshocking was used to assess fish use of the River Road rock spurs. Similar to 2017 and 2018, boat electroshocking was the exclusive capture method used to assess fish use of Upper Site 109L. Other capture and observation methods, including gillnets, minnow traps, backpack electrofishing, beach seining, visual surveys (both snorkel-based and boat-based), and sonar surveys, were considered or attempted during the 2017 survey period but were considered ineffective and were not employed in 2018 or 2019. Most of these methods were considered unsafe or impractical due to the physical characteristics of the offset areas (i.e., high water depths, water velocities, and turbidity).

Boat electroshocking techniques were consistent with techniques used during baseline studies (e.g., Golder and Gazey 2015–2017) and the 2017 and 2018 surveys (Golder 2018–2019), and followed industry standard methods (e.g., Nielsen and Johnson 1992). Sampling consisted of a three-person crew operating a Smith-Root Inc. (Vancouver, WA) high-output Generator Powered Pulsator (GPP 5.0) electroshocker from a 5.5 m outboard jet-drive riverboat. The electroshocking procedure generally consisted of manoeuvring the boat downstream along the shoreline of each sample site; however, Sites 109OSA and 109OSB (Appendix A, Figure A3) were located further from the shoreline to ensure adequate coverage of Upper Site 109L. Two crew members, positioned on a netting platform at the bow of the boat, netted stunned fish, while the third individual operated the boat and electroshocking unit. The two netters attempted to capture all fish that were stunned by the electrical field. Captured fish were immediately placed into a 175 L onboard live-well equipped with a freshwater pump. To prevent electroshocking-induced injuries, fish were netted one at a time (i.e., fish were not double-netted). Fish that were positively identified but avoided capture were enumerated and recorded as “observed”. The electroshocking unit was operated at a frequency of 30 Hz with pulsed direct current. Amperage was adjusted as needed to achieve the desired effect on fishes, which was the minimum level of immobilization that allowed efficient capture and did not cause undesired outcomes such as immediate tetany or visible haemorrhaging (Martinez and Kolz 2009). An amperage of 3.2 A typically produced the desired effect on fishes; however, the amperage was set as low as 2.0 A and as high as 4.0 A at some sites based on local water conditions. Electroshocker settings were based on information provided by Golder (2004, 2005) that resulted in less electroshocking-induced injuries on large-bodied Rainbow Trout in the Columbia River. These settings also align with recommendations by Snyder (2003) for pulsed direct current and low frequencies for adult salmonids.

Minnow traps were 0.4 m in length, 0.2 m in diameter, and had openings of 2 cm. Mesh size was 6 mm. Minnow traps were deployed from shore near at the River Road rock spurs in shallow water areas (i.e., less than approximately 1.5 m water depths). Hoop traps were 1.5 m in length, with four 0.4 m plastic hoops and had 2 cm openings. Mesh size was 3 mm. The cod end of the hoop trap was tied to shore and the trap was deployed by boat into the downstream eddies created by the rock spurs. The mouth of the hoop trap was held open using a weight on one side and a float and line on the other side. Hoop nets were retrieved using the float line.

During the first session, minnow traps and hoops traps were deployed for approximately 5 hours before they were retrieved and assessed. For all subsequent sessions, traps were left to fish for approximately 24 hours. Hoop traps were baited with either canned sardines in springwater or canned sardines and hot peppers in springwater. Minnow traps were baited with canned sardines in springwater, canned sardines and hot peppers in springwater, or cheese and cat treats.

Habitat variables recorded at each site (Table 4) included variables recorded during baseline Site C studies (e.g., Golder and Gazey 2015–2019) and the 2017 and 2018 surveys (Golder 2018, 2019).

Where water depths were sufficient, water clarity was estimated using a “Secchi Bar” that was manufactured based on the description provided by Mainstream and Gazey (2014). Mean and maximum sample depths were estimated by the boat operator based on the boat’s sonar depth display.

Table 4: Habitat variables and boat electroshocker settings recorded at each site during each sample session in 2019.

Variable	Description
Date	The date the site was sampled
Time	The time the site was sampled
Air Temp	Air temperature at the time of sampling (to the nearest 1°C)
Water Temp	Water temperature at the time of sampling (to the nearest 0.1°C)
Conductivity	Water conductivity at the time of sampling (to the nearest 10 µS/cm)
Secchi Bar Depth	The Secchi Bar depth recorded at the time of sampling (to the nearest 0.1 m)
Cloud Cover	A categorical ranking of cloud cover (Clear = 0-10% cloud cover; Partly Cloudy = 10-50% cloud cover; Mostly Cloudy = 50-90% cloud cover; Overcast = 90-100% cloud cover)
Boat Model	The model of boat used during sampling
Range	The range of voltage used during sampling (high or low)
Percent	The estimated duty cycle (as a percent) used during sampling
Amperes	The average amperes used during sampling
Mode	The mode (AC or DC) and frequency (in Hz) of current used during sampling
Length Sampled	The length of shoreline sampled (to the nearest 1 m)
Time Sampled	The duration of electroshocker operation (to the nearest 1 second)
Mean Depth	The mean water depth sampled (to the nearest 0.1 m)
Maximum Depth	The maximum water depth sampled (to the nearest 0.1 m)

2.2.1 River Road Rock Spurs

Data from two boat electroshocking sites (Site 0505 and 0506; Appendix A, Figure A3) situated along River Road and sampled as part of the Site C Peace River Large Fish Indexing Survey (Mon-2, Task 2a) were assessed to determine general fish use of the rock spurs. These two sites were previously surveyed each year between 2007 and 2018 under various BC Hydro projects and provide a baseline dataset for the River Road area. Under Mon-2, Task 2a, each of these two sites were sampled five times in 2019, approximately once per week, between 31 August and 7 October.

Seventeen baited minnow traps were set within Site 0505 and 0506 once a week between 9 September and 4 October (Appendix A, Figure A3). Six baited hoop traps were deployed in the eddies between the River Road rock spurs (Appendix A, Figure A3). Due to net damage and trap fouling from leaves and small woody debris, the hoop traps were only deployed twice (9 and 20 September).

2.2.2 Upper Site 109L

Four boat electroshocking sites (Site 0509, 109OSA, 109OSB and 109OSC) were situated within Upper Site 109L (Appendix A, Figure A3). Site 0509 was sampled as part of Mon-2, Task 2a and was sampled each year between 2007 and 2018 under various BC Hydro projects (e.g., Golder and Gazey 2019). Sites 109OSA and 109OSB were previously sampled in 2017 and 2018 and Site 109OSC was previously sampled in 2018. These three sites are not index sites and were sampled specifically to gather additional information on fish use of Upper Site 109L as part of offset effectiveness monitoring. All four sites situated within Upper Site 109L were sampled five times in 2019, approximately once per week between 31 August and 7 October.

2.2.3 Data Analysis

For all data analyses, the years 2016 to 2019 were defined as after construction years. Although offset effectiveness monitoring did not commence until 2017 (i.e., one year after the offsets were constructed), the offsets were fully constructed when sampling was conducted in 2016 as part of BC Hydro's Peace River Large Fish Indexing Survey (Mon-2, Task 2a; Golder and Gazey 2017). In order to have an equal number of sample years before and after offset construction, the four years of data immediately prior to construction (i.e., 2012-2015) were grouped and defined as before construction years. These groupings may lead to some bias in the diversity profiles because of the changes in methods that occurred in 2014 and 2015, as outlined in Section 2.2.

The fish species intended to benefit the most from the two constructed offsets were Arctic Grayling, Bull Trout, Mountain Whitefish, and Rainbow Trout. The number of Arctic Grayling, Bull Trout, and Rainbow Trout captured in the offsetting areas was too low to allow comparisons of life history metrics between years; therefore, life history metrics, including body condition and length-frequency distributions, were only calculated and compared between years for Mountain Whitefish. Length-frequency histograms were created for Mountain Whitefish to assess potential changes in size structure of fish using the offset areas. Separate length-frequency histograms were created for the rock spurs (Sites 0505 and 0506) and Upper Site 109L (Sites 0509, 109OSA, 109OSB, and 109OSC).

Fulton's condition factor was used to compare the body condition, as a general indicator of fish health (weight given length) before and after offset construction. Fulton's condition factor (hereafter "body condition") was calculated as follows:

1) $K = W / L^3 \times 100{,}000$

where *W* is the weight of the fish measured in grams and L is the fork length of the fish measured in millimetres. For each year, the mean and 95% confidence intervals of body condition were calculated, and values from years before and after offset construction were plotted and compared visually. Although not summarized and compared between years, body condition values for all fish captured during offset monitoring are presented along with raw length, weight, and tag information in Appendix C, Table C3.

For length-frequency and body condition analyses, only data from initially captured fish were used; recaptured fish were excluded from analyses. Recaptured fish were excluded from analyses in case previous captures or the presence of a tags affected the growth or health of fish, biasing data from recapture events.

Diversity profile analyses previously used for the Peace River (e.g., Golder and Gazey 2019) were modified and limited to only include data from the offset areas to monitor changes to the fish community's composition in response to the construction of the two offset areas. A diversity profile plots the relationship between diversity and the degree to which relative abundance is represented (Leinster and Cobbold 2012). The response variable in a diversity profile is the "effective number of species", which is the number of equally common species required to get a particular value of an index (Jost 2006). Effective numbers are recommended for comparisons of diversity because they allow intuitive and straightforward comparisons of the number of species, instead of individual indices, which are more difficult to interpret and can be misleading due to non-linearity (Jost 2006; Chao et al. 2014).

Diversity profiles were calculated using the following equation:

2) ${}^{q}D^{\mathbf{Z}}(\mathbf{p}) = \left(\sum p_i\, (\mathbf{Zp})_i^{q-1}\right)^{\frac{1}{1-q}}$

where *D* is the effective number of species, *p* is the relative abundance of the species present, *q* is the parameter representing the relative contribution of relative abundance data, and *Z* is the similarity matrix among species (Leinster and Cobbold 2012). A value of $q = 0$ represents no importance of relative abundance and is equivalent to a count of the number of species, often referred to as species richness. A value of $q = 1$ is equivalent to the Shannon index. Values less than 1 result in rare species being over-represented, and values greater than 1 result in common species being over-represented. Values on the right of a diversity profile (highest values of *q*) are insensitive to changes in rare species and values on the left are sensitive to rare species. The shape of diversity profiles can be used to interpret the community composition and compare composition between datasets. For instance, a flat profile indicates near equal abundance among species, whereas a steeper profile indicates more unequal abundance among species. Diversity profiles allow comparison of the number of effective species across the entire range of importance of rare/common species, instead of requiring the assumptions of a single diversity index. Diversity profiles were previously used in a power analysis to assess the likelihood of detecting significant differences in community composition in the Peace River before and after Project construction (Ma et al. 2015).

Diversity profiles were calculated separately for each year, combining the catch data from all sample sessions and sites within the offset areas. To assess differences in community composition, the mean values with 95% confidence intervals were calculated from the four years before offset construction (2012-2015) and the four years after offset construction (2016-2019) from the annual diversity profiles. The analysis used captured fish of all species but excluded fish not identified to the species level (e.g., fish recorded as sculpin species or sucker species). For the species similarity matrix (*Z*), values were set to 1 for all “small fish” species and for all sucker species, which treated each of these groups as one species. These settings were consistent with Ma et al. (2015) and based on groupings established in the Site C EIS. Diversity was not statistically compared between each section (e.g., t-test). Instead, the effective number of species are shown graphically to allow the reader to decide what magnitude of difference is biologically meaningful.

2.3 Mountain Whitefish Spawning Monitoring

The study design for Mountain Whitefish spawning monitoring consisted of deploying artificial substrate mats (egg mats) throughout Upper Site 109L and in adjacent areas (Appendix A, Figure A4 and A5) to collect eggs that were deposited in the area over the expected Mountain Whitefish spawning season. In 2019, ten egg mats were set outside the offset area to collect data to investigate the assumption that Mountain Whitefish spawn in the Peace River mainstem. The approximate locations for these ten egg mats were based on data collected during the Peace River Large Fish Indexing Survey (Mon-2, Task 2a). Specifically, the egg mats were deployed at locations where high numbers of pre-spawning Mountain Whitefish (based on the presence of nuptial tubercles or fish being classified as either ripe or gravid), were encountered during the Indexing Survey. The Mountain Whitefish spawning season was expected to extend from approximately late October to mid-December based on data from other systems (e.g., Golder 2014) and typical Peace River water temperatures. However, the 2019 survey was extended to mid-February to increase the likelihood of encountering eggs. Northcote and Ennis (1994) found that Mountain Whitefish initiate spawning in the fall when water temperatures decline below 6°C. In 2019, Peace River water temperatures averaged 6.9°C at the start of sampling and declined to a low of approximately -0.2°C during the monitoring period. Any eggs collected in the offset area during the survey would be considered as evidence that Mountain Whitefish used the offset area for spawning. Habitat near the River Road rock spurs was not predicted to provide potential Mountain Whitefish spawning habitats (Table 1); therefore, this area was not surveyed, per the monitoring plan (BC Hydro 2015). Mountain Whitefish spawning monitoring was conducted between 28 October 2019 and 10 February 2020 (Table 5).

Table 5: Summary of Mountain Whitefish spawn monitoring conducted as part of Site C Offset Effectiveness Monitoring, 2019.

Date(s)	Activity
28 and 29 October; 15 November[a]	Deployment of egg mats
14,15, 27 and 28 November; 8, 19 and 20 December	Retrieval, inspection, and redeployment of egg mats
27 and 28 January; 10 February	Retrieval, inspection, and removal of egg mats

[a] An additional six egg mats were set in areas downstream of Upper Site 109L on 15 November (Appendix A, Figures A4 and A5).

Mountain Whitefish spawning monitoring followed industry-accepted methods (e.g., Golder 2014, 2017) and was consistent with 2017 and 2018 methods (Golder 2018, 2019). Egg mats consisted of a 0.76 by 0.76 m iron frame that enclosed two layers of filter material (latex-coated animal hair). When deployed, the egg mats rested on the river bottom to trap eggs that drift downstream. All but one egg mat set deployed in 2019 were mid-channel sets, which consisted of an anchor system and a 10 m long steel cable that connected the anchor system to the egg mat. A float line with approximately 15 m of rope was attached to the egg mat to enable retrieval by boat. Another float line with approximately 15 m of rope was attached to the anchor system to allow removal of the anchor system at the end of the survey. Egg mats were retrieved by the float line. Carabiners were used at all float line attachment points to allow quick removal of the egg mats. The egg mats were then pulled off the river bottom by an electric winch mounted on the starboard side of the boat and brought on board the boat. Once the one egg mat was detached, the float line was attached to a new egg mat on the anchor cable and the set was redeployed.

A single shore-based set was deployed near the Highway #97 bridge near Taylor, BC. Conditions at this location were not conducive to a mid-set setup. As such, the egg mat was secured to the shore using a rope and a float line was attached to the egg mat to provide a secondary means of retrieval in case the shore line failed or became snagged.

Each egg mat was inspected by two different people, and if eggs were collected, they were to be removed using forceps and placed in preservative for later staging. During the collection process, the number of eggs collected on each egg mat, set time and date, retrieval time and date, water temperature, depth (determined by the boat-mounted echo sounder) and location (UTMs) were recorded on standardized field forms.

A total of 18 mid-channel sets and 1 shore-based set were deployed during the 2019 survey. Egg mats were positioned throughout Upper Site 109L and adjacent areas and were repositioned periodically over the study period to ensure adequate coverage of the area. Not all locations were sampled continuously over the study period. Over the 2019 study period, a total of 21 different locations were surveyed (Table 6; Appendix A, Figures A4 and A5). Egg mats were retrieved, checked, cleaned, and redeployed generally every two weeks; however, they were left unchecked between the 20 December 2019 and 27 January 2020, due to an extended period of extreme cold temperatures. Prior to each deployment, egg mats were inspected and the filter material was replaced as required.

Table 6: Locations sampled as part of the Mountain Whitefish spawning monitoring survey for Site C Offset Effectiveness Monitoring, 2019. All sites are located within UTM Zone 10.

Site Name[a]	UTM Easting	UTM Northing	Location
M501OS	632384	6229549	Upper 109L
M502OS	632588	6229644	Upper 109L
M503OS	632598	6229583	Upper 109L
M504OS	632674	6229708	Upper 109L
M505OS	632783	6229651	Upper 109L
M506OS	632868	6229615	Upper 109L
M507OS	633018	6229742	Upper 109L
M508OS	632976	6229704	Upper 109L
M509	633051	6229488	Adjacent to Upper 109L
M510	634593	6229792	Adjacent to Upper 109L
M511	635459	6230024	Outside offset area
M512	637396	6228583	Outside offset area
M513	637843	6227543	Outside offset area
M514	633762	6229900	Adjacent to Upper 109L
M601	646335	6222979	Outside offset area
M602	648111	6223006	Outside offset area
M603	649608	6223331	Outside offset area
M604	651905	6222212	Outside offset area
M605	652759	6221854	Outside offset area
S606	643875	6224178	Outside offset area
M607	649588	6223340	Outside offset area

[a] "OS" refers to egg mats set within the perimeter of Upper Site 109L; "M" refers to egg mats deployed as mid-sets; "S" refers to egg mats deployed as shore-based sets.

3.0 RESULTS

3.1 Physical Habitat

River cross section profiles were measured at eight transects in 2019 to provide channel profile data. Survey transect locations are provided in Appendix A, Figure A2, and cross section profiles are presented in Appendix B, Figures B1 to B8. Six of the channel cross sections were previously surveyed in July 2015 (Golder 2016) and all eight of these transects were previously surveyed in 2017 (Golder 2018) and 2018 (Golder 2019). Where possible, data from 2015, 2017, and 2018 were compared to results from the current survey.

3.1.1 River Road Rock Spurs

A series of rock spurs and bank armouring works were installed along River Road. Transects DS03, DS04, and DS05 are located along the length of the Peace River where River Road erosion protection works, including bank armouring and the rock spurs, were constructed between 2015 and 2016. These activities resulted in the left downstream bank (i.e., north shore) shifting southwards into the river when comparing 2015 to 2017 surveys. This result is evident in Appendix B; Figures B1 to B3. The main river thalweg (line with the lowest channel elevations) moved towards the middle of the river (i.e., towards the right downstream bank/south shore).

Water direction and speed data were collected at four River Road rock spurs and are presented in Appendix B, Figures B9 to B12. At each surveyed location, the same general water velocity patterns were observed. For approximately 20 m from the shoreline, the River Road rock spurs created a more turbulent flow pattern, when compared to the more laminar flows observed towards the mid-channel. The majority of water speeds around the River Road rock spurs were measured between 0.4 m/s and 0.8 m/s (average velocities over the entire water column), which was approximately 2.2 m/s slower than the average water velocities (approximately 3.0 m/s) recorded in the mid-channel area of these transects. The water vector directions measured for these velocities were affected by the rock spurs, with vectors pointing in different directions (towards the river bank, upstream, downstream, and towards the mid channel), representative of the vortex shedding (oscillating flow) that form at the rock spurs. Further south (i.e., towards mid-channel and away from the influence of the rock spurs), measured water speeds increased, and became typical for this reach of the Peace River. The majority of the flow away from the rock spurs was laminar with the water vector directions pointed downstream. Overall, flow patterns around the River Road rock spurs were similar to those recorded in 2018 and are consistent with River 2D model predictions (BC Hydro 2015).

3.1.2 Upper Site 109L

Upper Site 109L was recontoured in 2016 to have a channel bed elevation of less than 407 masl to ensure that the area remained permanently wetted, even under the minimum operating flows for the Project (409 masl; BC Hydro 2015). In 2019, field crews observed that most of the offset area remains wetted under low flows, consistent with previous years (2016-2018). However, on 23 April and again on 29 September 2019, field crews observed an exposed cobble bar within the perimeter of Upper Site 109L (Appendix B, Figure B13). On 23 April, Peace River discharge as measured at the Water Survey of Canada's Peace River at Pine River station (Station Number 07FA004), was approximately 502 m^3/s, and on 29 September, discharge was 580 m^3/s. Both discharge rates are above the minimum operating flows for the Project. The presence of the cobble bar indicates aggradation in a portion of the offset area, raising the elevation of the channel bed. When compared with the previous surveys from 2017 and 2018, the results of the 2019 surveys indicate profile changes along the left downstream bank at Transects DS06A and DS06B (Appendix B; Figures B4 and B6). At these two transect locations, riverbed elevations increased by an average of 1.5 m between 2017 and 2019. The majority of the changes observed at Transect DS06A occurred between the 2017 and 2018 surveys, while the majority of the changes observed at Transect DS06B occurred between the 2018 and 2019 surveys. Near the thalweg area at Transect DS06 (Appendix B; Figure B5), riverbed elevation increased by approximately 2 m between 2017 and 2018 with minimal change in riverbed elevation noted between 2018 and 2019. In addition, the overall riverbed elevations appear slightly higher in the 2019 surveys when compared to the previous surveys from 2017 and 2018.

Water depth measurements collected at Upper Site 109L in 2019 were used to create an interpolated bathymetric surface map (Appendix B; Figure B13). The excavated depressions within Upper Site 109L show an alternating high and low riverbed elevations pattern extending across the river from the left downstream bank towards the middle of the channel. These excavated depressions vary in length between 100 m and 200 m. The depressions are typically 1.5 m deep, with approximately 40 m spacing between depressions.

Mean water column velocity data over Upper Site 109L as measured with the ADP (Appendix B; Figure B14) generally indicate higher speeds near the upstream end of Upper Site 109L and lower speeds near the downstream end of the site. However, the velocities over the excavated depressions appear to have an alternating high and low pattern that is similar to the riverbed elevation pattern mentioned above. The nonlaminar and variable water velocities within the site, coupled with excavated channel depressions, likely increases habitat complexity and suitability for the target species when compared to habitats available prior to recontouring.

Overall, because most of Upper Site 109L is permanently wetted, the quantity of habitat available for primary and secondary production increases. Further, Upper Site 109L increases the area available for fish eggs to incubate without risk of dewatering and reduces fish stranding risk in this area.

3.1.2.1 Substrate Characteristics

Underwater video imagery collected on 27 and 28 January and 10 February 2020 indicates that substrate at Upper Site 109L is dominated by cobbles and gravels (Table 7) as detailed in Plate 1 and Plate 2. The Peace River's typically high turbidity levels reduces the effectiveness of underwater videography. Fish were not observed by crew members during the substrate characteristics survey.

Table 7: Substrate characteristics at Upper Site 109L surveyed as part of Site C Offset Effectiveness Monitoring on 27 and 28 January and 10 February 2020.

Video Site Name	Date	Start Time	Depth (m)	Dominant Substrate	Sub-dominant Substrate
Video-01	27-Jan	11:38	2.0	Gravel	Cobble
Video-02	27-Jan	11:39	2.9	Gravel	Cobble
Video-03	27-Jan	11:41	1.8	Cobble	Gravel
Video-04	27-Jan	11:43	1.0	Cobble	Gravel
Video-05	28-Jan	10:44	1.2	Cobble	Gravel
Video-06	28-Jan	10:45	1.5	Cobble	Gravel
Video-07	10-Feb	11:41	2.6	Cobble	Sand
Video-08	10-Feb	11:43	1.9	Cobble	Gravel
Video-09	10-Feb	11:44	1.2	Cobble	Gravel

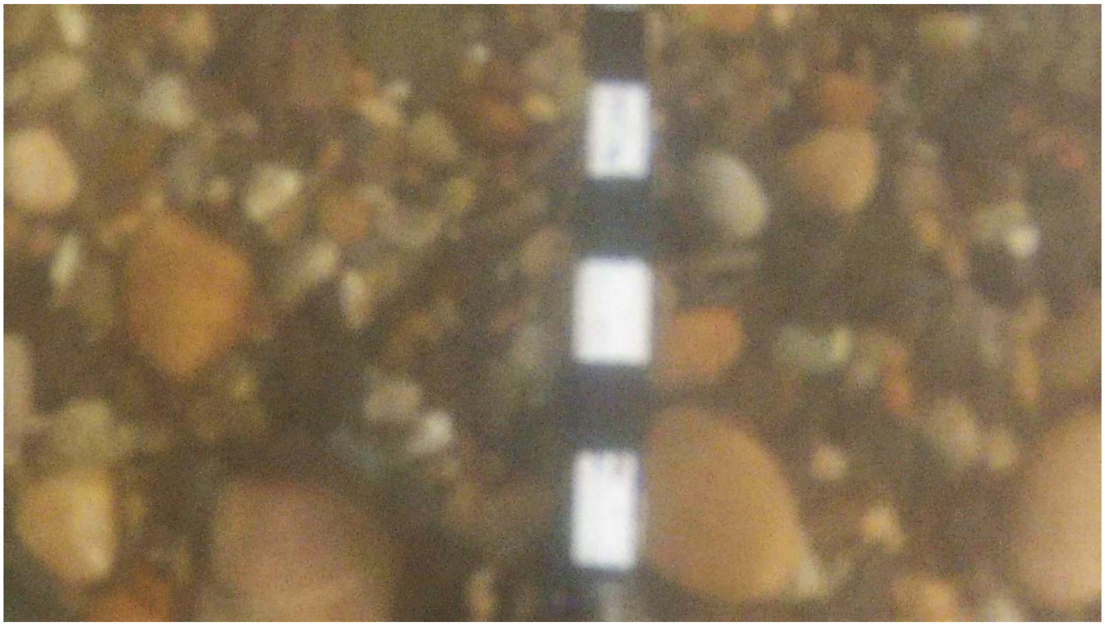

Plate 1 Riverbed substrate material image captured at the Video-09 site located near substrate mat M508 (Appendix A, Figure A4), 10 February 2019.

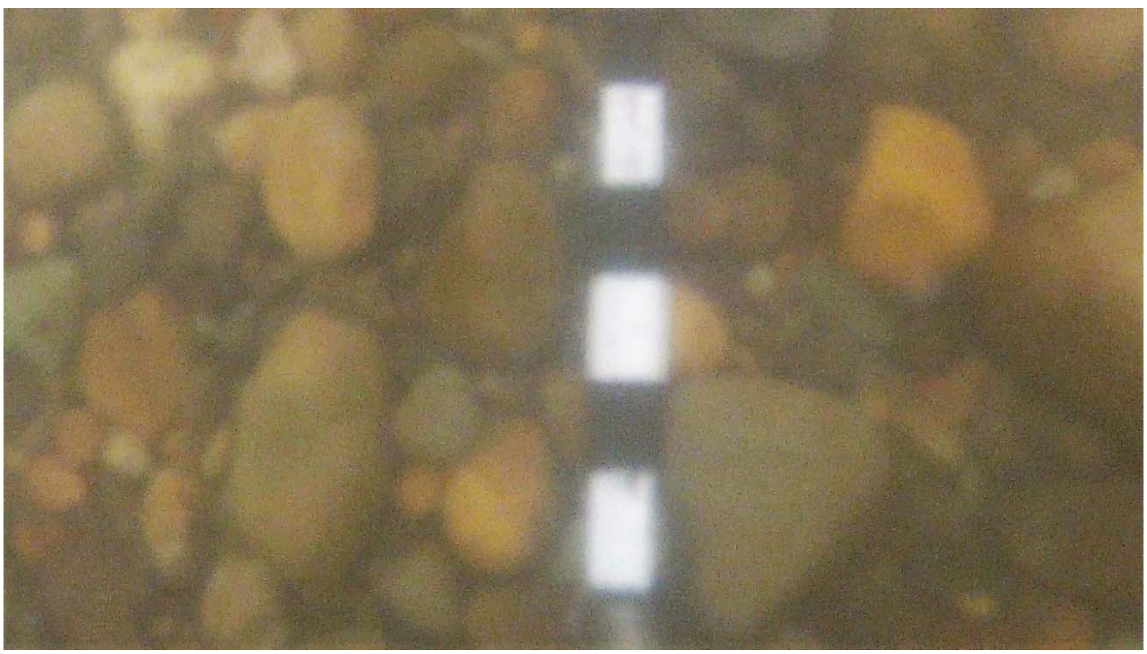

Plate 2 Riverbed substrate material image captured at the Video-08 site located upstream of substrate mat M505 (Appendix A, Figure A4), 10 February 2020.

Habitat conditions (depths, velocities and substrate) at the Upper Site 109L area are comparable to criteria preferred by the indicator species and life stages (e.g., CEMA 2009; Golder 2014). Water depths recorded over the survey period ranged from 1.2 to 4.7 m and velocities recorded during the 2019 APCP survey ranged from 0.06 to 1.7 m/s). Substate in the area was dominated by cobbles and gravels.

3.2 General Fish Use

To allow for more accurate comparisons across study years, before-after comparisons in the following sections were limited to data collected during the four years immediately prior to offset construction (i.e., 2012, 2013, 2014 and 2015; before) and data collected during the four years immediately after offset construction (i.e., 2016, 2017, 2018 and 2019; after).

Activities associated with the construction of the Project were ongoing during the 2019 field season. These activities were largely limited to locations upstream of the two offset areas and may have altered water quality, and therefore fish use of the offset areas at the time of sampling. Instream construction work associated with the construction of Side Channel Site 108R was ongoing during the 2019 field season. This work was located on the right downstream bank (i.e., south bank) of the Peace River near the downstream end of Upper Site 109L.

3.2.1 River Road Rock Spurs

3.2.1.1 Boat Electroshocking

During the 2016 to 2019 surveys, the efficiency of boat electroshocking the River Road rock spurs area was negatively impacted by the river hydraulics formed by the rock spurs. Variable water depths, velocities, and flow directions around the rock spurs made it difficult to effectively manoeuvre the boat and resulted in an inconsistent electrical field. These changes caused less predictable responses by fish, making them more difficult to capture by the netters.

During the four years of sampling conducted after construction of the rock spurs, a total of 705 fish were captured at Sites 0505 and 0506 combined (Table 8) using boat electroshocking. These numbers do not include fish that were observed but avoided capture. The total number of fish captured after the construction of the offsets (n = 705) was approximately half the total number of fish captured during the four years before offset construction (n = 1560). A large change in species composition before and after the construction of the rock spurs was related to the composition of non-indicator species. The three sucker species combined (Largescale Sucker [*Catostomus macrocheilus*], Longnose Sucker [*Catostomus catostomus*], and White Sucker [*Catostomus commersonii*]) represented 47% of the total catch before the construction of the rock spurs and 34% of the total catch after the construction of the rock spurs. The percentage of coldwater indicator species (i.e., Arctic Grayling, Bull Trout, Mountain Whitefish, and Rainbow Trout) in the catch increased from 52% before offset construction to 58% after offset construction. For these species, Bull Trout and Rainbow Trout showed the largest increases in composition, with both increasing by 5.6% relative to the rest of the catch.

Burbot (n = 8) were only captured at these sites after the construction of the rock spurs and were recorded in three of the four years of monitoring conducted after construction. A single Spottail Shiner (*Notropis hudsonius*) was captured and recorded in 2019, representing the first record for this species in 17 years of systematic sampling of these sites. Kokanee (*Oncorhynchus nerka*), Lake Chub (*Couesius plumbeus*), Lake Whitefish

(*Coregonus clupeaformis*) and Trout-Perch (*Percopsis omiscomaycus*) were recorded after the construction of the rock spurs but were not recorded in the four years prior to construction (although both Kokanee and Lake Whitefish were recorded in the area prior to 2012). The number of Walleye captured was greater before construction (*n* = 36) than after construction (*n* = 14).

Data collected before the construction of the offset and data collected after construction of the offset suggest increased use of the area for most coldwater indicator species (i.e., Arctic Grayling, Bull Trout, and Rainbow Trout). A decrease in Walleye, one of the coolwater indicator species, and in sucker species was observed after offset construction. The number of Mountain Whitefish (a coldwater indicator species) recorded in the study area varied substantially from year to year, but largely followed patterns observed throughout the BC portion of the Peace River mainstem (e.g., Golder and Gazey 2019); however, data do suggest increased use of the rock spur area by Mountain Whitefish in 2018 and 2019 relative to 2016 and 2017. Sparse data for all other species during all study years limit analysis and interpretation for these species.

Table 8: Number of fish caught by boat electroshocking and their frequency of occurrence in Sites 0505 and 0506 of the Peace River, 2012 to 2019.

Species	Year																			
	Before										After									
	2012		2013		2014		2015		Combined Before		2016		2017		2018		2019		Combined After	
	n[a]	%[b]	n[a]	%[b]	n[a]	%[b]	n[a]	%[b]	n[a]	%[b]	n[a]	%[b]	n[a]	%[b]	n[a]	%[b]	n[a]	%[b]	n[a]	%[b]
Indicator Species																				
Arctic Grayling	1	<1			1	<1	1	<1	3	<1	3	2	1	<1			1	<1	5	<1
Bull Trout	9	2	3	<1	4	1	6	1	22	1	12	9	14	11	13	7	11	4	50	7
Burbot													2	2	2	1	4	2	8	1
Mountain Whitefish	228	59	247	75	170	50	90	18	735	47	33	26	57	43	109	57	92	36	291	41
Rainbow Trout	4	1	3	<1			3	<1	10	<1	9	7	10	8	14	7	11	4	44	6
Walleye	8	2	14	4	11	3	3	<1	36	2	2	2	1	<1	8	4	3	1	14	2
Indicator Spp. Subtotal	**250**	**65**	**267**	**81**	**186**	**55**	**103**	**20**	**806**	**52**	**59**	**46**	**85**	**65**	**146**	**77**	**122**	**47**	**412**	**58**
Non-Indicator Species																				
Lake Trout			1	<1					1	<1										
Kokanee													1	<1					1	<1
Lake Chub													1	<1					1	<1
Largescale Sucker	20	5	11	3	20	6	61	12	112	7	4	3	3	2	8	4	20	8	35	5
Longnose Sucker	111	29	50	15	117	35	288	57	566	36	46	36	31	23	27	14	72	28	176	25
Northern Pike					2	<1			2	<1					2	1			2	<1
Northern Pikeminnow	4	1			2	<1	10	2	16	1	4	3	7	5	3	2	15	6	29	4
Redside Shiner							2	<1	2	<1	5	4	3	2			8	3	16	2
Prickly Sculpin																	5	2	5	<1
Slimy Sculpin							1	<1	1	<1					1	<1			1	<1
Spottail Shiner																	1	<1	1	<1
Trout-Perch															1	<1	1	<1	2	<1
White Sucker			2	<1	9	3	42	8	53	3	10	8	2	2	2	1	14	5	28	4
Sucker spp.[c]					1	<1			1	<1										
Non-Indicator Spp. Subtotal	**135**	**35**	**64**	**19**	**151**	**45**	**404**	**80**	**754**	**48**	**69**	**54**	**48**	**36**	**44**	**23**	**137**	**53**	**298**	**42**
All species	**385**	**100**	**331**	**100**	**337**	**100**	**507**	**100**	**1560**	**100**	**128**	**100**	**133**	**100**	**190**	**100**	**259**	**100**	**705**	**100**

In the diversity profiles, the effective number of species is used to indicate the diversity of fish species, while varying the value of *q*, which represents the relative contribution of rare species to the diversity metric. The steep decline in the effective number of species with increasing values of *q* reflects the community composition in the offset area, with a few species dominating the catch and low numbers of rare species (Figure 1). Species richness (*q* = 0) was approximately 2 effective species higher after the offset was constructed. Based on the Shannon Index (*q* = 1), community composition was substantially different after construction of the offset, indicating increased diversity (approximately two effective species greater) after offset construction with no overlap in confidence intervals.

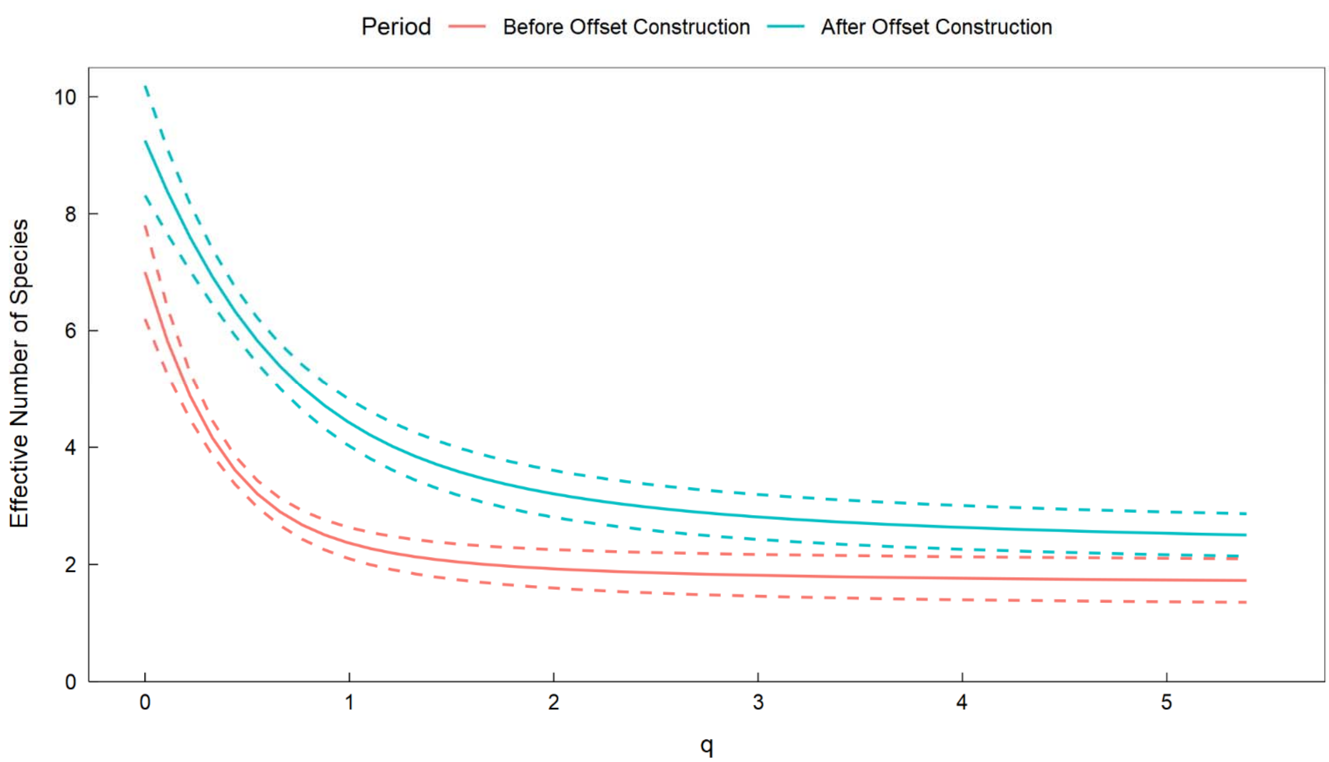

Figure 1: Diversity profiles for the River Road rock spurs area showing effective number of species versus the parameter (*q*) representing the importance of rare/common species in the calculation. Values are means (solid lines) with 95% confidence interval.

The River Road rock spurs are intended to provide additional rearing habitat for immature Arctic Grayling, Mountain Whitefish, and Rainbow Trout (Table 1). Both immature Mountain Whitefish and immature Rainbow Trout were recorded within Sites 0505 and 0506 after the construction of the offset (Appendix C, Table C3). Overall, Arctic Grayling numbers have decreased at these two sites since 2007 (*n* = 46) to 2018 (*n* = 0) with approximately two Arctic Grayling captured annually over the last eight years. One adult Arctic Grayling was captured in 2019 in Site 0505. Immature Arctic Grayling were not recorded within Sites 0505 or 0506 after the construction of the offset but were also rare in these sites before offset construction (one immature Arctic Grayling in 2014 and one immature Arctic Grayling in 2015).

Overall, data suggest increased use of the River Road rock spur area by the indicator species and that this area may provide more preferable habitats for some species that had not previously been captured at these sites (e.g., Burbot, Lake Chub and Trout-perch).

Length-frequency histograms were generated for Mountain Whitefish but not for other species because of the low number of individuals of other indicator species captured each year. In 2019, for all of these other species, the range of fork lengths recorded (Appendix C, Table C3) were similar to the ranges recorded before the construction of the rock spurs (Golder and Gazey 2018).

Length-frequency data for Mountain Whitefish (Figure 2) indicate that few small Mountain Whitefish (i.e., less than approximately 220 mm FL) were captured in the River Road rock spur area in all years before and after the construction of the rock spurs, with the exception of 2019. Data from 2019 indicates increased use of the rock spurs area by Mountain Whitefish less than 100 mm FL. Based on data presented by Golder and Gazey (2019), Mountain Whitefish captured in the late summer to early fall period in the Peace River that are less than approximately 100 mm FL are typically age-0, while individuals between approximately 130 and 200 mm FL are typically age-1.

The range of mean Mountain Whitefish body condition values was similar before (1.03 to 1.17) and after (1.05 to 1.12) construction at the River Road rock spur offset area (Figure 3). Raw body condition data for all species encountered in 2019 are provided in Appendix C, Table C3; data for all other years are provided in Golder and Gazey (2019).

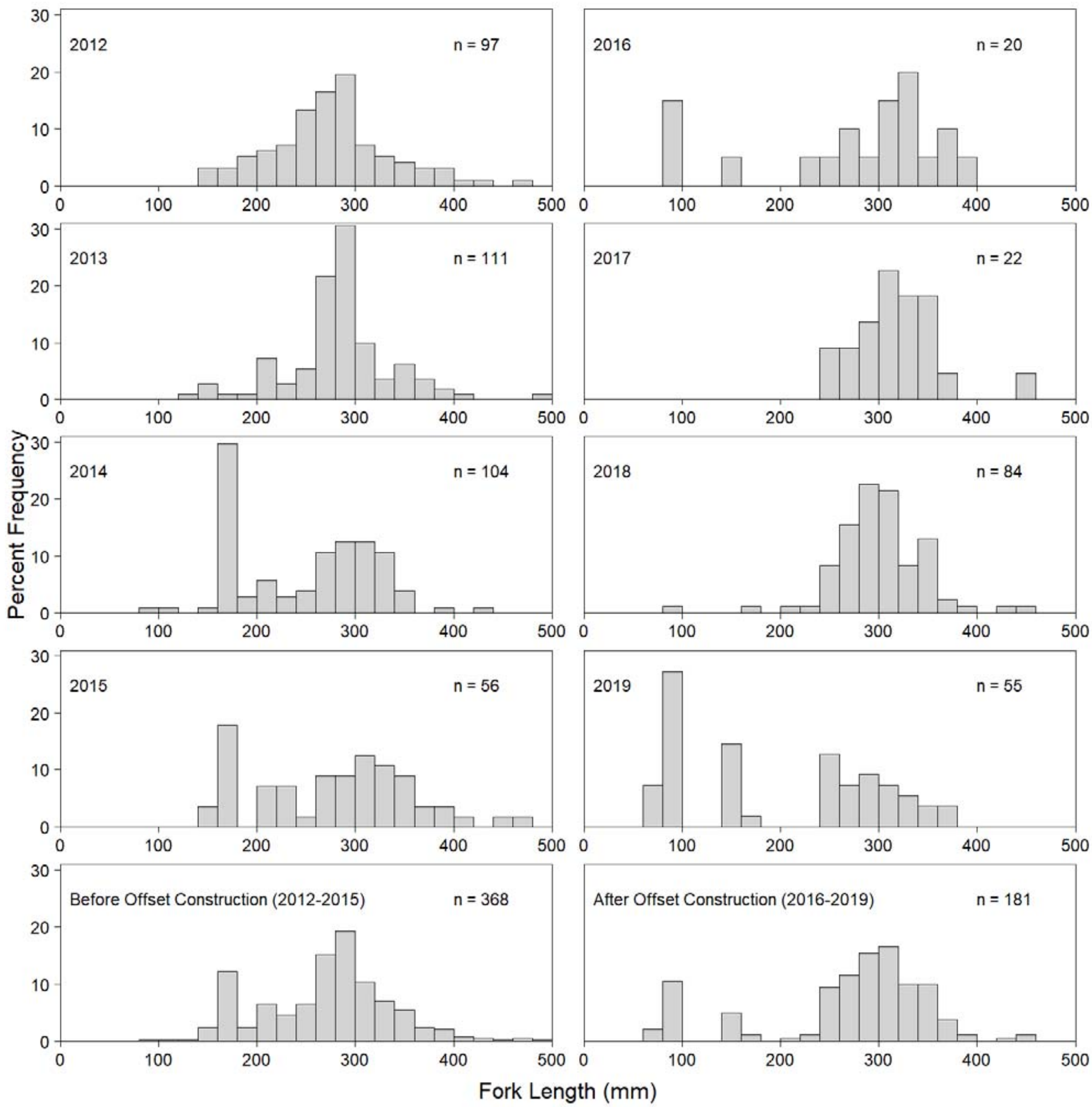

Figure 2: Length-frequency distributions for Mountain Whitefish captured by boat electroshocking in Sites 0505 and 0506 of the Peace River by year for the before and after construction periods.

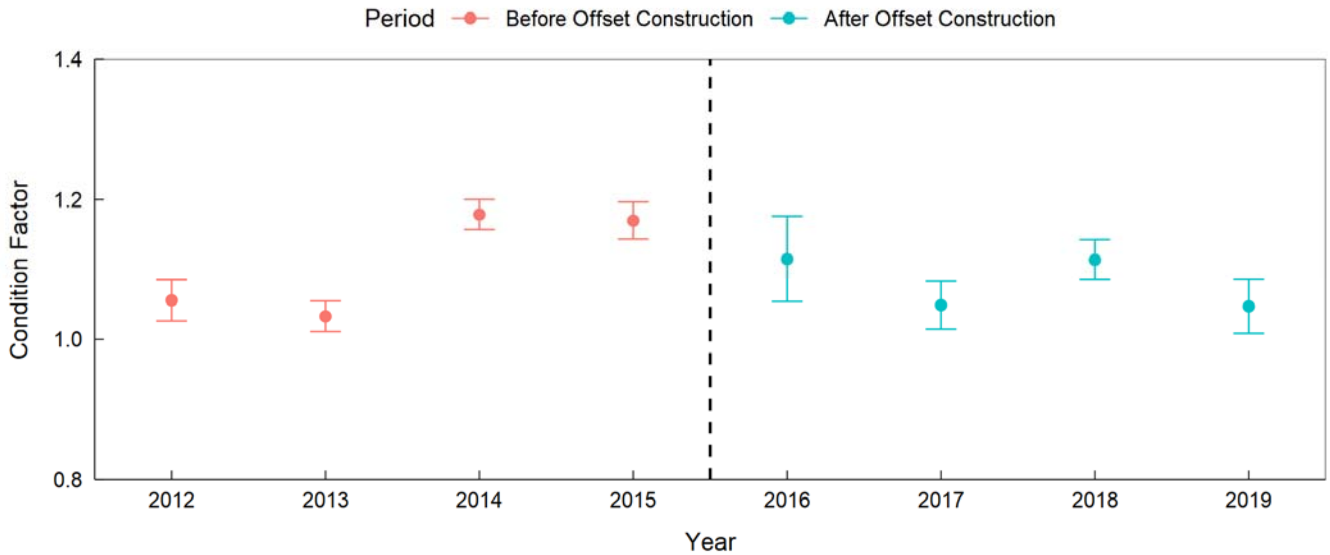

Figure 3: Mean body condition with 95% confidence intervals (CIs) for Mountain Whitefish captured by boat electroshocking in Sites 0505 and 0506 of the Peace River, 2012 to 2019.

3.2.1.2 Hoop Traps

During the first session, six baited hoop traps were set over approximately a five-hour period during the day. During the second session, six baited hoop traps were set overnight for approximately 20 hours. The hoop traps were not effective in the eddies between the rock spurs because of the dynamic flow conditions and high volume of debris. When inspected at the end of the second session, five of six traps were entangled with their shore lines and float lines, twisted amongst themselves, and trapped/filled with small woody debris. The remaining hoop trap was lost. In total, 128 hours of sampling were expended with hoop traps during the 2019 survey; fish were not captured (Appendix C; Table C4).

3.2.1.3 Minnow Traps

In total, 17 baited minnow traps were set on four different occasions (9, 20, and 28 September and 4 October 2019). Minnow traps set on 9 September were set for approximately five hours during the day. During the remaining sessions, the minnow traps were set overnight for between 20 and 25 hours. In total, 1255 hours of minnow trapping were expended. Over that time period, 17 Prickly Sculpin, 2 Slimy Sculpin, and 1 young-of-the-year sucker species were captured (Appendix C, Table C5).

3.2.2 Upper Site 109L

During the period after construction of the offsets (2016, 2017, 2018 and 2019), a total of 892 fish were captured at Sites 0509, 109OSA, 109OSB and 109OSC combined (Table 9; Appendix C, Table C2); only Site 0509 was sampled in 2016 and Site 109OSC was sampled in 2018 and 2019 only. The total number of fish captured after the construction of the offset (*n* = 892) was approximately 17% lower when compared to the total number of fish captured during the four years prior to offset construction (*n* = 1071). This decline was almost entirely due to a decline in the Mountain Whitefish catch (25% lower when compared to Mountain Whitefish captured in the four years prior to construction of the offset). Arctic Grayling have not been recorded in Upper Site 109L since its construction, but this species was rarely encountered prior to Upper Site 109L's development. The total number of different species captured was greater in the four years after construction than the four years before construction (Table 9). Several species were recorded in 2019 that were not recorded in Upper Site 109L before its development or during the first 3 years of post-construction monitoring. These included a single immature Kokanee, a single adult Lake Chub, and three adult Longnose Dace.

Upper Site 109L was predicted to provide additional rearing habitat for immature Arctic Grayling, Mountain Whitefish, and Rainbow Trout, and additional feeding habitat for adult Bull Trout, Mountain Whitefish, Rainbow Trout, and Walleye (Table 1). Immature Mountain Whitefish were common at these sites after construction of the offset and represented approximately 23% of the combined 2016–2019 Mountain Whitefish catch. These results are consistent with previous study years. The only Rainbow Trout recorded after construction of Upper Site 109L were classified as immature and were recorded in 2016 (Golder and Gazey 2017). Immature Arctic Grayling were not recorded within Upper Site 109L after construction; this species was rarely encountered in this area prior to construction. Adult Bull Trout and Walleye catch was low in Upper Site 109L in both pre- and post-construction periods (less than six individuals of each species each year).

Similar to the results from the River Road rock spur area, diversity profiles for Upper Site 109L indicate a steep decline in the effective number of species with increasing values of *q*, indicating that a few fish species dominate the catch with low numbers of rare species (Figure 4). The effective number of species was similar before and after construction of the offset, with differences of less than 1 effective species and overlapping confidence intervals at all values of *q*.

Table 9: Number of fish caught by boat electroshocking and their frequency of occurrence in Sites 0509, 109OSA, 109OSB and 109OSC of the Peace River, 2012 to 2019.

Species	Year																			
	Before										After									
	2012		2013		2014		2015		Combined Before		2016		2017		2018		2019		Combined After	
	n[a]	%[b]	n[a]	%[b]	n[a]	%[b]	n[a]	%[b]	n[a]	%[b]	n[a]	%[b]	n[a]	%[b]	n[a]	%[b]	n[a]	%[b]	n[a]	%[b]
Indicator Species																				
Arctic Grayling	1	<1	2	<1			2	<1	5	<1										
Bull Trout	3	1	4	1			5	2	12	1	2	2	3	2	3	1	4	1	12	1
Burbot	1	<1							1	<1										
Mountain Whitefish	195	86	305	87	223	91	162	66	885	83	87	65	133	68	203	77	210	71	633	71
Rainbow Trout	1	<1	3	<1			6	2	10	<1	3	2							3	<1
Walleye	4	2			1	<1			5	<1			1	<1	2	<1	3	1	6	<1
Indicator Spp. Subtotal	**205**	**90**	**314**	**89**	**224**	**91**	**175**	**71**	**918**	**86**	**92**	**69**	**137**	**70**	**208**	**79**	**217**	**73**	**654**	**73**
Non-Indicator Species																				
Lake Trout																				
Kokanee																	1	<1	1	<1
Lake Chub																	1	<	1	<1
Largescale Sucker	3	1	4	1	5	2	2	<1	14	1	7	5	13	7	14	5	15	5	49	6
Longnose Dace																	3	1	3	<1
Longnose Sucker	11	5	33	9	16	7	64	26	124	12	31	23	43	22	35	13	34	11	143	16
Northern Pike		1	<1						1	<1					1	<1	2	<1	3	<1
Northern Pikeminnow	1	<1					2	<1	3	<1	1	<1	1	<1			1	<1	3	<1
Prickly Sculpin															1	<1	1	<1	2	<1
Redside Shiner											2	2	3	2	1	<1	11	4	17	2
Slimy Sculpin							2	<1	2	<1					2	<1	8	3	10	1
Spottail Shiner															1	<1			1	<1
Trout-Perch															1	<1			1	<1
White Sucker	7	3			1	<1	1	<1	9	<1					1	<1	3	1	4	<1
Non-Indicator Spp. Subtotal	**22**	**10**	**38**	**11**	**22**	**9**	**71**	**29**	**153**	**14**	**41**	**31**	**60**	**31**	**57**	**22**	**80**	**27**	**238**	**27**
All species	**227**	**100**	**352**	**100**	**246**	**100**	**246**	**100**	**1071**	**100**	**133**	**100**	**197**	**100**	**265**	**100**	**297**	**100**	**892**	**100**

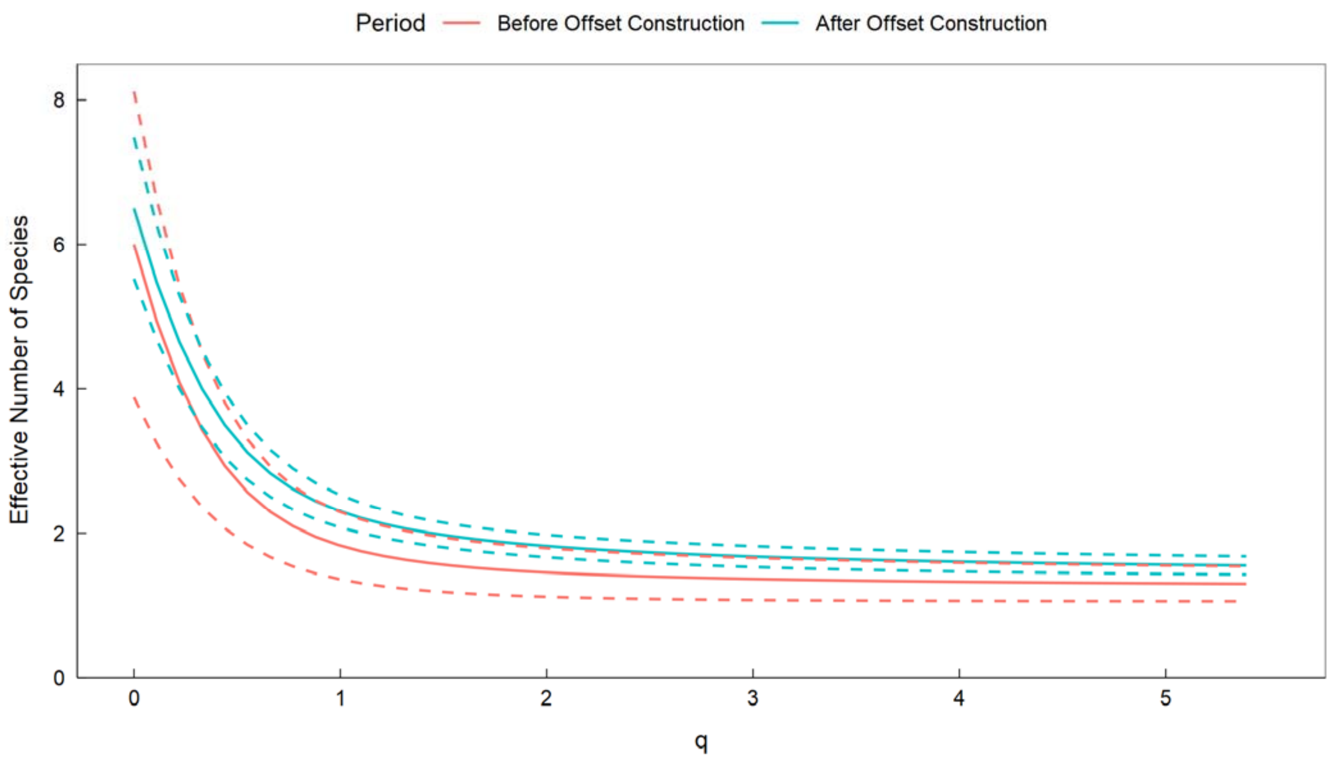

Figure 4: Diversity profiles for the Upper Site 109L area showing effective number of species versus the parameter (*q*) representing the importance of rare/common species in the calculation. Values are means (solid lines) with 95% confidence intervals (dashed line).

Length-frequency histograms were generated for Mountain Whitefish but not for other species because of the low number of individuals of other indicator species captured each year. For all other species, the range of fork lengths recorded after the construction of Upper Site 109L (Appendix C, Table C3) were similar to the ranges recorded before the construction of Upper Site 109L (Golder and Gazey 2018).

Length-frequency data for Mountain Whitefish (Figure 5) indicate that the Upper Site 109L area is used by age classes of Mountain Whitefish from young-of-the-year to adults. One difference between the length distribution of Mountain Whitefish captured before and after the construction of Upper Site 109L was a decrease in fish with fork lengths between approximately 170 and 200 mm, which are likely age-1 fish (based on length-at-age data provided by Golder and Gazey 2019). The difference was mostly attributed to a large cohort of age-1 Mountain Whitefish captured in 2014 compared to other study years. A large percentage of Mountain Whitefish with fork lengths less than 100 mm were captured in 2019, similar to the length-frequency data for Sites 0505 and 0506 (the River Road rock spurs area). Overall, length frequency distributions do not indicate any substantial differences in the sizes of Mountain Whitefish using habitats in Upper Site 109L before and after construction (Figure 5).

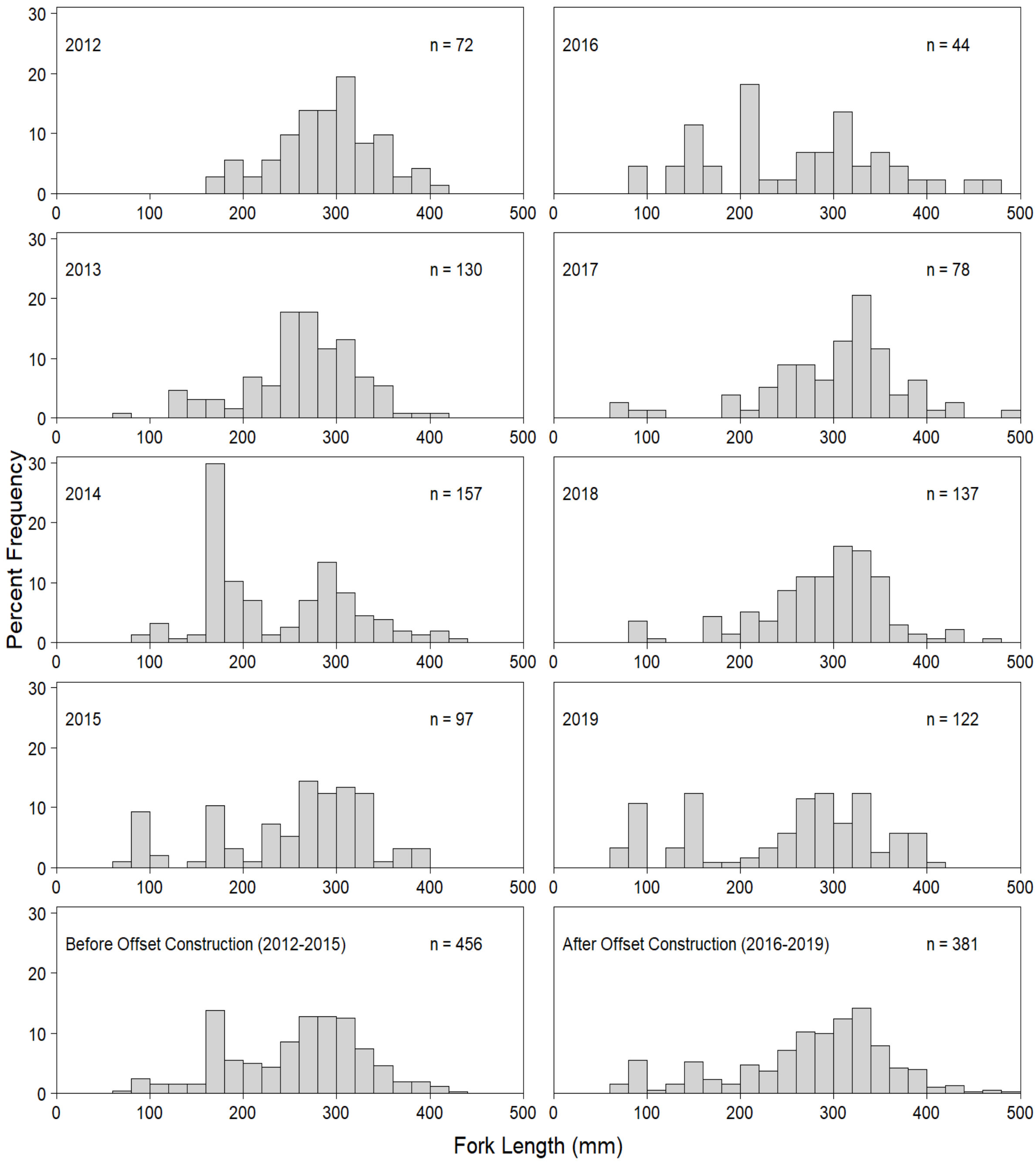

Figure 5: Length-frequency distributions for Mountain Whitefish captured by boat electroshocking in Sites 0509, 109OSA, 109OSB, and 109OSC of the Peace River by year for the before and after construction periods.

The range of mean body condition values was similar before (1.03 to 1.17) and after (1.06 to 1.10) construction of the Upper Site 109L offset area (Figure 6). Raw body condition data for all species encountered in 2019 are provided in Appendix C, Table C3; data for all other years is provided in Golder and Gazey (2018).

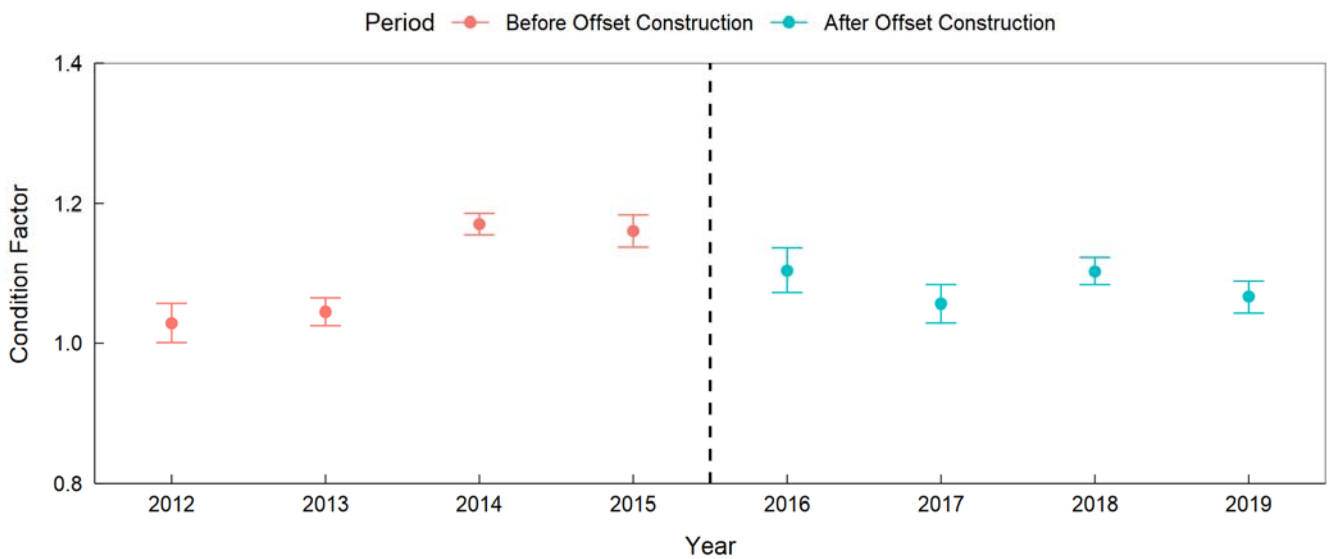

Figure 6: Mean body condition with 95% confidence intervals (CIs) for Mountain Whitefish captured by boat electroshocking in Sites 0509, 109OSA, 109OSB, and 109OSC of the Peace River, 2012 to 2019.

3.3 Mountain Whitefish Spawning

Egg mat sampling in Upper Site 109L and locations adjacent to the offset area, occurred from 28 October 2019 to 10 February 2020 (Table 5). Over this time period, mats were deployed on the river bottom at 21 different locations at water depths that ranged between 1.9 and 4.7 m (average water depth = 2.7 m). In total, 32,502 hours of egg mat sampling were expended during the 2019 survey (Appendix D, Table D1). Mountain Whitefish eggs were not captured.

4.0 DISCUSSION

This report summarizes results collected during the third of three years of proposed offset effectiveness monitoring for the River Road rock spurs and Upper Site 109L. The effectiveness of the offset areas in improving fish and fish habitat were evaluated at a site-scale, rather than a reach-scale. This monitoring is in addition to other ongoing monitoring components in this portion of the Peace River. Results from 2019 were compared to data from 2018 and 2017 and with baseline conditions, when possible.

A summary of the effectiveness of the offsets at a reach-scale was not conducted in 2019 because the offsets were not anticipated to have an immediate impact on Peace River fish populations over a short time period (i.e., 4 years is not long enough for a reach-level change to be detected). The effectiveness of the offset areas at a reach-scale, as outlined in the FAA, will be preliminarily explored after all offsets proposed as part of the Project are constructed. Monitoring over a long timeframe will likely be required to identify reach-level effects of the offsets. Long-term monitoring planned as currently planned under the Site C FAHMFP, most notably the Peace River Physical Habitat Monitoring Program (Mon-3) and the Peace River Fish Community Monitoring Program (Mon-2), will likely be required.

4.1 Physical Habitat

4.1.1 River Road Rock Spurs

The River Road rock spurs were designed to provide variability in water depths, water velocities, and substrate sizes (through the use of riprap and boulders), as well as lower nearshore water velocities, resulting in more suitable rearing and feeding habitat for most coldwater fish species and predation refuges. ADP data collected around a sub-sample of the rock spurs in 2018 and 2019 indicate substantial variability in water velocities and flow directions immediately upstream, downstream, and above the rock spurs. In addition, increased flow variability was observed in the areas immediately adjacent to the rock spurs (i.e., towards mid-channel). Flow and depth variability surrounding the rock spurs contrasts with adjacent Peace River shorelines, which typically consist of few bank irregularities and more laminar flows. Nearshore velocities along River Road were lower adjacent to rock spurs when compared to nearshore areas along River Road away from rock spurs (e.g., Transect DS06a).

Visual observations of the rock spurs and armoured rip-rap bank indicated these features had maintained their structure. As these substrates are substantially larger than the substrate sizes present in the area prior to the construction of the rock spurs (dominantly fines to cobbles; Golder 2016), they provide increased interstitial areas and predation refugia for juvenile large-bodied fish and all life stages of small-bodied fish.

Overall, the construction of the rock spurs and associated bank armouring provide physical habitat that is consistent with predictions made by BC Hydro (2015), which has resulted in lower, and more variable water velocities, and lower water depths compared to adjacent areas. In addition, the offset provides velocity and interstitial refugia for small fish. The habitat present along River Road is suitable for feeding and rearing for coldwater species like Arctic Grayling, Bull Trout, Mountain Whitefish, and Rainbow Trout.

4.1.2 Upper Site 109L

Upper Site 109L was designed and constructed to meet certain objectives, including increasing the quantity and quality of permanently wetted habitat available to support primary and secondary productivity, providing rearing, feeding, overwintering, and potential spawning habitats for fish, reducing fish stranding risk, and increasing the complexity and variability of fish habitat to support a variety of life stages for local fish populations.

ADP data collected from 2016 to 2019 indicate variability in water velocities, flow directions, and water depths associated with the constructed channel depressions. This variability results in increased habitat complexity when compared to pre-Project conditions.

Upper Site 109L was recontoured with an elevation of less than 407 masl, with the intent of ensuring that the area remains permanently wetted under the minimum operating flows for the Project (409 masl; BC Hydro 2015). Recontouring aimed to increase the quantity of permanently wetted habitat available for primary and secondary production, increase the area where eggs could incubate without risk of dewatering, and reduce fish stranding risk. The area was observed to remain wetted over a range of discharges; however, a dewatered cobble bar approximately 0.5 m wide by 1.5 m long was observed within the perimeter of Upper 109L area on 29 September 2019 while field crews were in the area conducting fish use surveys. At that time, Peace River discharge was approximately 580 m^3/s, higher than the minimum water levels expected under the Project. This exposed cobble bar was not observed during the ADP survey on 14 September 2019. At the time of the ADP survey, discharge ranged between 700 and 1100 m^3/s. The cobble bar was also noted on 23 April 2019 when discharge was approximately 502 m^3/s. The location of the cobble bar (marked on Appendix B, Figure B13) was consistent with the location of aggradation first identified in 2018 (Golder 2019). The exposed area and shallow water immediately adjected to it was inferred from satellite-based depth mapping (Aaron Tamminga, University of British Columbia, unpublished data) using imagery from September 19, 2018 (discharge of approximately 422 m^3/s). The area is also visible in aerial photographs taken of the area on 18 September 2018 (Underhill Geomatics Ltd. unpublished data).

Some other small changes (erosion and deposition) in riverbed elevations were noted along the surveyed transects. If these changes continue or expand over time, they could change the structure and function of features within Upper Site 109L over the long-term.

4.1.2.1 Substrate Characteristics

Although no riverbed substrate samples were collected, and the underwater video footage was limited to areas where the water depth was less than 2.0 m, interpretation of the images indicated a variety of riverbed substrate sizes. The majority of the substrate observed in Upper Site 109L was gravel and cobble with some accumulation of fines. Evidence of interstitial spaces for potential fish egg incubation was observed.

4.2 General Fish Use

During the 2019 field program, boat electroshocking, hoop traps, and minnow traps were used to assess fish use of the River Road rock spurs area. Boat electroshocking was the most effective method at capturing fish due to the conditions at the time of sampling (i.e., high water velocities, high water depths, and high turbidity). Hoop traps and minnow traps were used to potentially capture juvenile large-bodied fish and small-bodied fish in areas adjacent to the rock spurs where the boat electroshocker was not effective. Few fish were captured by these traps and none of the capture fish were indicator species. Boat electroshocking was the only method of fish capture employed in Upper Site 109L.

Successful boat electroshocking surveys were conducted in both offset areas, providing a reliable index of fish use for the sample period (August-October); however, smaller life stages of fish are typically underrepresented in boat electroshocking catches. Both offset areas are intended to increase the amount of rearing habitat available for Arctic Grayling, Mountain Whitefish, and Rainbow Trout and direct observations of these smaller life stages using boat electroshocking is difficult.

4.2.1 River Road Rock Spurs

Boat electroshocking was less efficient along River Road after the construction of the rock spurs. The eddies formed by the rock spurs resulted in less effective netting and made manoeuvring the boat more onerous when compared to the straight shoreline and laminar flows that were present in the area prior to the construction of the rock spurs. This decline in efficiency likely contributed to lower catch rates in Sites 0505 and 0506 after the rock spurs were constructed; however, this decline was likely consistent across species and size classes.

An increase in species diversity, compared to historical studies, since the construction of the River Road and the associated habitat structures could be due to the increased habitat complexity associated with the rock spurs and riprap. Eight Burbot were captured during the last three years of sampling (2017 to 2019) along the River Road rock spurs, and these were the first encounters of this species in this portion of the Peace River in 17 years of systematic sampling. Most of the Burbot captured in the rock spurs sites were greater than 300 mm in length, but two were smaller (82 and 154 mm), suggesting that this area may provide suitable habitat for both juvenile and adult life stages of Burbot. Burbot were frequently associated with similarly constructed rock spurs during boat electroshocking surveys conducted on the Columbia River (Golder 2005, 2006) and McPhail (2007) notes that juvenile Burbot strongly associate with riprap jetties and natural boulder areas. Based on these data, Burbot use of this area of the Peace River may increase as a result of the construction of the rock spurs. Lake Chub, Kokanee, Trout-perch, and Spottail Shiner were all recorded along the River Road sites after its development; however, these species were also recorded in immediately adjacent areas in recent study years (e.g., Golder and Gazey 2019).

Greater species diversity was recorded after construction of the rock spurs as reflected by diversity profiles. These profiles showed that the number of effective species was two species greater after construction, for values of q that corresponded to species richness and the Shannon index of diversity. The species similarity values used when calculating these profiles considered all small-bodied species as one species, and all suckers as one species, following the methods used by Ma et al. (2015) and Golder and Gazey (2019). If each small-bodied species was considered its own species, then the difference in diversity, measured in effective number of species, before and after construction, would have been larger.

Changes in methodology may have contributed to the increase in diversity in the catch after construction of the rock spurs. Field crews did not attempt to net fish smaller than 150 mm in fork length prior to 2015, but targeted all sizes of fish from 2015 onwards. Therefore, the increase in catch of small-bodied species, such as Lake Chub, Trout-perch, and Spottail Shiner, could be partly attributed to changes in the size of fish targeted by netters, rather than changes in fish density or habitat suitability for the species in the rock spurs area.

Catch data suggest increased use of the River Road and rock spur area for some coldwater species (i.e., Bull Trout and Rainbow Trout) and decreased use by some coolwater species (i.e., Walleye and Northern Pike) and sucker species (Largescale Sucker, Longnose Sucker, and White Sucker). Use of the area by Mountain Whitefish declined in the first two years after construction (2016 and 2017), but this decline was consistent with an overall decline in Mountain Whitefish catch throughout the Peace River (Golder and Gazey 2019). Over the whole eight-year time period considered, both the number captured and the percent composition of Mountain Whitefish was lower in the rock spurs area after construction (*n* = 735; 41%) than before construction (*n* = 291; 47%).

The River Road rock spurs are intended to provide additional rearing habitat for immature Arctic Grayling, Mountain Whitefish, and Rainbow Trout (Table 1). Both immature Mountain Whitefish (Figure 2) and immature Rainbow Trout were recorded within Sites 0505 and 0506 since the construction of the offset (Appendix C, Table C3). Immature Arctic Grayling were not recorded within Sites 0505 or 0506 after the construction of the offset but were also rare in these sites before offset construction (one immature Arctic Grayling in 2014 and one immature Arctic Grayling in 2015).

Overall, data collected since the construction of the River Road rock spurs suggest increased use of the area by some of the indicator species (i.e., Bull Trout, Rainbow Trout, and Burbot) but no change (Arctic Grayling) or a decrease (Mountain Whitefish and Walleye) in abundance of other indicator species. These changes could reflect site-specific changes in habitat suitability and use by these species, but the abundances captured are also influenced by abundance trends at the reach-scale in the Peace River. Effectiveness monitoring also suggested an increase in species diversity at the rock spurs area after their construction, due to an increase in Burbot and several small-bodied species (Lake Chub, Trout-perch, and Spottail Shiner). This may indicate better habitat suitability for these species after construction. However, changes in the catch while electroshocking the rock spur area were also likely influenced by changes in the size of fish targeted by netters, due to changing objectives of the monitoring program.

4.2.2 Upper Site 109L

Effectiveness monitoring results suggest similar use of Upper Site 109L in 2019 when compared to previous study years, with no substantial changes in use by fish species or life stage. Small differences in length-frequency distributions of Mountain Whitefish and percent composition by species before and after construction were observed between the before and after construction periods. These small differences could be partly related to changes in habitat related to the offset construction but are also likely affected by random chance due to small sample sizes, and changes in the overall Peace River fish community.

4.3 Mountain Whitefish Spawning

The results of sampling using egg mats did not indicate that Mountain Whitefish spawned immediately upstream of Upper Site 109L, within Upper Site 109L, or in the surrounding area in 2019. The timing of spawning by Mountain Whitefish in the Peace River is not known. For this reason, egg mats were deployed for the duration of what was expected to be the bulk of the Mountain Whitefish spawning season based on the water temperatures and the timing of spawning of other Mountain Whitefish population in British Columbia. Sampling in 2019 occurred from late October to mid-February when water temperatures declined from a high of 6.9°C to a low of -0.2°C. This sampling period encompassed a larger time period (half a month longer) of the potential spawning season over a larger range of water temperatures than both the 2017 (Golder 2018) and 2018 (Golder 2019) studies. In other systems, water temperatures at the onset of Mountain Whitefish spawning range between 6.0°C and 10°C, and spawning occurs typically in October and November. In the Columbia River, another large, regulated river, Mountain Whitefish spawning occurs as late as January or February (Golder 2014; Northcote and Ennis 1994 cited in Mainstream and Gazey 2014; McPhail 2007). Fish surveys were conducted between the Moberly River confluence and the CPR railway bridge as part of Mon-2, Task 2a up until 14 October 2019. Field staff identified two of 68 (3%) adult Mountain Whitefish as gravid (defined as releasing milt or eggs when light pressure is applied to the abdomen) on the last day of sampling (Golder and Gazey in prep.) and did not record any ripe individuals (defined as freely releasing milt or eggs). Based on the low number of gravid and ripe individuals recorded on 14 October, it is highly unlikely that the entire population spawned after 14 October, but prior to the egg mats being deployed on 28 October. Egg mats were deployed at a variety of water depths and locations within Upper Site 109L and adjacent areas downstream. Adequate spatial and temporal coverage of the Upper Site 109L area was assumed with the study design. The intensity of sampling was expected to capture eggs, if spawning occurred.

Upper Site 109L provides a potential area for egg incubation, as the area did not dewater over the range of discharges observed, with the exception of the cobble bar noted above, and the riverbed substrate provided adequate material and interstitial spaces to protect eggs during development.

5.0 CONCLUSION

The FAA lists three offset effectiveness criteria. Offset Effectiveness Monitoring's progress towards addressing each of these three criteria are briefly addressed below.

1) Offsets will be constructed according to designs. Information gathered during implementation monitoring will inform this assumption.

The offsets were constructed as described in Section 6.2.1 (Mitigation Measures Downstream of Site C Dam Site) of the Project's Fisheries and Aquatic Habitat Management Plan.

2) Offsets maintain their structure and function. For example, the depressions maintain their structure and function (i.e., infilling does not reduce physical function) and substrate at Upper Site 109L is suitable for spawning by Mountain Whitefish. This will be assessed in the physical component of the Offset Effectiveness Monitoring.

Physical habitat data, as well as visual assessment of the offset in 2019, indicate that the offsets have generally maintained their structure since their construction. Two of the channel profiles in Upper Site 109L showed evidence of deposition in areas along the north bank and one of the channel profiles showed evidence of scouring. In addition, an area of exposed cobbles was noted by field staff, indicating an increase in riverbed elevation, possibly due to deposition, that can result in a portion of Upper Site 109L becoming dewatered at low discharges. The physical characteristics of water depths and water velocities occurred as predicted (BC Hydro 2015). The construction of the rock spurs and associated bank armouring along River Road has increased habitat complexity and provides habitats that are uncommon in this reach of the Peace River. Upper Site 109L effectively increases the amount of permanently wetted habitat available to support primary and secondary productivity, while eliminating stranding risk, and increasing the complexity of habitat available to fish. Based on the interpretation of video images collected throughout the area, the riverbed substrate at Upper Site 109L consisted of gravel and cobble with limited fines and was considered suitable to support Mountain Whitefish spawning and egg incubation. Overall, the two offset areas increase the quantity and quality of rearing, feeding, overwintering, and potential spawning habitats available to fish and are capable of supporting a variety of life stages.

Physical habitat surveys did not indicate any substantial changes in the structure or effectiveness of the River Road rock spurs in 2017, 2018, or 2019.

3) Fish will use the offset areas. Information collected on fish use will inform this assumption.

The River Road rock spurs were designed to provide additional rearing habitat for Arctic Grayling, Mountain Whitefish, and Rainbow Trout. Young Mountain Whitefish and Rainbow Trout were recorded along River Road after the rock spurs were constructed. However, young Arctic Grayling were not recorded in this area after the rock spurs were constructed, but were also rarely recorded before the rock spurs were constructed.

The River Road rock spurs were also designed to provide additional feeding habitat for Arctic Grayling, Bull Trout, Mountain Whitefish, and Rainbow Trout. The adult life stages of these species represented a larger portion of the total catch after the rocks spurs were constructed, indicating that the area provides suitable feeding habitat for these species. The largest increase in catch was seen in Bull Trout and Rainbow Trout.

Upper Site 109L was designed to provide additional rearing habitat for Arctic Grayling, Mountain Whitefish, and Rainbow Trout; both immature Mountain Whitefish and immature Rainbow Trout were recorded in the area after construction. Young Arctic Grayling were not recorded in this area after construction, but they were also rarely recorded before construction.

Upper Site 109L was designed to provide additional feeding habitat for Bull Trout, Mountain Whitefish, Rainbow Trout, and Walleye. The adult life stages of these species were recorded after Upper Site 109L's construction at numbers that were similar to those recorded before Upper Site 109L's construction.

After its construction, Upper Site 109L provided habitat conditions that were similar to habitats known to successfully incubate Mountain Whitefish eggs in other systems (e.g., Golder 2014). Riverbed substrate that was suitable to support Mountain Whitefish spawning and egg incubation were recorded in 2018 and 2019. Mountain Whitefish eggs were not recorded in the area in 2018 or 2019.

6.0 CLOSURE

We trust the information contained in this report is sufficiently detailed for your review purposes. Please do not hesitate to contact us should you have any questions or require clarification.

Golder Associates Ltd.

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DB/DF/cmc

https://golderassociates.sharepoint.com/sites/108497/project files/6 deliverables/issued to client_for wp/19121769-005-r-rev0/19121769-005-r-rev0-offset monitoring 2019 27feb_20.docx

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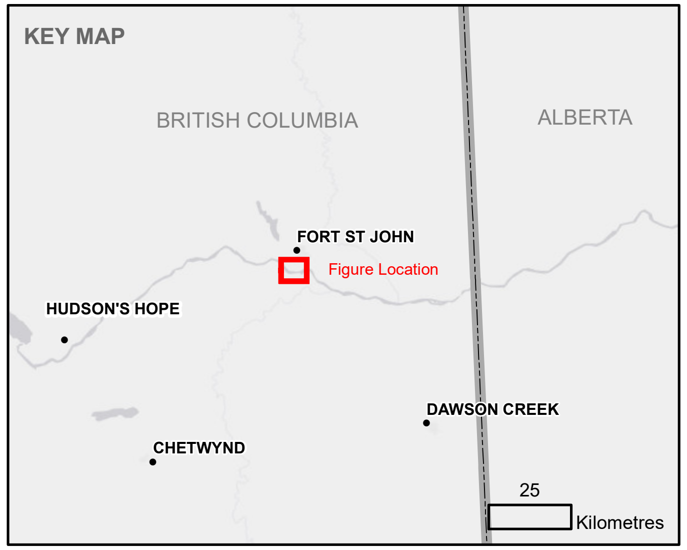
APPENDIX A

Maps

LEGEND

- APPROXIMATE LOCATION OF ROCK SPUR
- RIVER KILOMETRE AS MEASURED DOWNSTREAM FROM W.A.C. BENNETT DAM
- OUTLINE OF SITE C PERMANENT COMPONENTS
- UPPER SITE 109L
- ROAD
- FLOW DIRECTION



0 500 1,000

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REFERENCES

1. RIVER KILOMETER MARKERS OBTAINED FROM BC HYDRO.
2. IMAGERY PROVIDED BY CLIENT 2017-05-10. IMAGE DATE: 2016-11-10.
3. INSET MAP OBTAINED BY ESRI, HERE, GARMIN, (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

DATUM: NAD83 PROJECTION UTM10

CLIENT
BC HYDRO

PROJECT
SITE C OFFSET EFFECTIVENESS MONITORING PROGRAM - 2019

TITLE
OVERVIEW OF STUDY AREA

CONSULTANT

GOLDER

YYYY-MM-DD	2020-02-11
DESIGNED	DB
PREPARED	CD
REVIEWED	DF
APPROVED	DB

PROJECT NO.	PHASE	REV.	FIGURE
19121769	2019	0	A1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

LEGEND

- APPROXIMATE LOCATION OF ROCK SPUR
- RIVER KILOMETRE AS MEASURED DOWNSTREAM FROM W.A.C. BENNETT DAM
- ADCP HABITAT TRANSECT LOCATION
- OUTLINE OF SITE C PERMANENT COMPONENTS
- UPPER SITE 109L
- ROAD
- FLOW DIRECTION

0 500 1,000

1:25,000 METRES

REFERENCES
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2. IMAGERY PROVIDED BY CLIENT 2017-05-10. IMAGE DATE: 2016-11-10.

DATUM: NAD83 PROJECTION UTM10

CLIENT
BC HYDRO

PROJECT
SITE C OFFSET EFFECTIVENESS MONITORING PROGRAM - 2019

TITLE
OVERVIEW OF PHYSICAL HABITAT SAMPLE LOCATIONS

CONSULTANT

GOLDER

YYYY-MM-DD	2020-02-12
DESIGNED	DB
PREPARED	CD
REVIEWED	DF
APPROVED	DB

PROJECT NO.	PHASE	REV.	FIGURE
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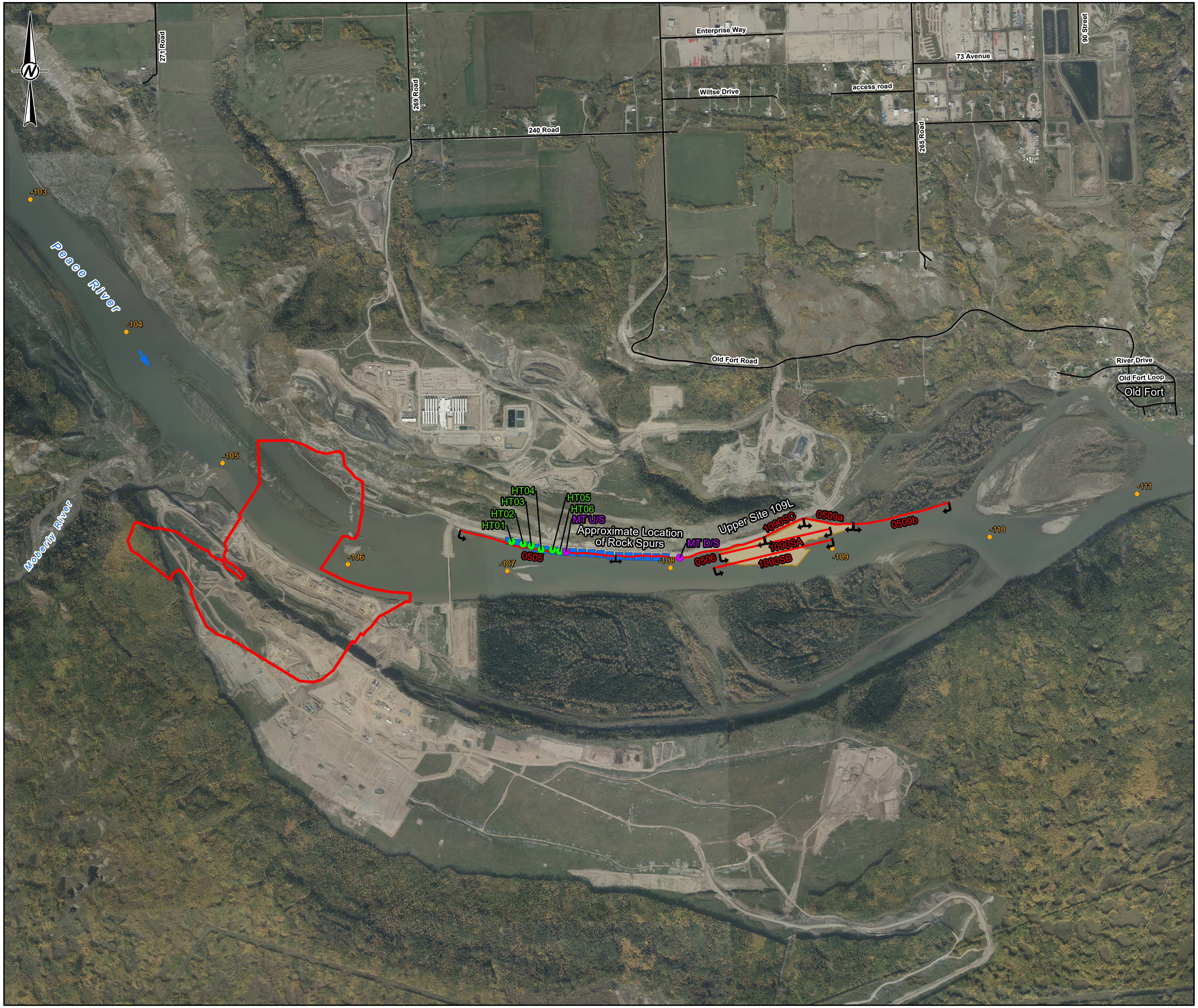

LEGEND

- HOOP TRAP
- MINNOW TRAP
- APPROXIMATE LOCATION OF ROCK SPUR
- RIVER KILOMETRE AS MEASURED DOWNSTREAM FROM W.A.C. BENNETT DAM
- OUTLINE OF SITE C PERMANENT COMPONENTS
- UPPER SITE 109L
- ROAD
- 0110 BOAT ELECTROSHOCKING SITE
- FLOW DIRECTION

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1:25,000 METRES

REFERENCES

1. RIVER KILOMETER MARKERS OBTAINED FROM BC HYDRO.
2. IMAGERY PROVIDED BY CLIENT 2017-05-10. IMAGE DATE: 2016-11-10.

DATUM: NAD83 PROJECTION UTM10

CLIENT

BC HYDRO

PROJECT

SITE C OFFSET EFFECTIVENESS MONITORING PROGRAM - 2019

TITLE

OVERVIEW OF GENERAL FISH USE SAMPLE LOCATIONS

CONSULTANT

GOLDER

YYYY-MM-DD	2020-02-11
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PREPARED	CD
REVIEWED	DF
APPROVED	DB

PROJECT NO.	PHASE	REV.	FIGURE
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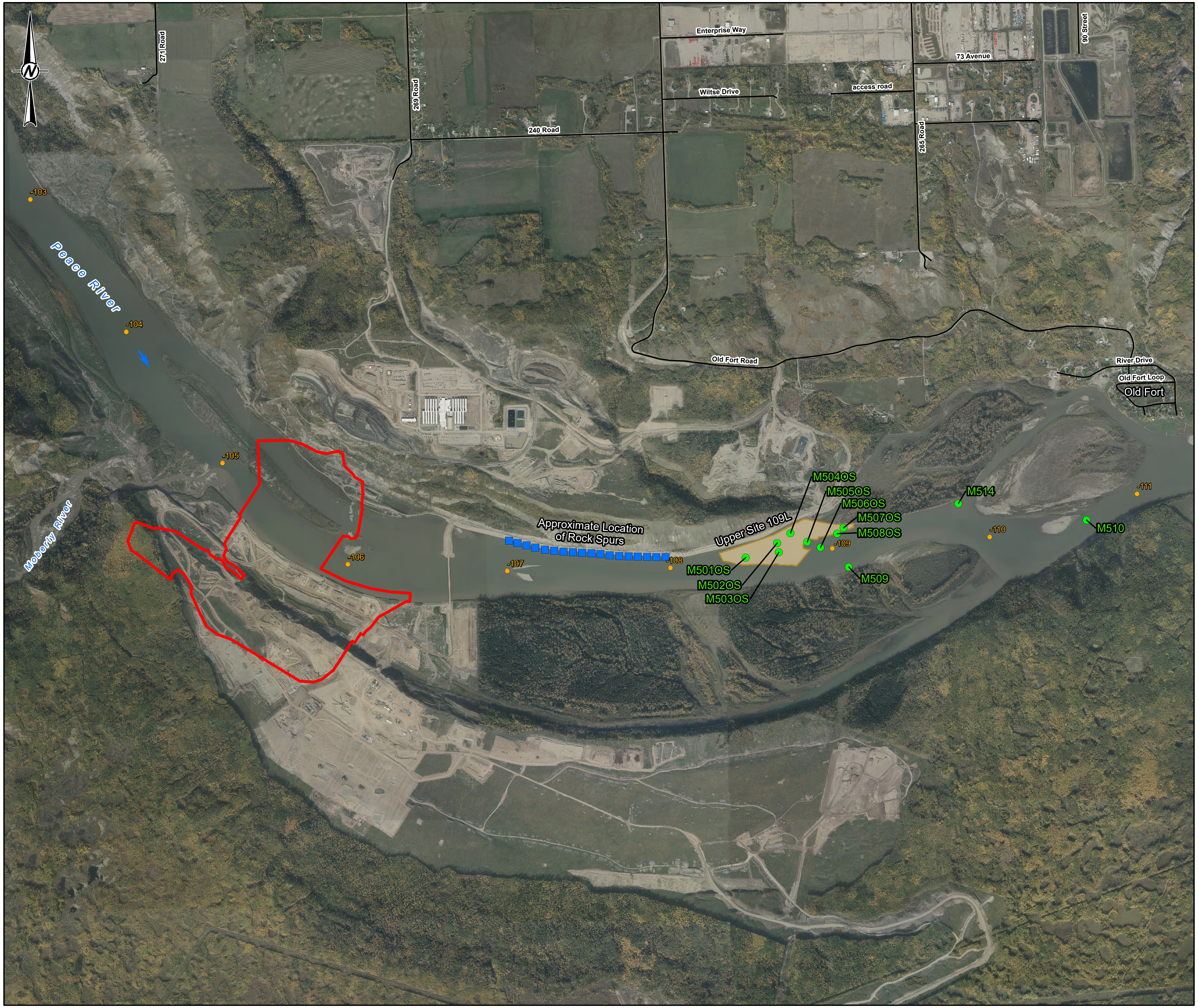

LEGEND

- MOUNTAIN WHITEFISH SPAWN MONITORING LOCATION
- APPROXIMATE LOCATION OF ROCK SPUR
- RIVER KILOMETRE AS MEASURED DOWNSTREAM FROM W.A.C. BENNETT DAM
- OUTLINE OF SITE C PERMANENT COMPONENTS
- UPPER SITE 109L
- ROAD
- FLOW DIRECTION

0 500 1,000

1:25,000 METRES

REFERENCES

1. RIVER KILOMETER MARKERS OBTAINED FROM BC HYDRO.
2. IMAGERY PROVIDED BY CLIENT 2017-05-10. IMAGE DATE: 2016-11-10.

DATUM: NAD83 PROJECTION UTM10

CLIENT

BC HYDRO

PROJECT

SITE C OFFSET EFFECTIVENESS MONITORING PROGRAM - 2019

TITLE

OVERVIEW OF MOUNTAIN WHITEFISH SPAWN MONITORING LOCATIONS

CONSULTANT

GOLDER

YYYY-MM-DD	2020-02-12
DESIGNED	DB
PREPARED	CD
REVIEWED	DF
APPROVED	DB

PROJECT NO.	PHASE	REV.	FIGURE
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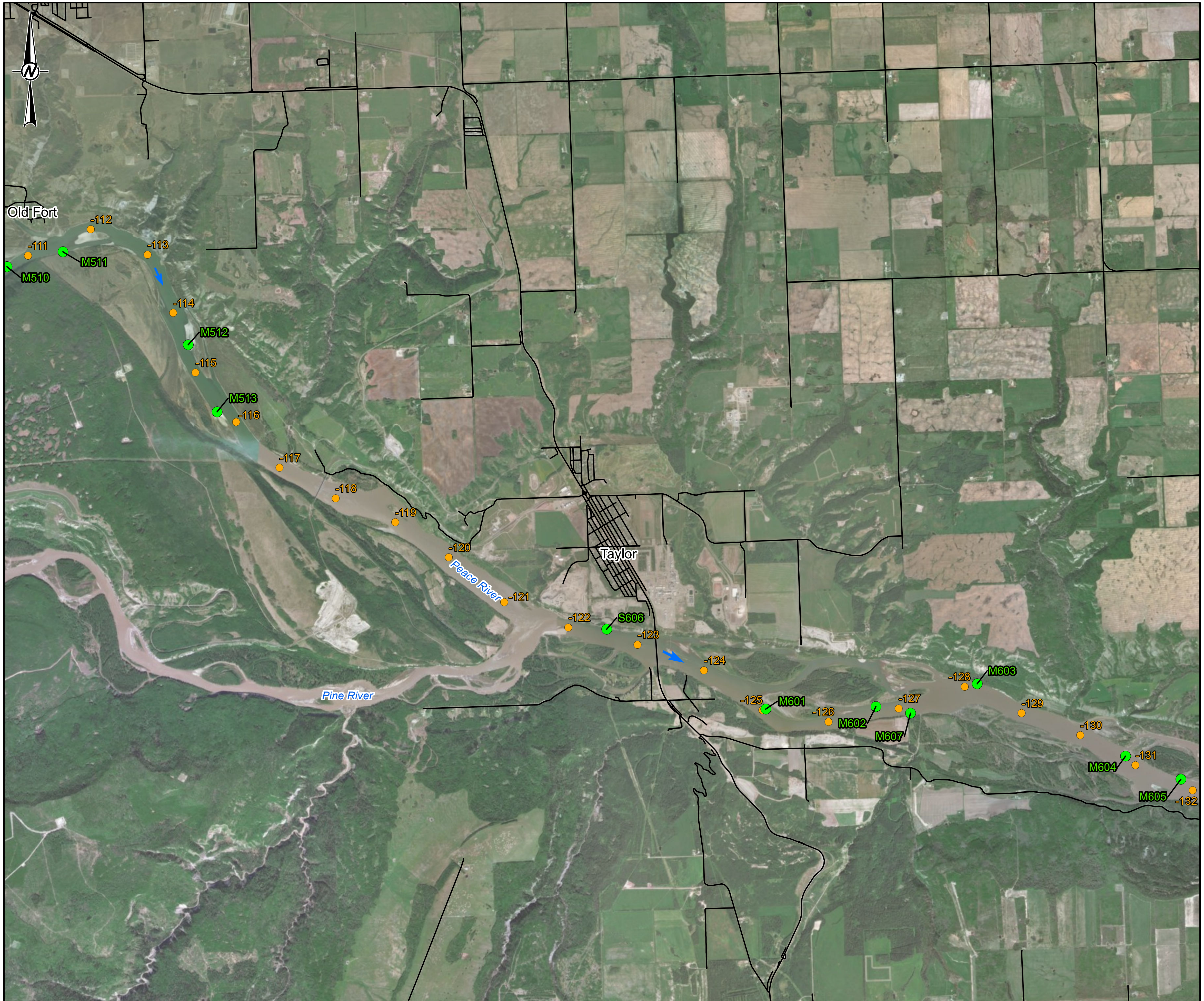

LEGEND

- MOUNTAIN WHITEFISH SPAWN MONITORING LOCATION
- RIVER KILOMETRE AS MEASURED DOWNSTREAM FROM W.A.C. BENNETT DAM
- ROAD
- FLOW DIRECTION

0 1 2

1:60,000 KILOMETRES

REFERENCES

1. RIVER KILOMETER MARKERS OBTAINED FROM BC HYDRO.
2. IMAGERY ESRI, HERE, GARMIN, (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

DATUM: NAD83 PROJECTION UTM10

CLIENT
BC HYDRO

PROJECT
SITE C OFFSET EFFECTIVENESS MONITORING PROGRAM - 2019

TITLE
OVERVIEW OF DOWNSTREAM MOUNTAIN WHITEFISH SPAWN MONITORING LOCATIONS

CONSULTANT

GOLDER

YYYY-MM-DD	2020-02-12
DESIGNED	DB
PREPARED	CD
REVIEWED	DF
APPROVED	DB

PROJECT NO.	PHASE	REV.	FIGURE
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APPENDIX B

Physical Habitat Data

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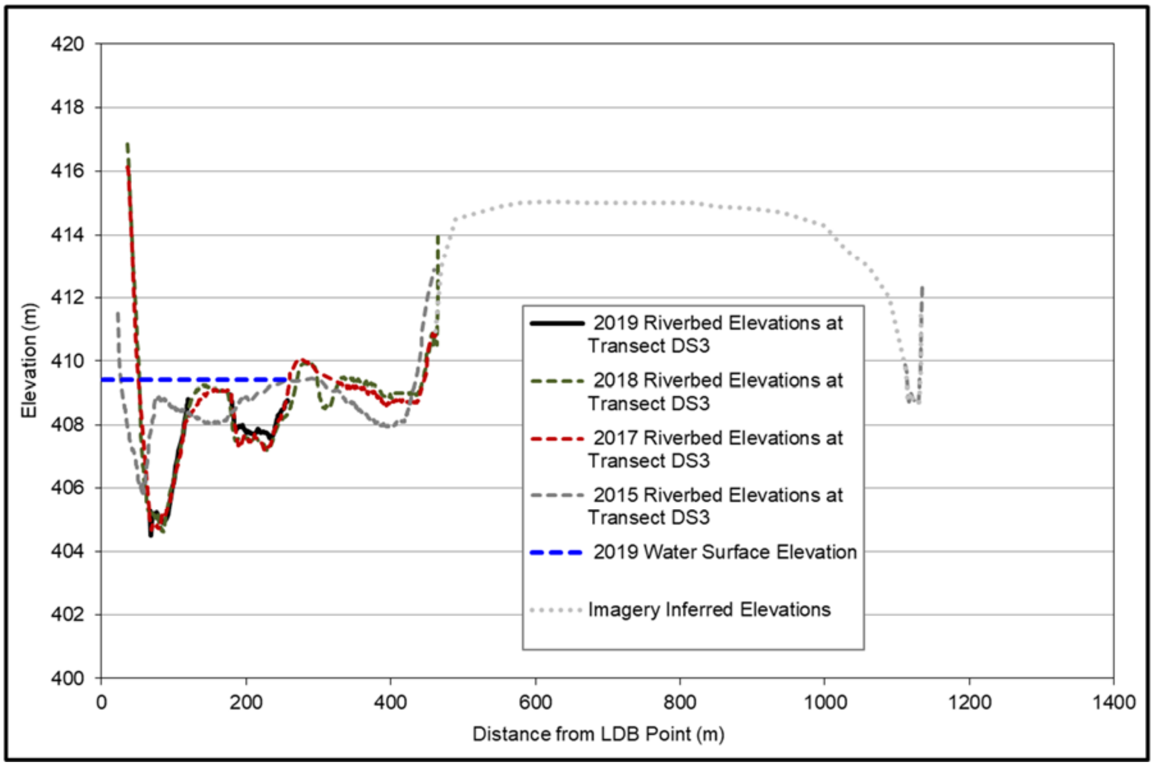

Figure 1: Cross section results for Transect DS03. Transect was surveyed as part of BC Hydro's Site C Offset Effectiveness Monitoring, 14 September 2019.

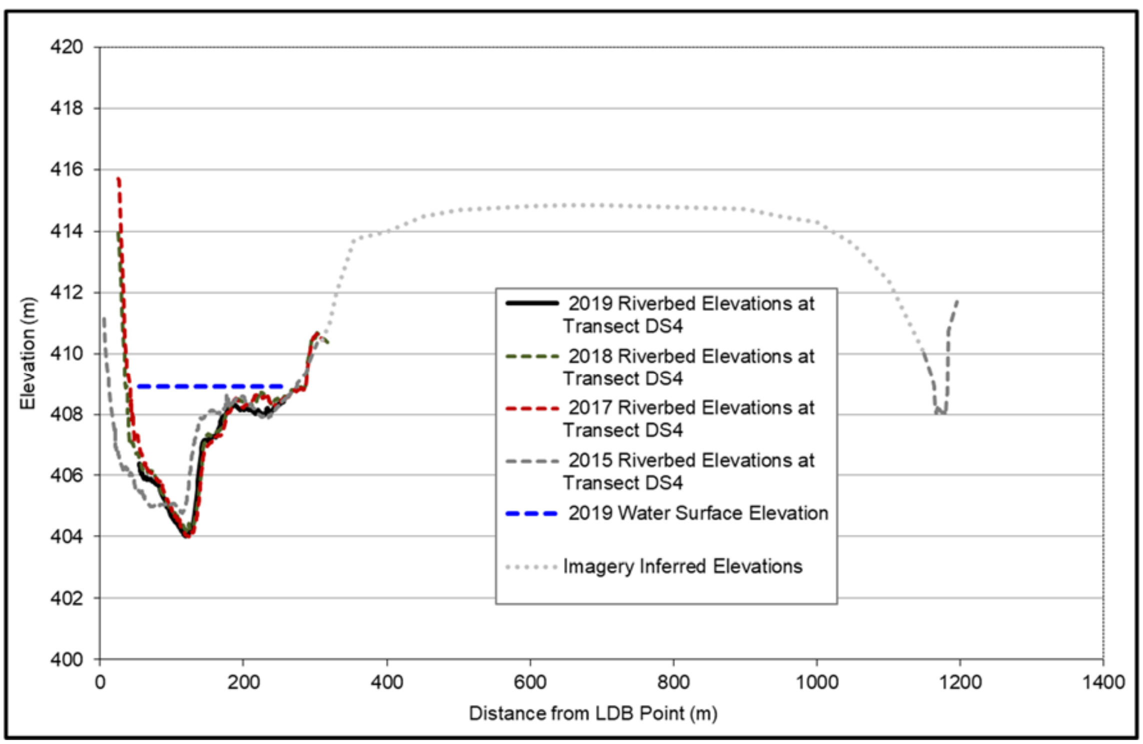

Figure 2: Cross section results for Transect DS04. Transect was surveyed as part of BC Hydro's Site C Offset Effectiveness Monitoring, 14 September 2019.

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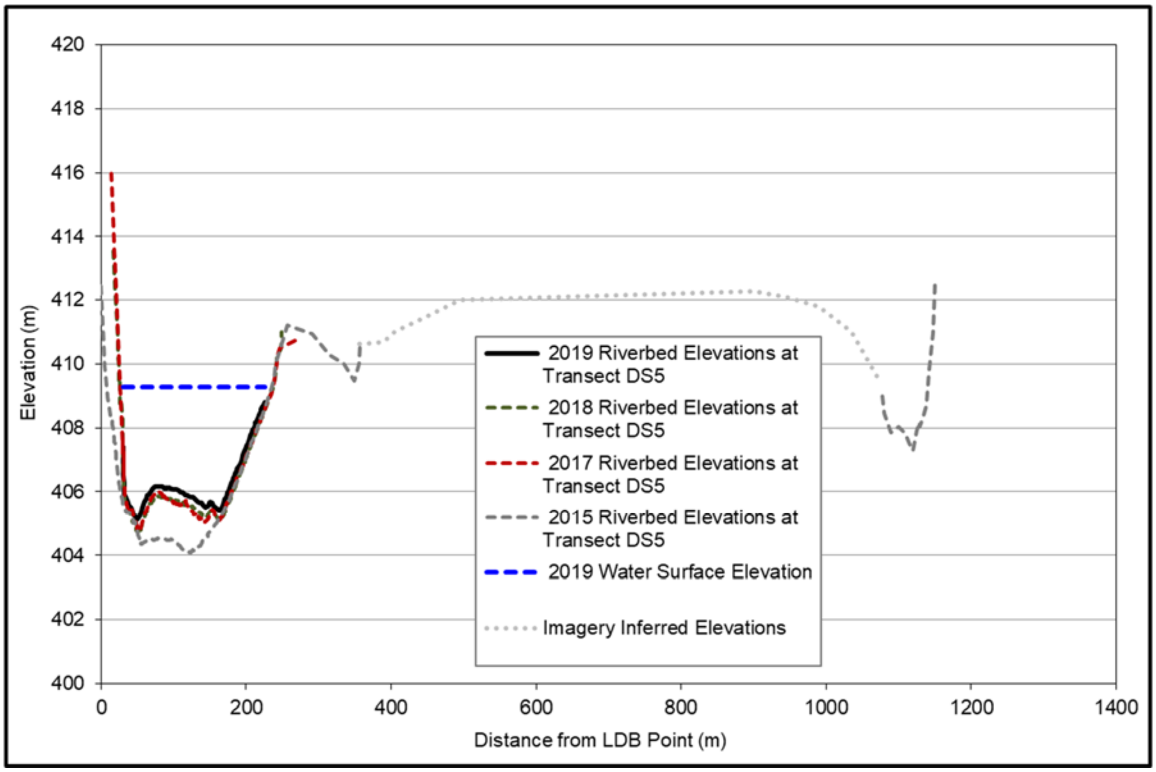

Figure 3: Cross section results for Transect DS05. Transect was surveyed as part of BC Hydro's Site C Offset Effectiveness Monitoring, 14 September 2019.

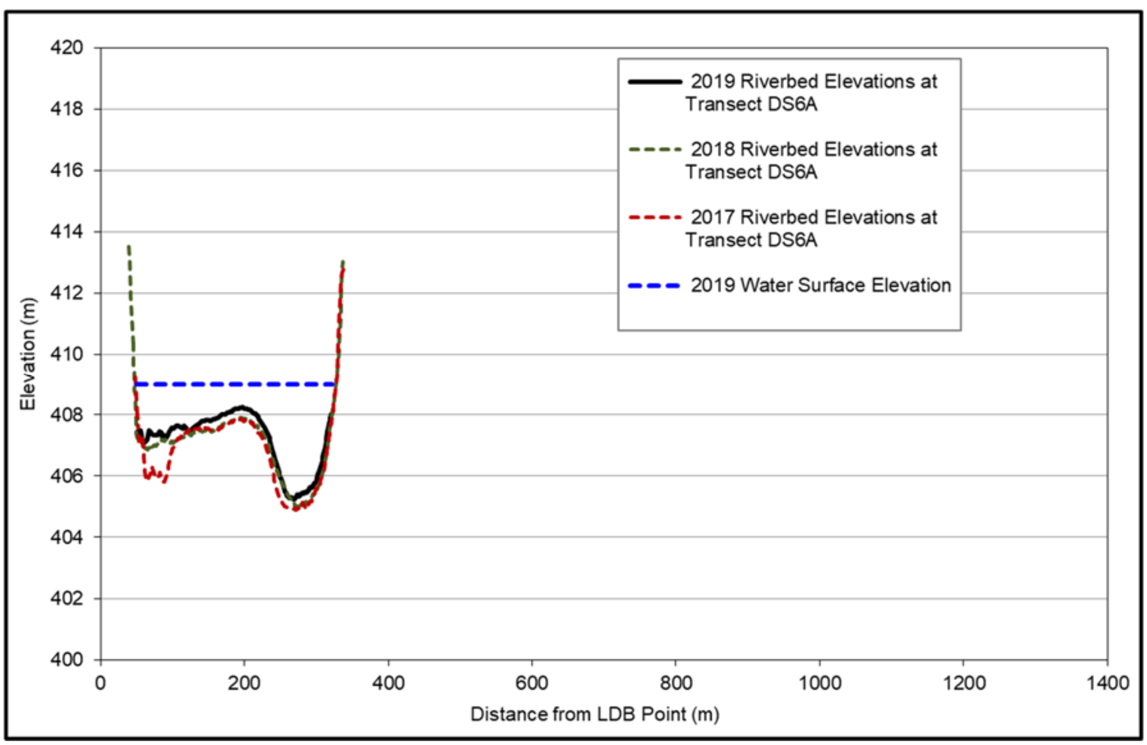

Figure 4: Cross section results for Transect DS06A. Transect was surveyed as part of BC Hydro's Site C Offset Effectiveness Monitoring, 14 September 2019.

0

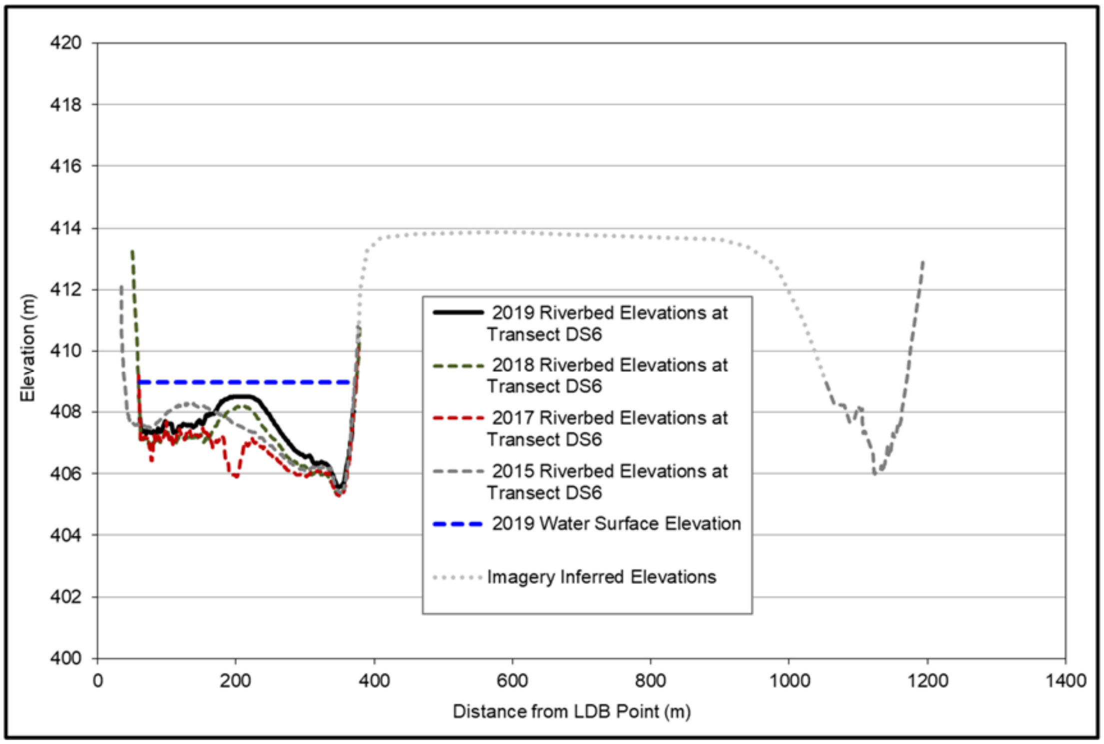

Figure 5: Cross section results for Transect DS06. Transect was surveyed as part of BC Hydro's Site C Offset Effectiveness Monitoring, 14 September 2019.

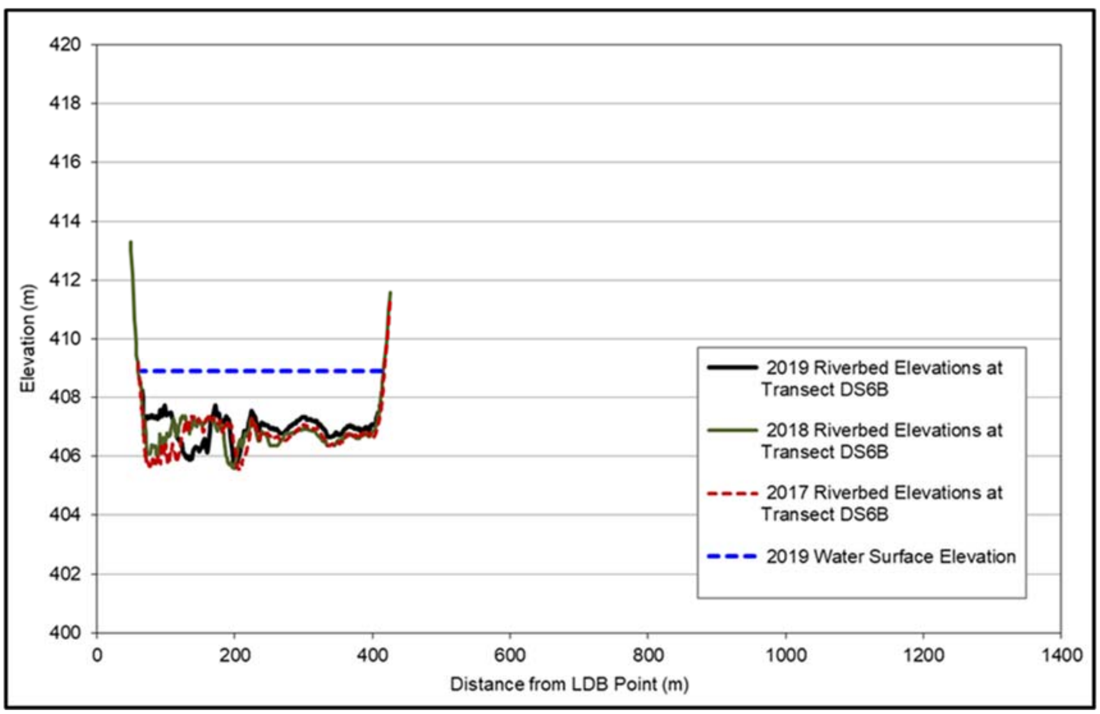

Figure 6: Cross section results for Transect DS06B. Transect was surveyed as part of BC Hydro's Site C Offset Effectiveness Monitoring, 14 September 2019.

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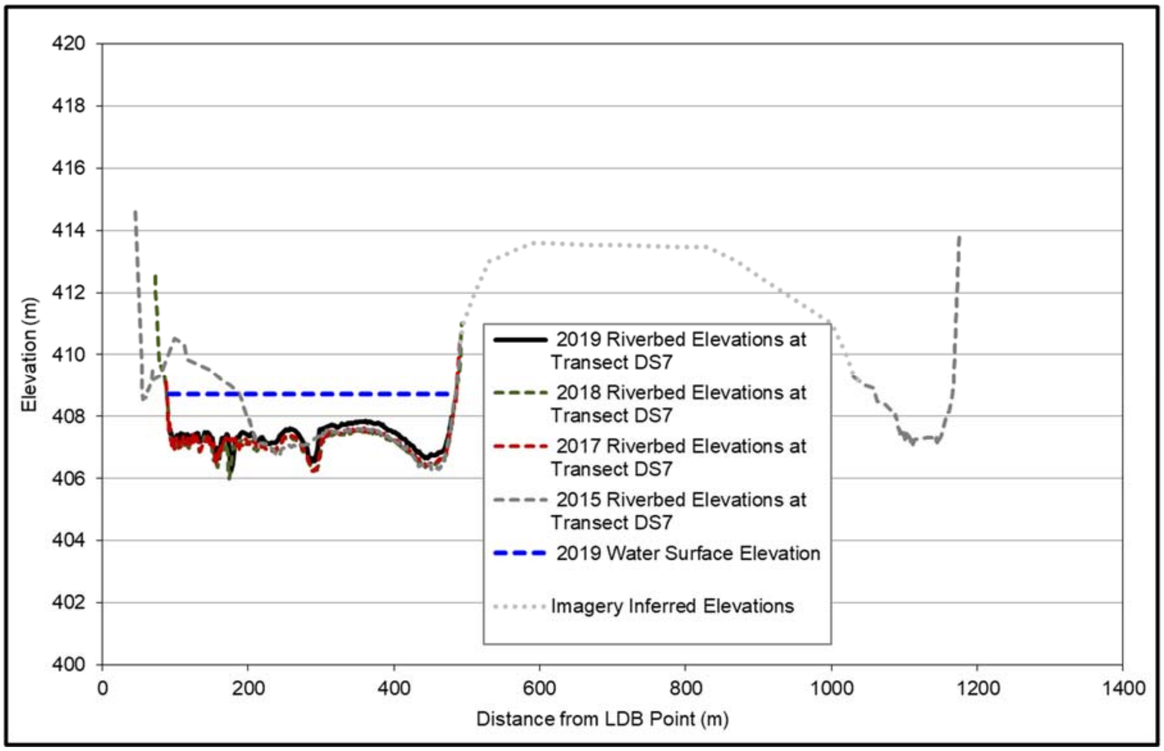


Figure 7: Cross section results for Transect DS07. Transect was surveyed as part of BC Hydro's Site C Offset Effectiveness Monitoring, 14 September 2019.

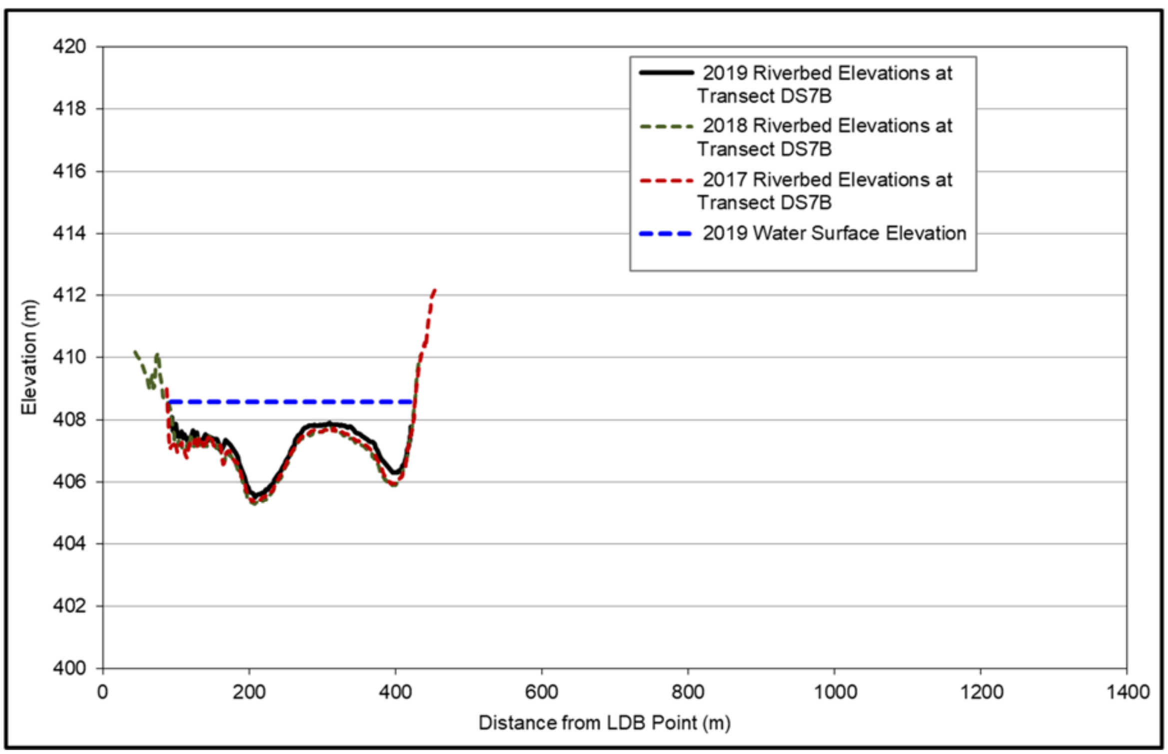
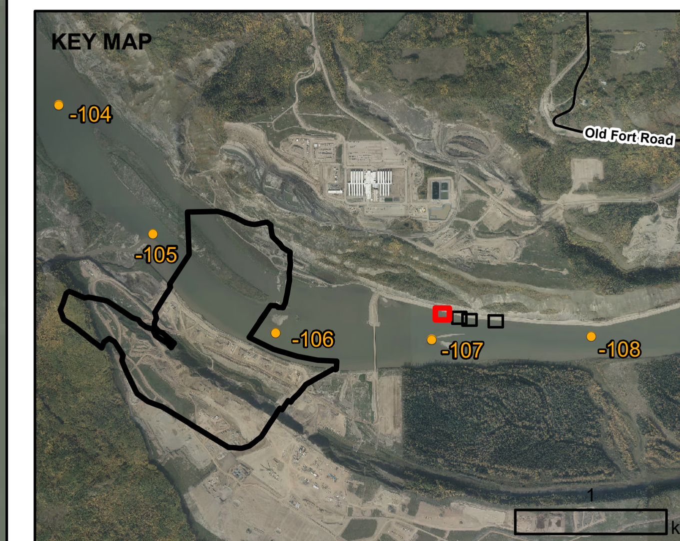


Figure 8: Cross Section results for Transect DS07B. Transect was surveyed as part of BC Hydro's Site C Offset Effectiveness Monitoring, 14 September 2019.

LEGEND

WATER SPEED AND DIRECTION VECTOR

- <= 0.4 m/s
- 0.4 - 0.8 m/s
- 0.8 - 1.2 m/s
- 1.2 - 1.6 m/s
- 1.6 - 3.0 m/s



0 3 6
1:200 METRES

REFERENCES

1. IMAGERY PROVIDED BY CLIENT 2017-05-10. IMAGE DATE: 2016-11-10.
2. TRANSECT SURVEY DATA OBTAINED BY GOLDER ASSOCIATES LTD. 14 SEPTEMBER 2019.

DATUM: NAD83 PROJECTION UTM10

CLIENT
BC HYDRO

PROJECT
SITE C OFFSET EFFECTIVENESS MONITORING - 2019

TITLE
WATER VELOCITY VECTORS AT LOCATION 1

CONSULTANT
GOLDER

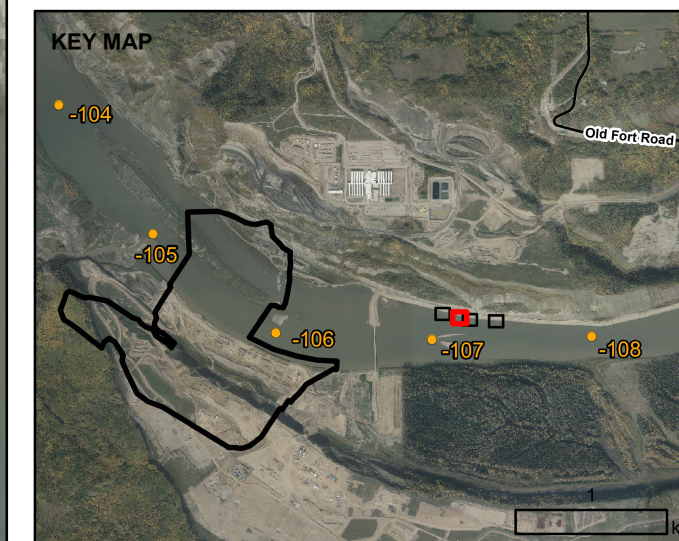
YYYY-MM-DD	2020-02-18
DESIGNED	DC
PREPARED	CD
REVIEWED	DF
APPROVED	DF

PROJECT NO.	PHASE	REV.	FIGURE
19121769	2019	0	B9

LEGEND

WATER SPEED AND DIRECTION VECTOR

- <= 0.4 m/s
- 0.4 - 0.8 m/s
- 0.8 - 1.2 m/s
- 1.2 - 1.6 m/s
- 1.6 - 3.0 m/s



0 3 6

1:200 METRES

REFERENCES
1. IMAGERY PROVIDED BY CLIENT 2017-05-10. IMAGE DATE: 2016-11-10.
2. TRANSECT SURVEY DATA OBTAINED BY GOLDER ASSOCIATES LTD. 14 SEPTEMBER 2019.

DATUM: NAD83 PROJECTION UTM10

CLIENT
BC HYDRO

PROJECT
SITE C OFFSET EFFECTIVENESS MONITORING - 2019

TITLE
WATER VELOCITY VECTORS AT LOCATION 1

CONSULTANT

GOLDER

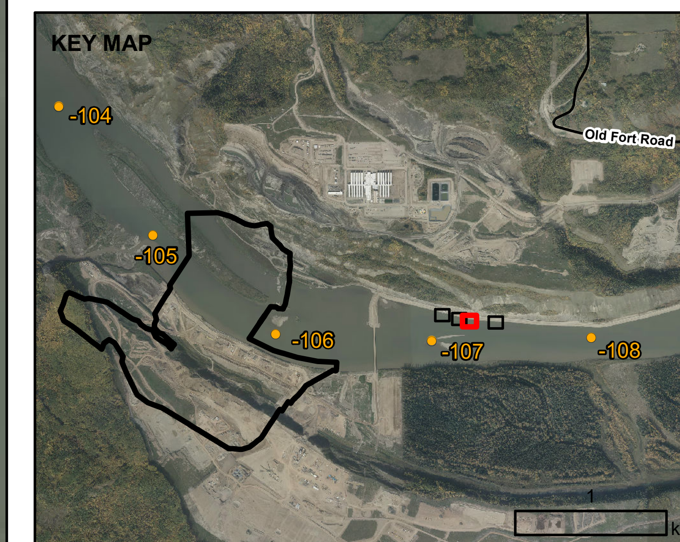
YYYY-MM-DD	2020-02-18
DESIGNED	DC
PREPARED	CD
REVIEWED	DF
APPROVED	DF

PROJECT NO.	PHASE	REV.	FIGURE
19121769	2019	0	**B10**

LEGEND

WATER SPEED AND DIRECTION VECTOR

- <= 0.4 m/s
- 0.4 - 0.8 m/s
- 0.8 - 1.2 m/s
- 1.2 - 1.6 m/s
- 1.6 - 3.0 m/s



0 3 6
1:200 METRES

REFERENCES
1. IMAGERY PROVIDED BY CLIENT 2017-05-10. IMAGE DATE: 2016-11-10.
2. TRANSECT SURVEY DATA OBTAINED BY GOLDER ASSOCIATES LTD. 14 SEPTEMBER 2019.

DATUM: NAD83 PROJECTION UTM10

CLIENT
BC HYDRO

PROJECT
SITE C OFFSET EFFECTIVENESS MONITORING - 2019

TITLE
WATER VELOCITY VECTORS AT LOCATION 1

CONSULTANT
GOLDER

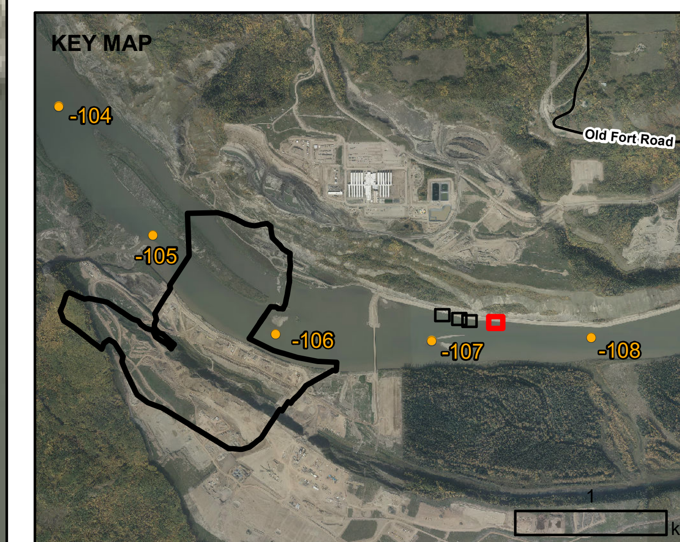
YYYY-MM-DD	2020-02-18
DESIGNED	DC
PREPARED	CD
REVIEWED	DF
APPROVED	DF

PROJECT NO.	PHASE	REV.	FIGURE
19121769	2019	0	B11

LEGEND

WATER SPEED AND DIRECTION VECTOR

- <= 0.4 m/s
- 0.4 - 0.8 m/s
- 0.8 - 1.2 m/s
- 1.2 - 1.6 m/s
- 1.6 - 3.0 m/s



0 3 6

1:200 METRES

REFERENCES

1. IMAGERY PROVIDED BY CLIENT 2017-05-10. IMAGE DATE: 2016-11-10.
2. TRANSECT SURVEY DATA OBTAINED BY GOLDER ASSOCIATES LTD. 14 SEPTEMBER 2019.

DATUM: NAD83 PROJECTION UTM10

CLIENT

BC HYDRO

PROJECT

SITE C OFFSET EFFECTIVENESS MONITORING - 2019

TITLE

WATER VELOCITY VECTORS AT LOCATION 1

CONSULTANT

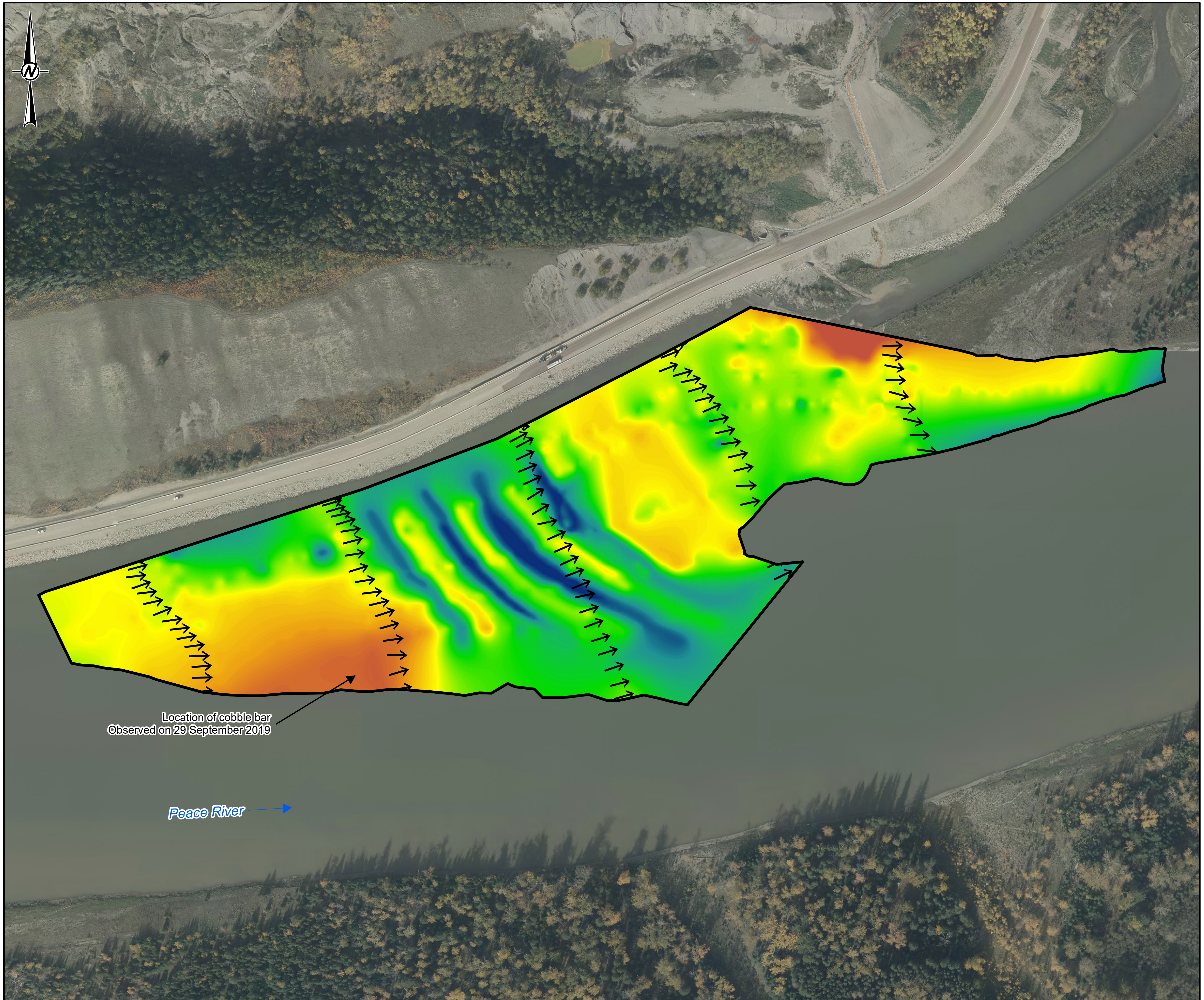
GOLDER

YYYY-MM-DD	2020-02-18
DESIGNED	DC
PREPARED	CD
REVIEWED	DF
APPROVED	DF

PROJECT NO.	PHASE	REV.	FIGURE
19121769	2019	0	**B12**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm



LEGEND

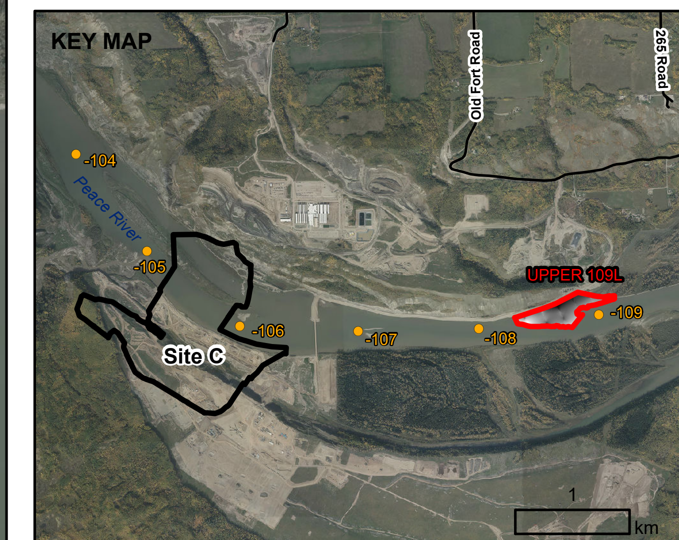
FLOW DIRECTION

UPPER109L

RIVERBED ELEVATION

HIGH (409 masl)

LOW (405 masl)



0 60 120

1:3,000 METRES

NOTE(S)

1. WATER ELEVATION IS 409.26 M GEODETIC AT THE UPSTREAM TRANSECT

REFERENCES

1. IMAGERY PROVIDED BY CLIENT 2017-05-10. IMAGE DATE: 2016-11-10.
2. TRANSECT SURVEY DATA OBTAINED BY GOLDER ASSOCIATES LTD. 14 SEPTEMBER 2019.

DATUM: NAD83 PROJECTION UTM10

CLIENT

BC HYDRO

PROJECT

SITE C OFFSET EFFECTIVENESS MONITORING - 2019

TITLE

BATHYMETRY PROFILE OF UPPER SITE 109L FROM ADP SURVEYS CONDUCTED ON 14 SEPTEMBER 2019.

CONSULTANT

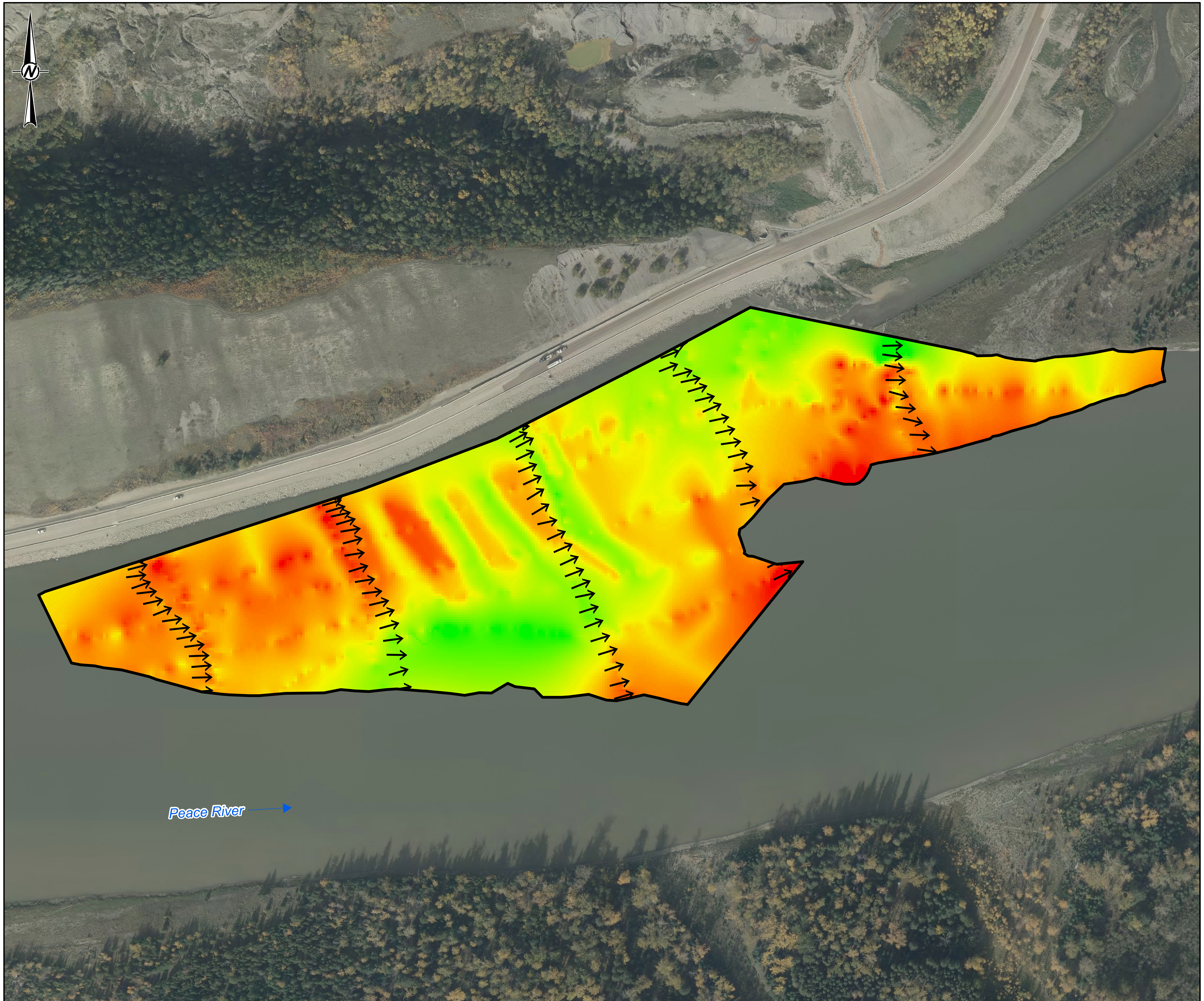
GOLDER

YYYY-MM-DD	2020-02-26
DESIGNED	DC
PREPARED	CD
REVIEWED	DB
APPROVED	DF

PROJECT NO.	PHASE	REV.	FIGURE
19121769	2019	0	B13

PATH: \\golder.gds\gal\burnaby\CAD-GIS\Client\BC_Hydro\Peace_River_GMS\99_PROJECTS\19121769_PeaceRiver_GMS\02_PRODUCTION\MXD\Report\Offset_Report\19121769_FIG_B13_WATER_DEPTHS_UPPER_109L.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B



LEGEND

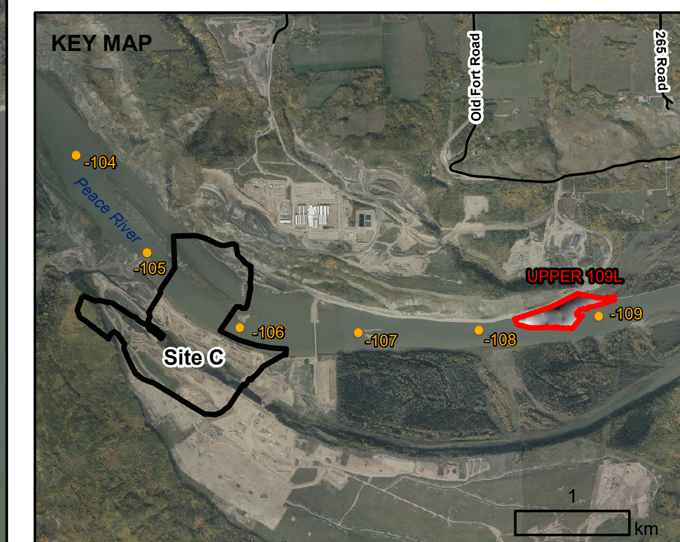
FLOW DIRECTION

UPPER109L

WATER VELOCITY

High : (1.74 m/s)

Low : (0.06 m/s)



0 60 120

1:3,000 METRES

REFERENCES
1. IMAGERY PROVIDED BY CLIENT 2017-05-10. IMAGE DATE: 2016-11-10.
2. TRANSECT SURVEY DATA OBTAINED BY GOLDER ASSOCIATES LTD. 14 SEPTEMBER 2019.

DATUM: NAD83 PROJECTION UTM10

CLIENT
BC HYDRO

PROJECT
SITE C OFFSET EFFECTIVENESS MONITORING - 2019

TITLE
SUMMARY OF WATER VELOCITIES RECORDED DURING ADP SURVEYS CONDUCTED ON 14 SEPTEMBER 2019

CONSULTANT

GOLDER

YYYY-MM-DD	2020-02-18
DESIGNED	DC
PREPARED	CD
REVIEWED	DF
APPROVED	DF

PROJECT NO.	PHASE	REV.	FIGURE
19121769	2019	0	**B14**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0

APPENDIX C

General Fish Use Data

Table C1 Summary of habitat variables recorded at boat electroshocking sites surveyed during Site C Offset Effectiveness Monitoring, 2019.

Offset Area	Site Name[a]	Sample Date	Sample Time	Sample Session	Air Temp. (°C)	Water Temp. (°C)	Water Cond. (µs/cm)	Sechi Depth (m)	Cloud Cover[b]	Boat Model	Electroshocker Settings				Length Sampled (m)	Time Sampled (s)	Mean Depth (m)	Max Depth (m)
											Range	Percent	Amperes	Mode				
Rock Spurs	505	31-Aug-2019	14:17	1	20.0	13.4	180	0.48	Clear	SR-18H(Cas)	High	15	3.9	30DC	1000	1100		
Rock Spurs	506	31-Aug-2019	16:28	1	20.0	13.8	190	0.52	Clear	SR-18H(Cas)	High	16	3.9	30DC	1000	864	1.1	1.7
Upper Site 109L	109OSA	31-Aug-2019	17:43	1	18.0	13.7	190	0.52	Clear	SR-18H(Cas)	High	15	4.0	30DC	730	452	0.7	2.0
Upper Site 109L	109OSB	1-Sep-2019	10:32	1	13.0	12.9	190	0.40	Mostly cloudy	SR-18H(Cas)	High	18	3.9	30DC	780	219	1.2	1.7
Upper Site 109L	109OSC	1-Sep-2019	10:44	1	13.0	12.8	190	0.40	Mostly cloudy	SR-18H(Cas)	High	15	4.0	30DC	730	229	0.8	1.0
Upper Site 109L	509	1-Sep-2019	13:30	1	15.0	13.2	190	0.40	Mostly cloudy	SR-18H(Cas)	High	17	4.0	30DC	975	760	0.7	1.0
Upper Site 109L	109OSA	9-Sep-2019	13:29	2	10.0	10.4	200	0.22	Overcast	SR-18E(Cas)	High	56	4.0	30DC	730	427	1.4	2.9
Upper Site 109L	109OSC	9-Sep-2019	13:40	2	10.0	10.4	200	0.22	Overcast	SR-18E(Cas)	High	60	4.0	30DC	730	239	1.0	1.9
Upper Site 109L	109OSB	9-Sep-2019	14:23	2		10.3	200	0.22	Overcast	SR-18E(Cas)	High	60	4.0	30DC	780	259	1.4	2.0
Upper Site 109L	509	9-Sep-2019	15:02	2	10.0	10.1	200	0.22	Overcast	SR-18E(Cas)	High	60	4.0	30DC	975	670	0.8	1.0
Rock Spurs	506	11-Sep-2019	12:19	2	9.0	9.9	180	0.16	Overcast	SR-18E(Cas)	High	50	4.0	30DC	1000	1181	1.8	3.9
Rock Spurs	505	11-Sep-2019	13:53	2	10.0	9.5	180	0.16	Mostly cloudy	SR-18E(Cas)	High	58	4.0	30DC	1000	1083	2.0	3.5
Rock Spurs	505	20-Sep-2019	10:21	3	7.0	9.8	190	0.45	Clear	SR-18E(Cas)	High	58	4.0	30DC	1000	1128	1.5	2.0
Rock Spurs	506	20-Sep-2019	12:38	3	15.0	9.8	190	0.45	Clear	SR-18E(Cas)	High	49	4.0	30DC	1000	955	1.4	2.8
Upper Site 109L	109OSA	20-Sep-2019	13:54	3	15.0	9.8	190	0.45	Clear	SR-18E(Cas)	High	58	4.0	30DC	730	372	1.5	2.6
Upper Site 109L	109OSC	20-Sep-2019	14:05	3	15.0	9.8	190	0.45	Clear	SR-18E(Cas)	High	58	4.0	30DC	730	258	1.0	1.2
Upper Site 109L	109OSB	20-Sep-2019	14:56	3	15.0	9.8	190	0.45	Clear	SR-18E(Cas)	High	50	4.0	30DC	780	301		1.7
Upper Site 109L	509	20-Sep-2019	15:16	3	15.0	10.2	190	0.45	Clear	SR-18E(Cas)	High	48	4.0	30DC	975	689	1.0	2.5
Upper Site 109L	509	28-Sep-2019	11:32	4	5.0	9.0	190	0.90	Overcast	SR-18E(Cas)	High	50	4.0	30DC	975	694	1.0	2.3
Rock Spurs	505	29-Sep-2019	10:00	4	1.0	8.6	190	0.70	Clear	SR-18E(Cas)	High	50	4.0	30DC	1000	989	1.9	3.8
Rock Spurs	506	29-Sep-2019	11:44	4	7.0	8.5	190	0.70	Clear	SR-18E(Cas)	High	50	4.0	30DC	1000	1000	1.5	2.5
Upper Site 109L	109OSA	29-Sep-2019	13:52	4	7.0	8.9	190	0.70	Clear	SR-18E(Cas)	High	57	4.0	30DC	730	481	1.3	2.5
Upper Site 109L	109OSC	29-Sep-2019	14:02	4	7.0	8.9	190	0.70	Clear	SR-18E(Cas)	High	58	4.0	30DC	730	230	1.0	2.5
Upper Site 109L	109OSB	29-Sep-2019	14:40	4	7.0	8.9	190	0.70	Clear	SR-18E(Cas)	High	50	4.0	30DC	780	427	1.0	2.1
Upper Site 109L	509	4-Oct-2019	11:06	5	6.0	9.3	200	0.85	Overcast	SR-18E(Cas)	High	60	4.0	30DC	975	132	1.6	1.8
Rock Spurs	505	7-Oct-2019	13:48	5	3.0	8.4	210	0.80	Overcast	Eagle Outlaw ty	High	30	2.0	30DC	1000	806	1.2	3.5
Rock Spurs	506	7-Oct-2019	13:54	5	3.0	8.4	210	0.80	Overcast	Eagle Outlaw ty	High	30	2.0	30DC	1000	978	1.9	3.8
Upper Site 109L	109OSA	7-Oct-2019	14:45	5	3.0	8.4	210	0.80	Overcast	Eagle Outlaw ty	High	30	2.0	30DC	730	485	1.1	3.0
Upper Site 109L	109OSB	7-Oct-2019	15:07	5	3.0	8.4	210	0.80	Overcast	Eagle Outlaw ty	High	30	2.0	30DC	780	315	1.5	3.0
Upper Site 109L	109OSC	7-Oct-2019	15:24	5	3.0	8.4	210	0.80	Overcast	Eagle Outlaw ty	High	30	2.0	30DC	730	258	1.0	2.0

[a] See Appendix A, Figure A3 for sample site locations.

[b] Clear = <10%; Partly Cloudy = 10-50%; Mostly Cloudy = 50-90%; Overcast = >90%.

Table C2 Summary of boat electroshockinging catch recorded during Site C Offset Effectiveness Monitoring, 2019.

Offset Area	Site Name[a]	Sample Date	Sample Session	Species Name	Size Class	Total Number Caught
Rock Spurs	0505	31-Aug-2019	1	Bull Trout	>300	2
				Lake Whitefish	>300	1
				Largescale Sucker	>300	1
				Longnose Sucker	<150	2
				Longnose Sucker	200-299	2
				Longnose Sucker	>300	6
				Mountain Whitefish	<150	2
				Mountain Whitefish	>300	1
				Northern Pikeminnow	>300	1
				Rainbow Trout	>300	3
				Redside Shiner	-	1
				Spottail Shiner	-	1
				Walleye	>300	1
		Session Total				**24**
		11-Sep-2019	2	Burbot	>300	1
				Bull Trout	200-299	1
				Bull Trout	>300	1
				Longnose Sucker	>300	5
				Mountain Whitefish	<150	9
				Mountain Whitefish	200-299	2
				Northern Pikeminnow	>300	2
				Prickly Sculpin	-	2
				Rainbow Trout	200-299	1
				White Sucker	>300	1
		Session Total				**25**
		20-Sep-2019	3	Arctic Grayling	>300	1
				Burbot	>300	1
				Largescale Sucker	150-199	2
				Longnose Sucker	150-199	3
				Longnose Sucker	>300	1
				Mountain Whitefish	<150	3
				Mountain Whitefish	150-199	2
				Mountain Whitefish	>300	1
				Northern Pikeminnow	<150	1
				Northern Pikeminnow	>300	1
				Prickly Sculpin	-	1
				Rainbow Trout	150-199	1
				Rainbow Trout	200-299	1
				Rainbow Trout	>300	2
				Redside Shiner	-	2
		Session Total				**23**
		29-Sep-2019	4	Bull Trout	200-299	2
				Largescale Sucker	150-199	1
				Largescale Sucker	>300	1
				Longnose Sucker	200-299	1
				Longnose Sucker	>300	1
				Mountain Whitefish	<150	2
				Mountain Whitefish	150-199	3
				Mountain Whitefish	>300	1
				Walleye	>300	1
				White Sucker	>300	2
		Session Total				**15**

…continued.

Table C2 Continued.

Offset Area	Site Name[a]	Sample Date	Sample Session	Species Name	Size Class	Total Number Caught
Rock Spurs	0505	7-Oct-2019	5	Largescale Sucker	>300	6
				Longnose Sucker	200-299	1
				Longnose Sucker	>300	1
				Mountain Whitefish	200-299	7
				Mountain Whitefish	>300	8
				Rainbow Trout	200-299	2
				White Sucker	>300	2
		Session Total				**27**
	Site Total					**114**
	0506	31-Aug-2019	1	Bull Trout	>300	1
				Longnose Sucker	<150	1
				Longnose Sucker	150-199	1
				Longnose Sucker	>300	7
				Mountain Whitefish	150-199	1
				Northern Pikeminnow	<150	2
				Northern Pikeminnow	>300	1
				Redside Shiner	-	4
				Walleye	>300	1
				White Sucker	>300	4
		Session Total				**23**
		11-Sep-2019	2	Burbot	150-199	1
				Burbot	>300	1
				Largescale Sucker	>300	2
				Longnose Sucker	<150	2
				Longnose Sucker	150-199	1
				Longnose Sucker	>300	7
				Mountain Whitefish	<150	6
				Mountain Whitefish	200-299	3
				Mountain Whitefish	>300	3
				Trout-Perch	-	1
				White Sucker	200-299	2
				White Sucker	>300	2
		Session Total				**31**
		20-Sep-2019	3	Bull Trout	>300	1
				Largescale Sucker	<150	1
				Largescale Sucker	>300	1
				Longnose Sucker	<150	2
				Longnose Sucker	150-199	2
				Longnose Sucker	>300	8
				Mountain Whitefish	200-299	5
				Mountain Whitefish	>300	5
				Northern Pikeminnow	>300	3
		Session Total				**28**
		29-Sep-2019	4	Bull Trout	>300	1
				Largescale Sucker	>300	4
				Longnose Sucker	<150	1
				Longnose Sucker	200-299	1
				Longnose Sucker	>300	1
				Mountain Whitefish	200-299	8
				Mountain Whitefish	>300	7
				Northern Pikeminnow	>300	3
				Prickly Sculpin	-	2
				Rainbow Trout	>300	1
				Redside Shiner	-	1
				White Sucker	>300	1
		Session Total				**31**

…continued.

Table C2 Continued.

Offset Area	Site Name[a]	Sample Date	Sample Session	Species Name	Size Class	Total Number Caught
Rock Spurs	0506	7-Oct-2019	5	Bull Trout	200-299	1
				Bull Trout	>300	1
				Largescale Sucker	200-299	1
				Longnose Sucker	150-199	1
				Longnose Sucker	200-299	3
				Longnose Sucker	>300	11
				Mountain Whitefish	<150	3
				Mountain Whitefish	150-199	1
				Mountain Whitefish	200-299	6
				Mountain Whitefish	>300	3
				Northern Pikeminnow	150-199	1
		Session Total				**32**
	Site Total					**145**
Rock Spurs Total						**259**
Upper Site 109L	0509	1-Sep-2019	1	Largescale Sucker	<150	1
				Largescale Sucker	150-199	2
				Largescale Sucker	>300	1
				Longnose Sucker	<150	3
				Longnose Sucker	150-199	2
				Longnose Sucker	>300	1
				Mountain Whitefish	<150	2
				Mountain Whitefish	150-199	1
				Mountain Whitefish	200-299	1
				Mountain Whitefish	>300	5
				Northern Pikeminnow	<150	1
				Redside Shiner	-	7
				Slimy Sculpin	-	1
				Spottail Shiner	-	1
		Session Total				**29**
		9-Sep-2019	2	Bull Trout	200-299	1
				Longnose Sucker	<150	1
				Longnose Sucker	150-199	1
				Longnose Sucker	>300	1
				Mountain Whitefish	<150	10
				Mountain Whitefish	150-199	1
				Mountain Whitefish	200-299	4
				Mountain Whitefish	>300	3
				Prickly Sculpin	-	1
				Redside Shiner	-	1
		Session Total				**24**
		20-Sep-2018	3	Largescale Sucker	200-299	1
				Largescale Sucker	>300	1
				Longnose Sucker	150-199	1
				Longnose Sucker	200-299	1
				Longnose Sucker	>300	3
				Mountain Whitefish	<150	5
				Mountain Whitefish	200-299	5
				Mountain Whitefish	>300	2
				Slimy Sculpin	-	1
				Redside Shiner	-	2
				Walleye	>300	3
		Session Total				**25**

…continued.

Table C2 Continued.

Offset Area	Site Name[a]	Sample Date	Sample Session	Species Name	Size Class	Total Number Caught
Upper Site 109L	0509	28-Sep-2019	4	Bull Trout	150-199	1
				Bull Trout	>300	1
				Largescale Sucker	>300	2
				Longnose Sucker	>300	2
				Mountain Whitefish	<150	1
				Mountain Whitefish	200-299	3
				Mountain Whitefish	>300	7
				Slimy Sculpin	-	4
				White Sucker	>300	1
		Session Total				**22**
		4-Oct-2019	5	Largescale Sucker	>300	2
				Longnose Sucker	>300	3
				Kokanee	150-199	1
				Mountain Whitefish	<150	4
				Mountain Whitefish	200-299	8
				Mountain Whitefish	>300	9
				Northern Pike	>300	1
				White Sucker	>300	2
		Session Total				**30**
	Site Total					**130**
	109OSA	31-Aug-2019	1	Longnose Dace	-	2
				Mountain Whitefish	200-299	6
				Mountain Whitefish	>300	6
				Redside Shiner	-	1
		Session Total				**15**
		9-Sep-2019	2	Mountain Whitefish	<150	1
				Mountain Whitefish	200-299	8
				Mountain Whitefish	>300	5
				Slimy Sculpin	-	2
		Session Total				**16**
		20-Sep-2019	3	Mountain Whitefish	<150	1
				Mountain Whitefish	150-199	1
				Mountain Whitefish	200-299	6
				Mountain Whitefish	>300	12
		Session Total				**20**
		29-Sep-2019	4	Mountain Whitefish	<150	2
				Mountain Whitefish	200-299	16
		Session Total				**18**
		7-Oct-2019	5	Longnose Sucker	>300	1
				Mountain Whitefish	<150	1
				Mountain Whitefish	200-299	12
				Mountain Whitefish	>300	5
		Session Total				**19**
	Site Total					**88**
	109OSB	1-Sep-2019	1	Mountain Whitefish	150-199	1
		Session Total				**1**
		9-Sep-2019	2	No Fish Caught	-	0
		Session Total				**0**
		20-Sep-2019	3	Lake Chub	-	1
				Largescale Sucker	>300	1
				Longnose Sucker	<150	3
				Mountain Whitefish	<150	1
				Mountain Whitefish	150-199	1
				Mountain Whitefish	200-299	3
		Session Total				**10**

…continued.

Table C2 Concluded.

Offset Area	Site Name[a]	Sample Date	Sample Session	Species Name	Size Class	Total Number Caught
Upper Site 109L	109OSB	29-Sep-2019	4	Largescale Sucker	200-299	1
				Largescale Sucker	>300	2
				Longnose Sucker	<150	1
				Mountain Whitefish	<150	7
				Mountain Whitefish	200-299	1
				Mountain Whitefish	>300	4
		Session Total				**16**
		7-Oct-2019	5	Mountain Whitefish	<150	2
				Mountain Whitefish	200-299	2
				Mountain Whitefish	>300	1
		Session Total				**5**
	Site Total					**32**
	109OSC	1-Sep-2019	1	Longnose Sucker	200-299	1
				Longnose Sucker	>300	1
				Mountain Whitefish	>300	2
		Session Total				**4**
		9-Sep-2019	2	Longnose Dace	-	1
				Longnose Sucker	<150	1
				Longnose Sucker	150-199	1
				Longnose Sucker	>300	2
				Mountain Whitefish	<150	2
				Mountain Whitefish	200-299	1
				Mountain Whitefish	>300	6
		Session Total				**14**
		20-Sep-2019	3	Longnose Sucker	200-299	1
				Longnose Sucker	>300	1
				Mountain Whitefish	<150	1
				Mountain Whitefish	200-299	1
				Mountain Whitefish	>300	5
				Northern Pike	>300	1
		Session Total				**10**
		29-Sep-2019	4	Mountain Whitefish	200-299	4
				Mountain Whitefish	>300	4
		Session Total				**8**
		7-Oct-2019	5	Bull Trout	>300	1
				Largescale Sucker	>300	1
				Longnose Sucker	200-299	1
				Longnose Sucker	>300	1
				Mountain Whitefish	200-299	4
				Mountain Whitefish	>300	4
		Session Total				**12**
	Site Total					**48**
Upper Site 109L Total						**298**
Survey Total						**557**

Table C3 Summary of life history data collected in the Peace River during boat electroshocking surveys conducted as part of BC Hydro's Site C Offset Effectiveness Monitoring Program, 2019.

Site Name	Date	Sample Number	Species	Length (mm)	Weight (g)	Condition (K)	Tag 1 Number	Tag 2 Number	Preserve Code[a]
0505	31-Aug-19	778	Longnose Sucker	426	962	1.244	900230000208438		
		779	Longnose Sucker	412	858	1.227	900230000208292		
		780	Walleye	384	666	1.176	900230000081104		
		781	Largescale Sucker	450	1080	1.185	900230000208323		
		782	Redside Shiner	78	2	0.421			3
		783	Longnose Sucker	107	12	0.98			
		784	Lake Whitefish	422	1124	1.496	900230000207910		
		785	Longnose Sucker	415	839	1.174	900230000207996		
		786	Longnose Sucker	395	770	1.249	900230000080497		
		787	Longnose Sucker	413	812	1.153	900230000207760		
		788	Northern Pikeminnow	407	746	1.107			
		789	Longnose Sucker	394	827	1.352	900230000208133		
		790	Mountain Whitefish	317	284	0.892	900230000207870		
		791	Longnose Sucker	295	366	1.426	900228000439187		
		792	Longnose Sucker	278	269	1.252	900228000678738		
		793	Longnose Sucker	114	16	1.08			
		794	Mountain Whitefish	80	5	0.977			
		795	Mountain Whitefish	81	4	0.753			
		796	Spottail Shiner	68	4	1.272			
		797	Bull Trout	480	1042	0.942	900228000349614		3
		798	Rainbow Trout	485	1498	1.313	900230000078021		3
		799	Rainbow Trout	350	446	1.04	900230000084318		3
		800	Rainbow Trout	370	630	1.244	900230000077403		3
		801	Bull Trout	392	534	0.887	900230000208243		3
	11-Sep-19	2210	Mountain Whitefish	81					
		2211	Mountain Whitefish	85					
		2212	Mountain Whitefish	289	282	1.168	900228000438206		
		2213	Mountain Whitefish	149	36	1.088			
		2214	Mountain Whitefish	91	10	1.327			

[a] 1 = Stomach contents (gastric lavage); 3 = DNA Sample; 5 = Mercury and SIA (biopsy)

Table C3 Continued.

Site Name	Date	Sample Number	Species	Length (mm)	Weight (g)	Condition (K)	Tag 1 Number	Tag 2 Number	Preserve Code[a]
0505	11-Sep-19	2215	Mountain Whitefish	89	9	1.277			
		2216	Northern Pikeminnow	438	948	1.128			
		2217	Northern Pikeminnow	350	576	1.343			
		2218	Longnose Sucker	417	800	1.103	900230000206169		
		2219	Mountain Whitefish	70					
		2220	Longnose Sucker	412	956	1.367	900230000203417		
		2221	Longnose Sucker	410	942	1.367	900230000077080		
		2222	Longnose Sucker	431	1074	1.341	900230000203764		
		2223	Longnose Sucker	338	546	1.414	900230000203988		
		2224	White Sucker	440	1122	1.317	900230000203608		
		2225	Mountain Whitefish	275	273	1.313	900228000680467		
		2226	Bull Trout	225	114	1.001	900228000439715		3
		2227	Rainbow Trout	238	168	1.246	900228000680552		3
		2228	Bull Trout	578	1694	0.877	900230000203947		3
		2229	Burbot	361	260	0.553	900230000203459		
		2230	Mountain Whitefish	149	31	0.937			
		2231	Mountain Whitefish	74					
		2232	Mountain Whitefish	83					
		2233	Prickly Sculpin	82					3
		2234	Prickly Sculpin	160	49	1.196			3
	20-Sep-19	3666	Redside Shiner	89	5	0.709			
		3667	Rainbow Trout	365	465	0.956	900230000084318		
		3668	Mountain Whitefish	157	35	0.904			
		3669	Northern Pikeminnow	315	349	1.117			
		3670	Northern Pikeminnow	97	10	1.096			
		3671	Mountain Whitefish	96	8	0.904			
		3672	Mountain Whitefish	152	37	1.054			
		3673	Mountain Whitefish	149	31	0.937			
		3674	Rainbow Trout	164	46	1.043	900226001039570		3
		3675	Longnose Sucker	308	379	1.297	900230000084406		

[a] 1 = Stomach contents (gastric lavage); 3 = DNA Sample; 5 = Mercury and SIA (biopsy)

Table C3 Continued.

Site Name	Date	Sample Number	Species	Length (mm)	Weight (g)	Condition (K)	Tag 1 Number	Tag 2 Number	Preserve Code[a]
0505	20-Sep-19	3676	Burbot	305	130	0.458	900230000211821		6
		3677	Mountain Whitefish	96	7	0.791			
		3678	Largescale Sucker	198	97	1.25			
		3679	Redside Shiner	102	15	1.413			
		3680	Longnose Sucker	168	60	1.265			
		3681	Longnose Sucker	159	51	1.269			
		3682	Longnose Sucker	164	53	1.202			
		3683	Mountain Whitefish	304	325	1.157	900230000084427		
		3684	Largescale Sucker	176	58	1.064			
		3685	Prickly Sculpin	93	7	0.87			3
		3686	Rainbow Trout	304	355	1.264	900230000211813		3
		3687	Rainbow Trout	262	209	1.162	900228000635994		3
		3688	Arctic Grayling	391	692	1.158	900230000211562		3, 6
	29-Sep-19	4827	Mountain Whitefish	305	336	1.184	900230000210832		
		4828	Walleye	436	1003	1.21	900230000210116		
		4829	White Sucker	352	657	1.506	900230000210350		
		4830	White Sucker	444	1146	1.309	900230000203608		
		4831	Longnose Sucker	435	1102	1.339	900230000203764		
		4832	Largescale Sucker	337	486	1.27	900230000206527		
		4833	Longnose Sucker	290	304	1.246	900228000636003		
		4834	Mountain Whitefish	156	41	1.08			
		4835	Largescale Sucker	154	35	0.958			
		4836	Mountain Whitefish	160	43	1.05			
		4837	Mountain Whitefish	154	44	1.205			
		4838	Mountain Whitefish	86	6	0.943			
		4839	Mountain Whitefish	82	6	1.088			
		4840	Bull Trout	205	82	0.952	900228000635653		3
		4841	Bull Trout	220	96	0.902	900228000635440		3
	07-Oct-19	5542	White Sucker	442	1128	1.306	900230000203608		
		5543	Largescale Sucker	476	1328	1.231	900230000076309		

[a] 1 = Stomach contents (gastric lavage); 3 = DNA Sample; 5 = Mercury and SIA (biopsy)

Table C3 Continued.

Site Name	Date	Sample Number	Species	Length (mm)	Weight (g)	Condition (K)	Tag 1 Number	Tag 2 Number	Preserve Code[a]
0505	07-Oct-19	5544	White Sucker	364	688	1.427	900230000206344		
		5545	Longnose Sucker	403	874	1.335	900230000079867		
		5546	Rainbow Trout	295	368	1.433	900230000211813		
		5547	Rainbow Trout	241	197	1.407	900228000680552		
		5548	Mountain Whitefish	330	370	1.03	965000000281123	900230000207466	
		5549	Mountain Whitefish	286	270	1.154	900228000591728		
0506	31-Aug-19	803	Bull Trout	325	341	0.993	900230000207846		3
		804	Northern Pikeminnow	433	929	1.144			
		805	White Sucker	366	776	1.583	900230000208233		
		806	Mountain Whitefish	152	37	1.054			
		807	Longnose Sucker	457	1205	1.263	900230000207786		
		808	Longnose Sucker	406	736	1.1	900230000207816		
		809	Longnose Sucker	378	663	1.228	900230000207937		
		810	Longnose Sucker	414	971	1.368	900230000208109		
		811	Northern Pikeminnow	94	7	0.843			
		812	Longnose Sucker	175	58	1.082			
		813	White Sucker	388	768	1.315	900230000208250		
		814	White Sucker	365	641	1.318	900230000207995		
		815	Redside Shiner	80	6	1.172			3
		816	Redside Shiner	83	4	0.7			3
		817	White Sucker	432	1114	1.382	900230000208238		
		818	Longnose Sucker	406	806	1.204	900230000208779		
		819	Redside Shiner	79	5	1.014			3
		820	Longnose Sucker	415	948	1.326	900228000591414		
		821	Walleye	379	631	1.159	900230000208201		
		822	Longnose Sucker	401	812	1.259	900230000208132		
		823	Longnose Sucker	110	17	1.277			
		824	Northern Pikeminnow	96	10	1.13			
		825	Redside Shiner	77	5	1.095			3
	11-Sep-19	2178	Mountain Whitefish	74	4	0.987			

[a] 1 = Stomach contents (gastric lavage); 3 = DNA Sample; 5 = Mercury and SIA (biopsy)

Table C3 Continued.

Site Name	Date	Sample Number	Species	Length (mm)	Weight (g)	Condition (K)	Tag 1 Number	Tag 2 Number	Preserve Code[a]
0506	11-Sep-19	2179	Mountain Whitefish	82	5	0.907			
		2180	Mountain Whitefish	69	4	1.218			
		2181	Longnose Sucker	137	33	1.283			
		2182	Mountain Whitefish	262	192	1.068	900228000635728		
		2183	Mountain Whitefish	364	428	0.887	900230000206003		
		2184	White Sucker	332	485	1.325	900230000203447		
		2185	Mountain Whitefish	84	6	1.012			
		2186	Mountain Whitefish	81					
		2187	Mountain Whitefish	331	299	0.824	900230000203884		
		2188	White Sucker	262	229	1.273	900228000680045		
		2189	Largescale Sucker	448	1154	1.283	900230000203967		
		2190	Burbot	154	24	0.657	900226001039556		
		2191	Mountain Whitefish	84					
		2192	Longnose Sucker	416	959	1.332	900228000591414		
		2193	Longnose Sucker	382	731	1.311	900230000203760		
		2194	Longnose Sucker	319	438	1.349	900230000203534		
		2195	Longnose Sucker	433	936	1.153	900230000203853		
		2196	White Sucker	371	682	1.336	900230000206344		
		2197	Mountain Whitefish	257	177	1.043	900228000680048		
		2198	Longnose Sucker	412	939	1.343	900230000203863		
		2199	Longnose Sucker	412	837	1.197	900230000076819		
		2200	Largescale Sucker	368	583	1.17	900230000203966		
		2201	Longnose Sucker	436	782	0.944			
		2202	Mountain Whitefish	357	405	0.89	900230000203723		
		2203	White Sucker	215	112	1.127	900228000680153		
		2204	Troutperch	67	5	1.662			
		2205	Longnose Sucker	199	91	1.155			
		2206	Mountain Whitefish	290	263	1.078	900228000636016		
		2207	Longnose Sucker	142	33	1.153			
		2208	Burbot	421	413	0.553	900230000203460		

[a] 1 = Stomach contents (gastric lavage); 3 = DNA Sample; 5 = Mercury and SIA (biopsy)

Table C3 Continued.

Site Name	Date	Sample Number	Species	Length (mm)	Weight (g)	Condition (K)	Tag 1 Number	Tag 2 Number	Preserve Code[a]
0506	20-Sep-19	3689	Mountain Whitefish	247	150	0.995	900228000636083		
		3690	Mountain Whitefish	347	426	1.02	900230000054321		
		3691	Mountain Whitefish	282	230	1.026	900228000635485		
		3692	Mountain Whitefish	328	351	0.995	900230000211935		
		3693	Mountain Whitefish	294	267	1.051	900228000680023		
		3694	Mountain Whitefish	376	567	1.067	900230000084671		
		3695	Mountain Whitefish	272	222	1.103	900228000680246		
		3696	Mountain Whitefish	311	308	1.024	900228000591878		
		3697	Mountain Whitefish	324	366	1.076	900230000084282		
		3698	Mountain Whitefish	251	191	1.208	900228000680726		
		3699	Northern Pikeminnow	466	1443	1.426			
		3700	Northern Pikeminnow	349	511	1.202			
		3701	Longnose Sucker	456	1069	1.127	900230000084402		
		3702	Largescale Sucker	517	2144	1.552	900230000211260		
		3703	Longnose Sucker	437	1092	1.309	900230000084657		
		3704	Longnose Sucker	436	1091	1.316	900230000211701		
		3705	Longnose Sucker	431	916	1.144	900230000084474		
		3706	Longnose Sucker	415	823	1.151	900230000084397		
		3707	Longnose Sucker	441	953	1.111	900230000084563		
		3708	Northern Pikeminnow	356	550	1.219			
		3709	Longnose Sucker	309	371	1.257	900230000211485		
		3710	Longnose Sucker	347	480	1.149	900230000079323		
		3711	Longnose Sucker	160	41	1.001			
		3712	Longnose Sucker	137	24	0.933			
		3713	Longnose Sucker	172	56	1.101			
		3714	Largescale Sucker	147	40	1.259			
		3715	Longnose Sucker	144	32	1.072			
		3716	Bull Trout	393	557	0.918	900228000586311		3
	29-Sep-19	4843	Prickly Sculpin	94	10	1.204			3
		4844	Prickly Sculpin	81	8	1.505			3

[a] 1 = Stomach contents (gastric lavage); 3 = DNA Sample; 5 = Mercury and SIA (biopsy)

Table C3 Continued.

Site Name	Date	Sample Number	Species	Length (mm)	Weight (g)	Condition (K)	Tag 1 Number	Tag 2 Number	Preserve Code[a]
0506	29-Sep-19	4845	Longnose Sucker	124	28	1.469			
		4846	Mountain Whitefish	328	328	0.93	900026000052671		
		4847	Mountain Whitefish	252	169	1.056	900228000635900		
		4848	Redside Shiner	50	1	0.8			
		4849	Mountain Whitefish	305	287	1.012	900230000080059		
		4850	Mountain Whitefish	310	315	1.057	900228000368769		
		4851	Mountain Whitefish	281	253	1.14	900228000680298		
		4852	Mountain Whitefish	346	357	0.862	900230000206385		
		4853	Mountain Whitefish	334	393	1.055	900026000055817	900230000206742	
		4854	Rainbow Trout	303	351	1.262	900230000211813		
		4855	Largescale Sucker	481	1523	1.369	900230000080268		
		4856	Largescale Sucker	437	1091	1.307	900230000210430		
		4857	Mountain Whitefish	249	203	1.315	900228000635370		
		4858	Mountain Whitefish	309	248	0.841	900230000076105		
		4859	Mountain Whitefish	290	274	1.123	900228000369551		
		4860	Mountain Whitefish	311	304	1.011	900230000210218		
		4861	Mountain Whitefish	273	213	1.047	900228000635786		
		4862	Northern Pikeminnow	510	1831	1.38			
		4863	Largescale Sucker	385	824	1.444	900230000210089		
		4864	Largescale Sucker	403	913	1.395	900230000210445		
		4865	Longnose Sucker	355	564	1.261	900230000206166		
		4866	Longnose Sucker	284	286	1.249	900228000635801		
		4867	Mountain Whitefish	263	208	1.143	900228000635728		
		4868	Mountain Whitefish	254	176	1.074	900228000680534		
		4869	White Sucker	399	834	1.313	900230000206577		
		4870	Northern Pikeminnow	504	1687	1.318			
		4871	Northern Pikeminnow	466	1368	1.352			
		4872	Mountain Whitefish	244	180	1.239	900228000635668		
		4873	Bull Trout	750	3868	0.917			3
	07-Oct-19	5551	Mountain Whitefish	311	356	1.184	900230000203637		

[a] 1 = Stomach contents (gastric lavage); 3 = DNA Sample; 5 = Mercury and SIA (biopsy)

Table C3 Continued.

Site Name	Date	Sample Number	Species	Length (mm)	Weight (g)	Condition (K)	Tag 1 Number	Tag 2 Number	Preserve Code[a]
0506	07-Oct-19	5552	Mountain Whitefish	347	388	0.929	900026000154732		
		5553	Bull Trout	267	190	0.998	900228000681868		3
		5554	Bull Trout	302	227	0.824	900230000209406		3
		5555	Mountain Whitefish	258	204	1.188	900228000635728		
		5556	Northern Pikeminnow	161	50	1.198			
0509	01-Sep-19	902	Mountain Whitefish	435	780	0.948	900230000033292		
		903	Largescale Sucker	540	1838	1.167	900230000206216		
		904	Largescale Sucker	539	2139	1.366	900230000203987		
		905	Mountain Whitefish	365	479	0.985	900230000077424		
		906	Longnose Sucker	385	794	1.391	900230000203698		
		907	Longnose Sucker	187	88	1.346			
		908	Longnose Sucker	154	40	1.095			
		909	Longnose Sucker	127	23	1.123			
		910	Redside Shiner	85	8	1.303			
		911	Redside Shiner	79	7	1.42			
		912	Redside Shiner	84	6	1.012			
		913	Longnose Sucker	133	19	0.808			
		914	Northern Pikeminnow	91	10	1.327			
		915	Redside Shiner	76	5	1.139			
		916	Redside Shiner	75	6	1.422			
		917	Redside Shiner	78	6	1.264			
		918	Spottail Shiner	70	4	1.166			
		920	Mountain Whitefish	418	733	1.004	900230000203725		
		921	Mountain Whitefish	311	272	0.904	900230000084319		
		922	Mountain Whitefish	278	224	1.043	900228000681329		
		923	Mountain Whitefish	334	331	0.888	900230000203875		
		924	Mountain Whitefish	154	39	1.068			
		925	Mountain Whitefish	143	33	1.129			
		926	Mountain Whitefish	139	29	1.08			
		927	Largescale Sucker	142	30	1.048			

[a] 1 = Stomach contents (gastric lavage); 3 = DNA Sample; 5 = Mercury and SIA (biopsy)

Table C3 Continued.

Site Name	Date	Sample Number	Species	Length (mm)	Weight (g)	Condition (K)	Tag 1 Number	Tag 2 Number	Preserve Code[a]
0509	01-Sep-19	928	Longnose Sucker	140	29	1.057			
		929	Largescale Sucker	199	77	0.977			
		930	Redside Shiner	66	3	1.043			
		931	Slimy Sculpin	76	4	0.911			3
	09-Sep-19	1973	Redside Shiner	95	12	1.4			
		1974	Mountain Whitefish	81	6	1.129			
		1975	Mountain Whitefish	145	31	1.017			
		1976	Mountain Whitefish	252	169	1.056	900228000681120		
		1977	Mountain Whitefish	78	5	1.054			
		1978	Mountain Whitefish	76	4	0.911			
		1979	Mountain Whitefish	142	32	1.118			
		1980	Mountain Whitefish	145	28	0.918			
		1981	Longnose Sucker	101	11	1.068			
		1982	Mountain Whitefish	317	322	1.011	900230000203902		
		1983	Mountain Whitefish	171	48	0.96			
		1984	Mountain Whitefish	362	447	0.942	900230000080569		
		1985	Bull Trout	223	105	0.947	900228000635593		3, 5
		1986	Mountain Whitefish	245	181	1.231	900228000680221		
		1987	Mountain Whitefish	408	685	1.009	900230000203861		
		1988	Mountain Whitefish	140	27	0.984			
		1989	Mountain Whitefish	91	8	1.062			
		1990	Longnose Sucker	366	538	1.097	900230000206249		
		1991	Mountain Whitefish	81	5	0.941			
		1992	Mountain Whitefish	248	167	1.095	900228000680700		
		1993	Mountain Whitefish	284	251	1.096	900228000680622		
		1994	Longnose Sucker	157	45	1.163			
		1995	Prickly Sculpin	87	5	0.759			3
		1996	Mountain Whitefish	143	26	0.889			
	20-Sep-19	3761	Walleye	368	564	1.132	900230000084279		
		3762	Walleye	390	671	1.131	900230000084164		

[a] 1 = Stomach contents (gastric lavage); 3 = DNA Sample; 5 = Mercury and SIA (biopsy)

Table C3 Continued.

Site Name	Date	Sample Number	Species	Length (mm)	Weight (g)	Condition (K)	Tag 1 Number	Tag 2 Number	Preserve Code[a]
0509	20-Sep-19	3763	Walleye	428	855	1.091	900230000211934		
		3764	Mountain Whitefish	255	178	1.073	900228000679064		
		3765	Mountain Whitefish	306	308	1.075	900230000084528		
		3766	Mountain Whitefish	288	260	1.088	900228000635713		
		3767	Largescale Sucker	454	1005	1.074	900230000084184		
		3768	Longnose Sucker	438	1180	1.404	900230000126915		
		3769	Longnose Sucker	410	690	1.001	900230000211805		
		3770	Longnose Sucker	338	471	1.22	900230000084413		
		3771	Largescale Sucker	292	282	1.133	900228000635644		
		3772	Longnose Sucker	182	66	1.095			
		3773	Longnose Sucker	290	285	1.169	900228000635577		
		3774	Slimy Sculpin	57	3	1.62			3
		3775	Mountain Whitefish	76	4	0.911			
		3776	Mountain Whitefish	89	9	1.277			
		3777	Redside Shiner	94	11	1.324			
		3778	Redside Shiner	82	9	1.632			
		3779	Mountain Whitefish	315	347	1.11	900026000054864	900230000084660	
		3780	Mountain Whitefish	297	299	1.141	900228000635407		
		3781	Mountain Whitefish	226	129	1.118	900228000680074		
		3782	Mountain Whitefish	261	180	1.012	900228000368921		
		3783	Mountain Whitefish	136	29	1.153			
		3784	Mountain Whitefish	144	28	0.938			
		3785	Mountain Whitefish	90	9	1.235			
	28-Sep-19	4679	Mountain Whitefish	265	195	1.048	900228000635315		
		4680	Mountain Whitefish	140	40	1.458			
		4681	Bull Trout	430	679	0.854	900230000210988		3
		4682	Mountain Whitefish	312	275	0.905	900228000294316		
		4683	Mountain Whitefish	350	348	0.812	900230000210241		
		4684	Mountain Whitefish	325	344	1.002	900230000210939		
		4685	Largescale Sucker	410	795	1.153	900230000206544		

[a] 1 = Stomach contents (gastric lavage); 3 = DNA Sample; 5 = Mercury and SIA (biopsy)

Table C3 Continued.

Site Name	Date	Sample Number	Species	Length (mm)	Weight (g)	Condition (K)	Tag 1 Number	Tag 2 Number	Preserve Code[a]
0509	28-Sep-19	4686	Mountain Whitefish	370	492	0.971	900230000206643		
		4687	Mountain Whitefish	315	320	1.024	900230000210121		
		4688	White Sucker	415	909	1.272	900230000211448		
		4689	Mountain Whitefish	360	310	0.664	900230000206435		
		4690	Mountain Whitefish	290	261	1.07	900228000635981		
		4691	Mountain Whitefish	295	261	1.017	900228000680347		
		4692	Mountain Whitefish	430	782	0.984	900230000203948		
		4693	Longnose Sucker	350	549	1.28	900230000210038		
		4694	Longnose Sucker	410	733	1.064			
		4695	Largescale Sucker	461	1372	1.4	900230000210284		
		4696	Bull Trout	196	76	1.009	900226001039569		3
		4698	Slimy Sculpin	72	6	1.608			3
		4699	Slimy Sculpin	81	6	1.129			3
		4700	Slimy Sculpin	75	6	1.422			3
		4701	Slimy Sculpin	58	2	1.025			3
	04-Oct-19	5470	Mountain Whitefish	280	283	1.289	900228000636089		
		5471	Mountain Whitefish	323	326	0.967	900228000540140		
		5472	Mountain Whitefish	276	233	1.108	900228000541383		
		5473	Kokanee	185	78	1.232			
		5474	Northern Pike	755	3330	0.774	900230000206829		5
109OSA	31-Aug-19	827	Mountain Whitefish	321	323	0.977	900230000208630		
		828	Mountain Whitefish	350	414	0.966	900230000077549		
		829	Mountain Whitefish	284	259	1.131	900228000439384		
		830	Mountain Whitefish	321	330	0.998	900230000126075		
		831	Mountain Whitefish	326	338	0.976	900230000208098		
		832	Mountain Whitefish	344	409	1.005	900230000207992		
		833	Mountain Whitefish	268	223	1.159	900228000591660		
		834	Mountain Whitefish	322	364	1.09	900230000208665		
		835	Mountain Whitefish	292	268	1.076	900228000438382		
		836	Mountain Whitefish	233	103	0.814	900228000439505		

[a] 1 = Stomach contents (gastric lavage); 3 = DNA Sample; 5 = Mercury and SIA (biopsy)

Table C3 Continued.

Site Name	Date	Sample Number	Species	Length (mm)	Weight (g)	Condition (K)	Tag 1 Number	Tag 2 Number	Preserve Code[a]
109OSA	31-Aug-19	837	Mountain Whitefish	277	214	1.007	900228000678644		
		838	Mountain Whitefish	290	283	1.16	900228000438461		
		839	Redside Shiner	72	4	1.072			3
		840	Longnose Dace	106	15	1.259			3
		841	Longnose Dace	84					3
	09-Sep-19	1955	Mountain Whitefish	268	221	1.148	900228000680015		
		1956	Mountain Whitefish	268	196	1.018	900228000635969		
		1957	Mountain Whitefish	334	341	0.915	900230000203848		
		1958	Mountain Whitefish	341	471	1.188	900026000186632	900230000203980	
		1959	Mountain Whitefish	390	522	0.88	900230000203519		
		1960	Mountain Whitefish	296	273	1.053	900228000681019		
		1961	Mountain Whitefish	258			900228000591968		
		1962	Mountain Whitefish	309	304	1.03	900230000126770		
		1963	Mountain Whitefish	124	26	1.364			
		1964	Mountain Whitefish	232	130	1.041	900228000368526		
		1965	Mountain Whitefish	251	184	1.164	900228000438288		
		1966	Mountain Whitefish	355	399	0.892	900230000057658		
		1967	Slimy Sculpin	68	2	0.636			3
		1968	Slimy Sculpin	62	3	1.259			3
		1970	Mountain Whitefish	275	262	1.26	900228000681298		
		1971	Mountain Whitefish	208	89	0.989	900228000680028		
	20-Sep-19	3729	Mountain Whitefish	332	427	1.167	900230000084353		
		3730	Mountain Whitefish	355	464	1.037	900230000211768		
		3731	Mountain Whitefish	295	292	1.137	900228000636045		
		3732	Mountain Whitefish	368	507	1.017	900230000084236		
		3733	Mountain Whitefish	346	411	0.992	900230000076952		
		3734	Mountain Whitefish	316	352	1.116	900230000211964		
		3735	Mountain Whitefish	281	244	1.1	900228000636093		
		3736	Mountain Whitefish	384	592	1.046	900230000084527		
		3737	Mountain Whitefish	288	219	0.917	900228000591660		

[a] 1 = Stomach contents (gastric lavage); 3 = DNA Sample; 5 = Mercury and SIA (biopsy)

Table C3 Continued.

Site Name	Date	Sample Number	Species	Length (mm)	Weight (g)	Condition (K)	Tag 1 Number	Tag 2 Number	Preserve Code[a]
109OSA	20-Sep-19	3738	Mountain Whitefish	386	535	0.93	900230000084217		
		3739	Mountain Whitefish	328	422	1.196	900230000084494		
		3740	Mountain Whitefish	364	451	0.935	900230000211997		
		3741	Mountain Whitefish	374	522	0.998	900230000084154		
		3742	Mountain Whitefish	323	385	1.142	900230000211981		
		3743	Mountain Whitefish	320	430	1.312	981098104942981	900230000211314	
		3744	Mountain Whitefish	287	217	0.918	900228000635615		
		3745	Mountain Whitefish	278	243	1.131	900228000680709		
		3746	Mountain Whitefish	207	97	1.094	900228000635309		
		3747	Mountain Whitefish	151	37	1.075			
		3748	Mountain Whitefish	146	31	0.996			
	29-Sep-19	4884	Mountain Whitefish	305	336	1.184	900230000076805		
		4885	Mountain Whitefish	314	340	1.098	900230000210211		
		4886	Mountain Whitefish	290	311	1.275	981098104939598	900228000680363	
		4887	Mountain Whitefish	331	346	0.954	900230000206965		
		4888	Mountain Whitefish	392	666	1.106	900230000080330		
		4889	Mountain Whitefish	323	417	1.237	981098104935299	900230000206792	
		4890	Mountain Whitefish	246	183	1.229	900228000635746		
		4891	Mountain Whitefish	311	360	1.197	900230000127022		
		4892	Mountain Whitefish	275	294	1.414	900228000635853		
		4893	Mountain Whitefish	320	363	1.108	900230000081167		
		4894	Mountain Whitefish	321	389	1.176	900230000210308		
		4895	Mountain Whitefish	282	254	1.133	900228000541336		
		4896	Mountain Whitefish	273	244	1.199	900228000678854		
		4897	Mountain Whitefish	283	265	1.169	900228000635846		
		4898	Mountain Whitefish	300	318	1.178	900230000211269		
		4899	Mountain Whitefish	271	231	1.161	900228000439746		
		4900	Mountain Whitefish	149	45	1.36			
		4901	Mountain Whitefish	133	28	1.19			
	07-Oct-19	5558	Mountain Whitefish	365	506	1.041	900230000084236		

[a] 1 = Stomach contents (gastric lavage); 3 = DNA Sample; 5 = Mercury and SIA (biopsy)

Table C3 Continued.

Site Name	Date	Sample Number	Species	Length (mm)	Weight (g)	Condition (K)	Tag 1 Number	Tag 2 Number	Preserve Code[a]
109OSA	07-Oct-19	5559	Mountain Whitefish	323	392	1.163	981098104934058	900230000203232	
109OSB	01-Sep-19	848	Mountain Whitefish	195	79	1.065			
	20-Sep-19	3750	Mountain Whitefish	271	182	0.914	900228000635322		
		3751	Mountain Whitefish	236	123	0.936	900228000635811		
		3752	Mountain Whitefish	267	222	1.166	900228000636069		
		3753	Largescale Sucker	412	805	1.151	900230000084325		
		3754	Mountain Whitefish	156	37	0.975			
		3755	Mountain Whitefish	147	33	1.039			
		3756	Longnose Sucker	142	28	0.978			
		3757	Longnose Sucker	148	48	1.481			
		3758	Lake Chub	82	7	1.27			
		3759	Longnose Sucker	148	31	0.956			
	29-Sep-19	4903	Mountain Whitefish	319	293	0.903	900230000206474		
		4904	Mountain Whitefish	321	328	0.992	900230000210190		
		4905	Mountain Whitefish	331	414	1.142	900230000210544		
		4906	Mountain Whitefish	295	314	1.223	900228000439290		
		4907	Mountain Whitefish	315	310	0.992	900230000210060		
		4908	Largescale Sucker	410	816	1.184	900230000206752		
		4909	Largescale Sucker	495	1536	1.266	900230000206372		
		4910	Largescale Sucker	226	152	1.317	900228000635802		
		4911	Mountain Whitefish	95	11	1.283			
		4912	Longnose Sucker	147	36	1.133			
		4913	Mountain Whitefish	86	8	1.258			
		4914	Mountain Whitefish	93	10	1.243			
		4915	Mountain Whitefish	94	10	1.204			
		4916	Mountain Whitefish	90	8	1.097			
		4917	Mountain Whitefish	81	6	1.129			
		4918	Mountain Whitefish	71	5	1.397			
	07-Oct-19	5561	Mountain Whitefish	327	380	1.087	900230000203232		
109OSC	01-Sep-19	843	Mountain Whitefish	321	138	0.417	900228000368526		

[a] 1 = Stomach contents (gastric lavage); 3 = DNA Sample; 5 = Mercury and SIA (biopsy)

Table C3 Continued.

Site Name	Date	Sample Number	Species	Length (mm)	Weight (g)	Condition (K)	Tag 1 Number	Tag 2 Number	Preserve Code[a]
109OSC	01-Sep-19	844	Longnose Sucker	382	684	1.227	900230000203509		
		845	Mountain Whitefish	329	346	0.972	900230000203848		
		846	Longnose Sucker	268	229	1.19	900228000680714		
	09-Sep-19	1940	Mountain Whitefish	392	567	0.941	900230000203842		
		1941	Mountain Whitefish	95	6	0.7			
		1942	Mountain Whitefish	396	598	0.963	900230000203630		
		1943	Mountain Whitefish	366	523	1.067	900230000206328		
		1944	Mountain Whitefish	330	358	0.996	900230000076811		
		1945	Longnose Sucker	364	583	1.209	900230000206332		
		1946	Mountain Whitefish	396	631	1.016	900230000206340		
		1947	Mountain Whitefish	257	188	1.108	900228000680057		
		1948	Mountain Whitefish	86	6	0.943			
		1949	Mountain Whitefish	371	453	0.887	965000000089617	900230000203860	
		1950	Longnose Sucker	436	1003	1.21	900230000203732		
		1951	Longnose Sucker	162	54	1.27			
		1952	Longnose Sucker	148	36	1.11			
		1953	Longnose Dace	95	12	1.4			3
	20-Sep-19	3718	Mountain Whitefish	377	570	1.064	900230000076365		
		3719	Mountain Whitefish	321	361	1.091	900230000084610		
		3720	Northern Pike	499	850	0.684	900230000211545		5
		3721	Mountain Whitefish	363	516	1.079	900230000084570		
		3722	Mountain Whitefish	288	253	1.059	900228000680242		
		3723	Mountain Whitefish	326	319	0.921	900230000080629		
		3724	Mountain Whitefish	329	362	1.017	900230000211989		
		3725	Mountain Whitefish	145	32	1.05			
		3726	Longnose Sucker	435	947	1.15	900230000084535		
		3727	Longnose Sucker	270	218	1.108	900228000635329		
	29-Sep-19	4875	Mountain Whitefish	279	236	1.087	900228000591295		
		4876	Mountain Whitefish	230	123	1.011	900228000680783		
		4877	Mountain Whitefish	320	331	1.01	900230000203848		

[a] 1 = Stomach contents (gastric lavage); 3 = DNA Sample; 5 = Mercury and SIA (biopsy)

Table C3 Continued.

Site Name	Date	Sample Number	Species	Length (mm)	Weight (g)	Condition (K)	Tag 1 Number	Tag 2 Number	Preserve Code[a]
109OSC	29-Sep-19	4878	Mountain Whitefish	325	339	0.988	900228000349474		
		4879	Mountain Whitefish	380	565	1.03	900230000206616		
		4880	Mountain Whitefish	305	291	1.026	900230000210870		
		4881	Mountain Whitefish	277	222	1.045	900228000680032		
		4882	Mountain Whitefish	274	208	1.011	900228000635878		
	07-Oct-19	5563	Mountain Whitefish	360	443	0.95	900230000211768		
		5564	Longnose Sucker	365	619	1.273	900230000030442		
		5565	Bull Trout	396	615	0.99	900228000586311		

[a] 1 = Stomach contents (gastric lavage); 3 = DNA Sample; 5 = Mercury and SIA (biopsy)

Table C4 Summary of hoop trap data collected during fish use surveys at River Road Rock Spurs under Site C Offset Effectiveness Monitoring, 2019.

Hoop Trap Number	Date Set	Time Set	Date Pulled	Time Pulled	Effort (H)	Bait	Depth (m)	Fish Caught
HT01	09-Sep-19	10:30	9-Sep-19	15:54	5.40	Sardines in springwater	3.5	0
HT02	09-Sep-19	10:46	9-Sep-19	15:59	5.22	Sardines in springwater	2.3	0
HT03	09-Sep-19	10:57	9-Sep-19	16:03	5.10	Sardines in springwater	3.1	0
HT04	09-Sep-19	11:02	9-Sep-19	16:07	5.08	Sardines in springwater	4.4	0
HT05	09-Sep-19	11:12	9-Sep-19	16:11	4.98	Sardines in springwater	4.0	0
HT06	09-Sep-19	11:16	9-Sep-19	16:14	4.97	Sardines in springwater	3.2	0
HT01	20-Sep-19	17:51	21-Sep-19	13:22	19.52	Sardines and hot peppers in springwater	3.0	0
HT02	20-Sep-19	17:55	21-Sep-19	13:27	19.53	Sardines and hot peppers in springwater	2.5	0
HT03	20-Sep-19	17:59	21-Sep-19	n/a[a]		Sardines and hot peppers in springwater	1.4	n/a[a]
HT04	20-Sep-19	18:11	21-Sep-19	13:44	19.55	Sardines and hot peppers in springwater	4.0	0
HT05	20-Sep-19	18:15	21-Sep-19	13:47	19.53	Sardines and hot peppers in springwater	2.7	0
HT06	20-Sep-19	18:22	21-Sep-19	13:50	19.47	Sardines and hot peppers in springwater	2.6	0
Total					**128.35**			**0**

[a]Hoop trap missing at pull.

Table C5 Summary of minnow trap data collected during fish use surveys at River Road Rock Spurs under Site C Offset Effectiveness Monitoring, 2019.

Hoop Trap Number	Date Set	Time Set	Date Pulled	Time Pulled	Effort (H)	Bait	Fish Caught	Species
MT01	09-Sep-19	11:20	09-Sep-19	16:18	4.97	Sardines in springwater	0	
MT02	09-Sep-19	11:22	09-Sep-19	16:19	4.95	Sardines in springwater	0	
MT03	09-Sep-19	11:24	09-Sep-19	16:20	4.93	Sardines in springwater	0	
MT04	09-Sep-19	11:26	09-Sep-19	16:21	4.92	Sardines in springwater	0	
MT05	09-Sep-19	11:28	09-Sep-19	16:22	4.90	Sardines in springwater	0	
MT06	09-Sep-19	11:30	09-Sep-19	16:23	4.88	Sardines in springwater	0	
MT07	09-Sep-19	11:32	09-Sep-19	16:24	4.87	Sardines in springwater	0	
MT08	09-Sep-19	11:34	09-Sep-19	16:25	4.85	Sardines in springwater	0	
MT09	09-Sep-19	11:36	09-Sep-19	16:26	4.83	Sardines in springwater	0	
MT10	09-Sep-19	11:38	09-Sep-19	16:27	4.82	Sardines in springwater	2	Prickly Sculpin
MT11	09-Sep-19	11:40	09-Sep-19	16:28	4.80	Sardines in springwater	0	
MT12	09-Sep-19	11:42	09-Sep-19	16:29	4.78	Sardines in springwater	0	
MT13	09-Sep-19	11:44	09-Sep-19	16:30	4.77	Sardines in springwater	0	
MT14	09-Sep-19	11:46	09-Sep-19	16:31	4.75	Sardines in springwater	0	
MT15	09-Sep-19	11:48	09-Sep-19	16:32	4.73	Sardines in springwater	0	
MT16	09-Sep-19	11:50	09-Sep-19	16:33	4.72	Sardines in springwater	0	
MT17	09-Sep-19	11:50	09-Sep-19	16:39	4.82	Sardines in springwater	0	
MT01	20-Sep-19	17:44	21-Sep-19	13:55	20.18	Sardines and hot peppers in springwater	0	
MT02	20-Sep-19	17:47	21-Sep-19	13:57	20.17	Sardines and hot peppers in springwater	0	
MT03	20-Sep-19	17:50	21-Sep-19	13:59	20.15	Sardines and hot peppers in springwater	3	Prickly Sculpin
MT04	20-Sep-19	17:53	21-Sep-19	14:01	20.13	Sardines and hot peppers in springwater	2	Prickly Sculpin
MT05	20-Sep-19	17:56	21-Sep-19	14:03	20.12	Sardines and hot peppers in springwater	2	Prickly Sculpin
MT06	20-Sep-19	17:59	21-Sep-19	14:05	20.10	Sardines and hot peppers in springwater	1	Prickly Sculpin
MT07	20-Sep-19	18:02	21-Sep-19	14:07	20.08	Sardines and hot peppers in springwater	0	
MT08	20-Sep-19	18:05	21-Sep-19	14:09	20.07	Sardines and hot peppers in springwater	0	
MT09	20-Sep-19	18:08	21-Sep-19	14:11	20.05	Sardines and hot peppers in springwater	3	Prickly Sculpin
MT10	20-Sep-19	18:11	21-Sep-19	14:13	20.03	Sardines and hot peppers in springwater	0	
MT11	20-Sep-19	18:14	21-Sep-19	14:15	20.02	Sardines and hot peppers in springwater	0	
MT12	20-Sep-19	18:17	21-Sep-19	14:17	20.00	Sardines and hot peppers in springwater	0	
MT13	20-Sep-19	18:20	21-Sep-19	14:19	19.98	Sardines and hot peppers in springwater	0	
MT14	20-Sep-19	18:23	21-Sep-19	14:21	19.97	Sardines and hot peppers in springwater	0	
MT15	20-Sep-19	18:26	21-Sep-19	14:23	19.95	Sardines and hot peppers in springwater	0	
MT16	20-Sep-19	18:29	21-Sep-19	14:25	19.93	Sardines and hot peppers in springwater	0	
MT17	20-Sep-19	18:40	21-Sep-19	14:25	19.75	Sardines and hot peppers in springwater	0	
MT01	28-Sep-19	9:55	29-Sep-19	11:00	25.08	Sardines and hot peppers in springwater	0	
MT02	28-Sep-19	9:56	29-Sep-19	11:03	25.12	Sardines and hot peppers in springwater	0	
MT03	28-Sep-19	9:57	29-Sep-19	11:06	25.15	Sardines and hot peppers in springwater	0	
MT04	28-Sep-19	9:58	29-Sep-19	11:09	25.18	Sardines and hot peppers in springwater	0	
MT05	28-Sep-19	9:59	29-Sep-19	11:12	25.22	Sardines and hot peppers in springwater	1	Prickly Sculpin
MT06	28-Sep-19	10:00	29-Sep-19	11:15	25.25	Sardines and hot peppers in springwater	0	
MT07	28-Sep-19	10:01	29-Sep-19	11:18	25.28	Sardines and hot peppers in springwater	0	
MT08	28-Sep-19	10:02	29-Sep-19	11:21	25.32	Sardines and hot peppers in springwater	1	Prickly Sculpin
MT09	28-Sep-19	10:03	29-Sep-19	11:24	25.35	Sardines and hot peppers in springwater	0	
MT10	28-Sep-19	10:04	29-Sep-19	11:27	25.38	Sardines and hot peppers in springwater	1	Sucker Spp.
MT11	28-Sep-19	10:05	29-Sep-19	11:30	25.42	Sardines and hot peppers in springwater	0	
MT12	28-Sep-19	10:06	29-Sep-19	11:31	25.42	Sardines and hot peppers in springwater	0	
MT13	28-Sep-19	10:07	29-Sep-19	11:32	25.42	Sardines and hot peppers in springwater	0	
MT14	28-Sep-19	10:08	29-Sep-19	11:33	25.42	Sardines and hot peppers in springwater	0	
MT15	28-Sep-19	10:09	29-Sep-19	11:34	25.42	Sardines and hot peppers in springwater	0	
MT16	28-Sep-19	10:10	29-Sep-19	11:35	25.42	Sardines and hot peppers in springwater	0	
MT17	28-Sep-19	10:10	29-Sep-19	11:39	25.48	Sardines and hot peppers in springwater	0	
MT01	04-Oct-19	9:45	5-Oct-19	9:15	23.50	Cheese and cat treats	0	
MT02	04-Oct-19	9:46	5-Oct-19	9:17	23.52	Cheese and cat treats	0	
MT03	04-Oct-19	9:47	5-Oct-19	9:19	23.53	Cheese and cat treats	1	Slimy Sculpin
MT04	04-Oct-19	9:48	5-Oct-19	9:21	23.55	Cheese and cat treats	0	
MT05	04-Oct-19	9:49	5-Oct-19	9:23	23.57	Cheese and cat treats	2	Prickly Sculpin
MT06	04-Oct-19	9:50	5-Oct-19	9:25	23.58	Cheese and cat treats	0	
MT07	04-Oct-19	9:51	5-Oct-19	9:27	23.60	Cheese and cat treats	0	
MT08	04-Oct-19	9:52	5-Oct-19	9:29	23.62	Cheese and cat treats	1	Slimy Sculpin
MT09	04-Oct-19	9:53	5-Oct-19	9:31	23.63	Cheese and cat treats	0	
MT10	04-Oct-19	9:54	5-Oct-19	9:33	23.65	Cheese and cat treats	0	
MT11	04-Oct-19	9:55	5-Oct-19	9:35	23.67	Cheese and cat treats	0	
MT12	04-Oct-19	9:56	5-Oct-19	9:37	23.68	Cheese and cat treats	0	
MT13	04-Oct-19	9:57	5-Oct-19	9:39	23.70	Cheese and cat treats	0	
MT14	04-Oct-19	9:58	5-Oct-19	9:41	23.72	Cheese and cat treats	0	
MT15	04-Oct-19	9:59	5-Oct-19	9:43	23.73	Cheese and cat treats	0	
MT16	04-Oct-19	10:05	5-Oct-19	9:45	23.67	Cheese and cat treats	0	
MT17	04-Oct-19	10:07	5-Oct-19	9:47	23.67	Cheese and cat treats	0	
Total					**1254.87**		**20**	

APPENDIX D

Mountain Whitefish Spawning Monitoring Data

Table D1 Summary of egg collection mat data collected during Mountain Whitefish spawning monitoring under Site C Offset Effectiveness Monitoring, 2019.

Station Name[a]	Number of Samplers Deployed	Set		Pull		Effort (h)	Water Temperature (°C)		Water Depth (m)	Number of Mountain Whitefish Eggs
		Date	Time	Date	Time		Set	Pull		
M501OS	1	28-Oct-19	10:31	14-Nov-19	12:52	410.35	6.9	4.8	2.0	0
M502OS	1	28-Oct-19	11:08	14-Nov-19	13:00	409.87	6.9	4.8	2.4	0
M503OS	1	28-Oct-19	11:27	14-Nov-19	13:08	409.68	6.9	4.8	3.0	0
M504OS	1	28-Oct-19	11:52	15-Nov-19	13:30	433.63	6.9	5.1	3.3	0
M505OS	1	28-Oct-19	13:03	14-Nov-19	13:18	408.25	6.9	4.8	2.8	0
M506OS	1	28-Oct-19	13:21	14-Nov-19	13:23	408.03	6.9	4.8	2.8	0
M5070S	1	28-Oct-19	14:37	14-Nov-19	13:00	406.38	6.9	4.8	2.1	0
M508OS	1	28-Oct-19	14:39	14-Nov-19	13:53	407.23	6.9	4.8	3.1	0
M601	1	29-Oct-19	10:19	14-Nov-19	15:07	388.80	6.1	5.0	2.2	0
M602	1	29-Oct-19	10:40	15-Nov-19	12:31	409.85	6.1	5.0	2.7	0
M603	1	29-Oct-19	10:58	14-Nov-19	15:56	N/A[b]	6.1	5.0	4.1	
M604	1	29-Oct-19	11:16	14-Nov-19	15:32	388.27	6.1	5.0	2.5	0
M605	1	29-Oct-19	11:30	14-Nov-19	15:40	388.17	6.1	5.0	3.4	0
S606	1	29-Oct-19	14:21	14-Nov-19	14:50	384.48	6.0	5.0	1.9	0
M501OS	1	14-Nov-19	12:53	27-Nov-19	10:32	309.65	4.8	3.9	1.9	0
M502OS	1	14-Nov-19	13:01	27-Nov-19	10:40	309.65	4.8	3.9	2.4	0
M503OS	1	14-Nov-19	13:09	27-Nov-19	10:48	309.65	4.8	3.9	3.0	0
M504OS	1	15-Nov-19	13:59	27-Nov-19	10:55	284.93	5.1	3.9	2.3	0
M505OS	1	14-Nov-19	13:19	27-Nov-19	11:01	309.70	4.8	3.9	2.7	0
M506OS	1	14-Nov-19	13:42	27-Nov-19	11:07	309.42	4.8	3.9	2.9	0
M507OS	1	14-Nov-19	13:01	27-Nov-19	11:17	310.27	4.8	3.9	3.3	0
M508OS	1	14-Nov-19	13:54	27-Nov-19	13:21	311.45	4.8	3.9	2.0	0
M509	1	15-Nov-19	10:15	28-Nov-19	11:31	313.27	4.8	3.9	2.4	0
M510	1	15-Nov-19	10:42	27-Nov-19	11:59	289.28	4.8	3.9	4.0	0
M511	1	15-Nov-19	11:03	27-Nov-19	12:15	289.20	4.8	3.9	2.4	0
M512	1	15-Nov-19	11:26	27-Nov-19	12:51	289.42	5.1	3.9	1.8	0
M513	1	15-Nov-19	11:52	27-Nov-19	13:02	289.17	5.1	3.9	1.7	0
M601	1	14-Nov-19	15:09	28-Nov-19	13:47	334.63	5.0	2.6	2.8	0
M602	1	15-Nov-19	12:51	28-Nov-19	13:34	312.72	5.1	2.6	2.1	0
M603	1	14-Nov-19	16:14	28-Nov-19	13:30	N/A[b]	5.0	2.6	3.5	
M604	1	14-Nov-19	15:33	28-Nov-19	12:55	333.37	5.0	2.6	2.5	0
M605	1	14-Nov-19	15:41	28-Nov-19	12:44	333.05	5.0	2.6	3.8	0
S606	1	14-Nov-19	15:02	28-Nov-19	14:07	335.08	5.0	2.6	1.7	0
M501OS	1	27-Nov-19	10:39	08-Dec-19	11:49	265.17	3.9	2.3	1.9	0
M502OS	1	27-Nov-19	10:41	08-Dec-19	11:43	265.03	3.9	2.3	2.3	0
M503OS	1	27-Nov-19	10:50	08-Dec-19	11:39	264.82	3.9	2.3	3.0	0
M504OS	1	27-Nov-19	10:56	08-Dec-19	11:33	264.62	3.9	2.3	2.3	0
M505OS	1	27-Nov-19	11:04	08-Dec-19	12:02	264.97	3.9	2.3	2.8	0
M506OS	1	27-Nov-19	11:11	08-Dec-19	11:27	264.27	3.9	2.3	3.0	0
M507OS	1	27-Nov-19	11:26	08-Dec-19	11:17	263.85	3.9	2.3	4.4	0
M508OS	1	27-Nov-19	13:48	08-Dec-19	11:23	261.58	3.9	2.3	2.8	0

[a] See Appendix A, Figure A4 for sample site locations. …continued.

[b] Mat was missing at retrieval time.

[c] Complete mat set missing; including mat, anchors, chain, cable, floats and rope. Possibility of retrieval at lower water levels.

Table D1 Continued.

Station Name[a]	Number of Samplers Deployed	Set		Pull		Effort (h)	Water Temperature (°C)		Water Depth (m)	Number of Mountain Whitefish Eggs
		Date	Time	Date	Time		Set	Pull		
M509	1	27-Nov-19	11:41	08-Dec-19	11:10	263.48	3.9	2.3	2.0	0
M510	1	27-Nov-19	12:04	08-Dec-19	11:01	262.95	3.9	2.3	3.5	0
M511	1	27-Nov-19	12:45	08-Dec-19	10:53	262.13	3.9	2.3	1.2	0
M512	1	27-Nov-19	12:54	08-Dec-19	10:44	261.83	3.9	2.3	1.9	0
M513	1	27-Nov-19	13:04	08-Dec-19	10:39	261.58	3.9	2.3	1.5	0
M601	1	28-Nov-19	13:56	08-Dec-19	10:10	236.23	2.6	2.3	2.9	0
M602	1	28-Nov-19	13:40	08-Dec-19	10:02	236.37	2.6	2.3	2.2	0
M603	1	28-Nov-19	13:28	08-Dec-19	9:57	236.48	2.6	2.3	2.0	0
M604	1	28-Nov-19	13:00	08-Dec-19	9:44	236.73	2.6	2.3	2.8	0
M605	1	28-Nov-19	12:50	08-Dec-19	9:38	236.80	2.6	2.3	3.8	0
S606	1	28-Nov-19	14:14	08-Dec-19	10:22	236.13	2.6	2.3	2.3	0
M501OS	1	08-Dec-19	11:50	20-Dec-19	11:58	288.13	2.2	1.7	1.9	0
M502OS	1	08-Dec-19	11:44	20-Dec-19	11:46	288.03	2.3	1.7	2.3	0
M503OS	1	08-Dec-19	11:40	20-Dec-19	11:52	288.20	2.3	1.7	3.1	0
M504OS	1	08-Dec-19	11:34	20-Dec-19	11:38	288.07	2.3	1.7	2.3	0
M505OS	1	08-Dec-19	12:04	19-Dec-19	13:32	265.47	2.3	1.7	1.9	0
M506OS	1	08-Dec-19	11:28	20-Dec-19	11:30	288.03	2.3	1.7	3.0	0
M507OS	1	08-Dec-19	11:18	19-Dec-19	13:39	266.35	2.3	1.7	2.7	0
M508OS	1	08-Dec-19	11:24	20-Dec-19	11:25	288.02	2.3	1.7	2.9	0
M509	1	08-Dec-19	11:11	19-Dec-19	13:44	266.55	2.3	1.7	2.0	0
M510	1	08-Dec-19	11:03	19-Dec-19	13:25	266.37	2.3	1.7	3.8	0
M511	1	08-Dec-19	10:55	19-Dec-19	13:16	266.35	2.3	1.7	2.3	0
M512	1	08-Dec-19	10:45	19-Dec-19	13:06	266.35	2.3	1.7	1.8	0
M513	1	08-Dec-19	10:40	19-Dec-19	12:59	266.32	2.3	1.7	1.7	0
M601	1	08-Dec-19	10:11	19-Dec-19	12:14	266.05	2.3	1.7	2.9	0
M602	1	08-Dec-19	10:03	19-Dec-19	12:05	266.03	2.3	1.7	2.6	0
M607	1	08-Dec-19	9:58	19-Dec-19	11:59	266.02	2.3	1.7	2.0	0
M604	1	08-Dec-19	9:45	19-Dec-19	11:50	266.08	2.3	1.7	2.8	0
M605	1	08-Dec-19	9:39	19-Dec-19	11:40	266.02	2.3	1.7	3.9	0
S606	1	08-Dec-19	10:26	19-Dec-19	12:27	266.02	2.3	1.7	2.7	0
M501OS	1	20-Dec-19	11:59	Mat set missing[c]			1.7		2.0	
M502OS	1	20-Dec-19	11:47	10-Feb-20	11:29	1247.70	1.7	-0.6	2.4	0
M503OS	1	20-Dec-19	11:53	10-Feb-20	11:20	N/A[b]	1.7	-0.6	3.6	
M504OS	1	20-Dec-19	11:39	28-Jan-20	12:45	N/A[b]	1.7	-0.2	2.6	
M514	1	19-Dec-19	13:13	28-Jan-20	10:56	957.72	1.7	-0.2	2.3	0
M506OS	1	20-Dec-19	11:31	Mat set missing[c]			1.7		3.1	
M507OS	1	19-Dec-19	13:40	28-Jan-20	13:04	959.40	1.7	-0.2	4.7	0
M508OS	1	20-Dec-19	11:26	28-Jan-20	12:40	937.23	1.7	-0.2	3.6	0
M509	1	19-Dec-19	13:45	Mat set missing[c]			1.7		2.3	

[a]See Appendix A, Figure A4 for sample site locations. …continued.

[b]Mat was missing at retrieval time.

[c]Complete mat set missing; including mat, anchors, chain, cable, floats and rope. Possibility of retrieval at lower water levels.

Table D1 Concluded.

Station Name[a]	Number of Samplers Deployed	Set		Pull		Effort (h)	Water		Water Depth (m)	Number of Mountain Whitefish Eggs
		Date	Time	Date	Time		Set	Pull		
M510	1	19-Dec-19	13:26				1.7		3.7	
M511	1	19-Dec-19	13:17	28-Jan-20	11:30	958.22	1.7	-0.2	1.8	0
M512	1	19-Dec-19	13:07	28-Jan-20	11:20	958.22	1.7	-0.2	1.6	0
M513	1	19-Dec-19	13:00	27-Jan-20	15:40	938.67	1.7	-0.6	1.7	0
M601	1	19-Dec-19	12:15	27-Jan-20	13:32	937.28	1.7	-0.6	2.8	0
M602	1	19-Dec-19	12:06	27-Jan-20	13:02	936.93	1.7	-0.6	2.4	0
M607	1	19-Dec-19	12:00	27-Jan-20	12:48	936.80	1.7	-0.6	1.9	0
M604	1	19-Dec-19	11:49	Mat set missing[c]			1.7		2.7	
M605	1	19-Dec-19	11:44	27-Jan-20	12:20	936.60	1.7	-0.6	3.7	0
S606	1	19-Dec-19	12:47	27-Jan-20	14:05	937.30	1.7	-0.6	2.6	0
Total						**32502**				**0**

[a]See Appendix A, Figure A4 for sample site locations. Concluded.

[b]Mat was missing at retrieval time.

[c]Complete mat set missing; including mat, anchors, chain, cable, floats and rope. Possibility of retrieval at lower water levels.

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