Site C Clean Energy Project

Peace River Fish Community (Mon-2)

Task 2f - Beatton River Arctic Grayling Status Assessment

Construction Year 4 (2018)

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2 May 2019

REPORT

Beatton River Arctic Grayling Status Assessment

Study Year 2, 2018 (Site C Construction Year 4)

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1780320-003-R-Rev0

2 May 2019

Cover Photo: Downstream view of index sample site on Bratland Creek, 15 September 2018.

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Keywords: Beatton River, Peace River, Site C Clean Energy Project, Arctic Grayling, abundance, literature review, habitat use, migration, backpack electrofishing.

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Executive Summary

Fish and fish habitat are valued components of the Peace River that are considered important to 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, may affect fish and fish habitat via three key pathways: changes to fish habitat, changes to fish health and fish survival, and changes to fish movement (Site C Environmental Impact Statement [EIS], Volume 2[1]).

In accordance with Provincial Environmental Assessment Certificate Condition No. 7 and Federal Decision Statement Condition Nos. 8.4.3 and 8.4.4 for the Project, BC Hydro developed the Site C Fisheries and Aquatic Habitat Monitoring and Follow-up Program (FAHMFP). The Peace River Fish Community Monitoring Program (Mon-2) represents one component of the FAHMFP that monitors fish abundance, biomass, distribution, community composition, and population structure in the Peace River. The Beatton River Arctic Grayling Status Assessment (Task 2f) is one component of Mon-2 that aims to increase the current knowledge and understanding of the life history patterns of Arctic Grayling (*Thymallus arcticus*) in the Beatton River Watershed.

BC Hydro does not anticipate the Project will affect Beatton River Arctic Grayling, as the population appears to be resident to the Upper Beatton River and its tributaries and is genetically distinct from other populations in the Peace River Basin. Mon-2, Task 2f will collect information on the age and size structure, growth, recruitment, and population abundance of Beatton River Arctic Grayling and make inter-year comparisons of these population characteristics. Such information will help fill data gaps on Arctic Grayling in British Columbia and provide *Complementary Measures* for offsetting[2] through "*investments in data collection and scientific research related to maintaining or enhancing the productivity of commercial, recreational and Aboriginal fisheries*".

Mon-2, Task 2f also aims to compare data to metrics assessed in other Arctic Grayling populations elsewhere in the Peace River Basin (e.g., Moberly River and the Halfway River through Mon-1b, Task 2c) that may be affected by the Project, as well as Arctic Grayling populations in other watersheds. Comparisons among populations will be conducted after an additional year of data collection.

Review of the literature in 2017 found that the Upper Beatton River likely supports a substantial Arctic Grayling population that is resident (i.e., does not leave the drainage; Diversified 1999; AMEC and LGL 2009). Data collected in 2018 confirmed the presence of an Arctic Grayling population in the Upper Beatton River. Condition is a measure of energy reserves, and growth and reproduction are indicators of the ability of fish to use the food resources (i.e., energy) available to them (Environment Canada 2012). Fulton's body condition index and length-weight regression analysis in 2018 indicated that body condition increases with size for Arctic Grayling captured in the Upper Beatton River. Growth rates (length-at-age relationship) of Arctic Grayling in 2018 indicated near linear growth over the range of ages in the dataset. This finding has limited certainty based on low sample numbers and the absence of older fish (age 4+) in the dataset. The young age cohorts captured (age-0 and age-1) by backpack electrofishing in 2018 indicated that recruitment and rearing occurs in the

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

[2] Available at http://www.dfo-mpo.gc.ca/pnw-ppe/offsetting-guide-compensation/index-eng.html

Upper Beatton River. The high variability in catch rates suggests that strong recruitment may be limited to a small number of streams. Older Arctic Grayling (age 4+) were not captured in 2018, which may be the result of sampling related biases (i.e., older individuals occupying habitats/areas not effectively sampled or targeted during backpack electrofishing).

Habitat availability and suitability also do not appear to be limiting in the Upper Beatton River, as large amounts of what appears to be suitable habitat for Arctic Grayling has been documented in the region (Diversified 2001; Mainstream 2012).

Results from the current study indicate that by late summer, mainly age-0 and age-1 Arctic Grayling are using habitat in tributaries to the Beatton River. The majority of age-2 and age-3 Arctic Grayling were captured in the Beatton River mainstem, suggesting that by late summer, most older individuals were using deeper, higher velocity environments in the Beatton River.

Acknowledgements

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The following employees of **GOLDER ASSOCIATES LTD.** contributed to the collection of data and the preparation of this report.

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Table of Contents

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

1.1 Background

Fish and fish habitat are valued components of the Peace River that are considered important to 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, may affect fish and fish habitat via three key pathways: changes to fish habitat, changes to fish health and fish survival, and changes to fish movement (Site C Environmental Impact Statement [EIS], Volume 2[3]).

In accordance with Provincial Environmental Assessment Certificate Condition No. 7 and Federal Decision Statement Condition Nos. 8.4.3 and 8.4.4 for the Project, BC Hydro developed the Site C Fisheries and Aquatic Habitat Monitoring and Follow-up Program (FAHMFP). The Peace River Fish Community Monitoring Program (Mon-2) represents one component of the FAHMFP that monitors fish abundance, biomass, distribution, community composition, and population structure in the Peace River. The Beatton River Arctic Grayling Status Assessment (Task 2f) is one component of Mon-2 that aims to increase the current knowledge and understanding of the life history patterns of Arctic Grayling (*Thymallus arcticus*) in the Beatton River Watershed.

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 Dam Construction, Reservoir Preparation, and Filling (BC Hydro 2015). Section 9.6 of the *Fisheries Act* Authorization summarizes the impacts of the Project on Arctic Grayling in the Peace River Basin and outlines the need for additional data collection to help support the management of the species in the region. Briefly, the main effects of the Project on Arctic Grayling are as follows (BC Hydro 2015):

- *A reduction in abundance caused by the loss of riverine habitat inundated by the reservoir; and*
- *A potential loss of the distinct group of Arctic Grayling that spawn in the Moberly River and rear in the Peace River because of changes in habitat and hindered fish movement.*

BC Hydro does not anticipate the Project will affect Beatton River Arctic Grayling, as the population appears to be resident to the Upper Beatton River and its tributaries and is genetically distinct from other populations in the Peace River Basin (Taylor and Yau 2012). Mon-2, Task 2f will collect information on the age and size structure, growth, and habitat use of Arctic Grayling in the Upper Beatton River and make inter-year comparisons of these population dynamics. Comparisons to populations elsewhere in the Peace River Basin (e.g., Moberly River and the Halfway River through Mon-1b, Task 2c) that will be affected by the Project will also be made. Such information will help fill data gaps on Arctic Grayling in British Columbia (BCCF 2015) and provide *Complementary Measures* for offsetting[4] through "*investments in data collection and scientific research related to maintaining or enhancing the productivity of commercial, recreational and Aboriginal fisheries*" (BC Hydro 2015).

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

[4] Available at http://www.dfo-mpo.gc.ca/pnw-ppe/offsetting-guide-compensation/index-eng.html

BC Hydro's *Fisheries Act* Authorization for Dam Construction, Reservoir Preparation and Filling (BC Hydro 2015) provides the following summary with regards to monitoring Arctic Grayling in British Columbia:

> *Monitoring and assessment data are a key component of Arctic Grayling management because they are geographically widespread, targeted by anglers, vulnerable to harvest pressure, sensitive to environmental degradation, and have complex life history patterns. These threats have led to poorly documented declines in status in some regions. For example, a status assessment of Alberta Arctic Grayling indicated that 50% of populations have declined by over 90%, mostly during the 1950–1980 time period (ASRD 2005). Data on the basic biology, population status and habitat condition are key elements to inform management and prevent these declines and restore populations. The Monitoring Plan for the Site C Project will generate these types of data, including the four Measures of status provided by BC MOE (2011) for Arctic Grayling.*
>
> *The BC Conservation Framework provides information on management and data needs for Arctic Grayling (BCCF 2015). The highest priority for Arctic Grayling is Goal 2 [Prevent species and ecosystems from becoming at risk] and the recommended Actions depend on the collection and analysis of data. In addition to a direct need for monitoring trends, habitat protection and restoration depend on data that identifies the locations and characteristics of critical habitat. Regulation of harvest requires estimates of sustainable harvest rates and abundance targets, which require data on current values and trends of indicators such as growth, survival and density.*
>
> *Management plans for BC Arctic Grayling (Northcote 1993; Blackman 2001; Williamson and Zimmerman 2005; Ballard and Shrimpton 2009; PFWCP 2014) have consistently placed a high priority on research and monitoring to provide information on Arctic Grayling distribution, habitat use, demographic information, and interspecific interactions to inform management decisions.*

BC Hydro (2015) also outlines the benefits of the FAHMFP in helping guide the management of Arctic Grayling in the Peace River Basin through the BC Conservation Framework:

> *There are several aspects of the Site C Monitoring Plan that would assist management agencies in meeting 'Ecological Integrity and Sustainable Use' Objectives for Arctic Grayling in the lower Peace River Basin (BC MOE 2011). These include:*
>
> 1. *Additional information on the genetic and demographic structure of Arctic Grayling within the LAA (Local Assessment Area) relative to other Arctic Grayling in the lower Peace*
> 2. *Assessment and ongoing monitoring of:*
>   a. *Abundance, growth rates, age, and size distribution*
>   b. *Habitat preferences and status by age and size class*
>   c. *Threats to Arctic Grayling and their habitat*
>   d. *Exploitation rates in recreational and First Nations fisheries*
>   e. *Opportunities for habitat enhancement*
> 3. *Application of monitoring and assessment data to establish watershed-specific Targets for Arctic Grayling Conservation and Use Objectives*
> 4. *Planning and implementing Management Actions designed to meet Objectives including:*
>   a. *Harvest regulation*
>   b. *Habitat protection*
>   c. *Habitat restoration*
> 5. *Monitoring the effectiveness of these Management Actions*

In addition to information already identified in the Monitoring Plan, additional data collection and evaluations of the status of Arctic Grayling within the Halfway and Beatton rivers are described here. Status assessment would involve collection of data on age and size structure for comparison with data from other systems (e.g., Ballard and Shrimpton 2009) as well as for a within-system time trend analysis. This type of data can be used to assess whether a population is subject to high adult mortality (younger than expected age distribution), poor growth conditions for adults (lower than expected length-at-age, condition, lipid concentration), or poor recruitment conditions (higher than expected lengths of mature adults combined with lower than expected juvenile length-at-age, condition, and lipid concentration).

Mon-2, Task 2f will help management agencies address the objectives listed above through monitoring the Beatton River Arctic Grayling population in 2018 and 2019, and once every five years from Operation Years 1 to 30. The information collected during this program will also support the management of fisheries within the Peace River Basin and potential mitigation efforts in the future.

1.2 Objectives, Management Questions, and Hypotheses

The overarching management question for the Peace River Fish Community Monitoring Program (Mon-2) is as follows:

1) *How does the Project affect fish in the Peace River between the Project and the Many Islands in Alberta during the short (10 years after Project operations begin) and longer (30 years after Project operations begin) term?*

The Beatton River Arctic Grayling Status Assessment is designed to:

1. Assess the status of Arctic Grayling in the Upper Beatton River; and
2. If necessary, identify opportunities to enhance the status of this population to offset losses of Arctic Grayling values attributable to the Project.

Information gathered by the Beatton River Arctic Grayling Status Assessment will test the following management hypothesis:

H_8: *Use of the Upper Beatton River by resident Arctic Grayling does not change with the construction and operation of the Project*.

1.3 Report Scope

This document reports on the sampling activities conducted in 2018 as part of the assessment. The literature review in 2017 (Golder 2018) informed the selection of index sites that were sampled in 2018.

2.0 METHODS

2.1 Study Area

The Beatton River was divided into five regions (Figure 1) as described by Mainstream (2011):

1) The Lower Mainstem Region extends from the confluence with the Peace River to the mouth of Blueberry River, which is the largest tributary in the watershed.

2) The Middle Mainstem Region extends from the Blueberry River confluence to approximately 80 km upstream where the Beatton River enters the foothills of the mountains.

3) The Upper Mainstem Region extends to the headwaters.

4) The East Inputs Region includes the Doig River, Milligan Creek, Big Arrow Creek, Black Creek, and their tributaries.

5) The West Inputs Region includes Montney Creek, the Blueberry River, Nig Creek, and their tributaries.

The study area for the Beatton River Arctic Grayling Status Assessment encompassed the Upper Mainstem Region of the Beatton River, including several of its tributaries (La Prise, Bratland, Julienne, Holman, and Atick creeks, plus one other unnamed tributary). Locations of sites sampled in 2018 are provided in Figure 2.

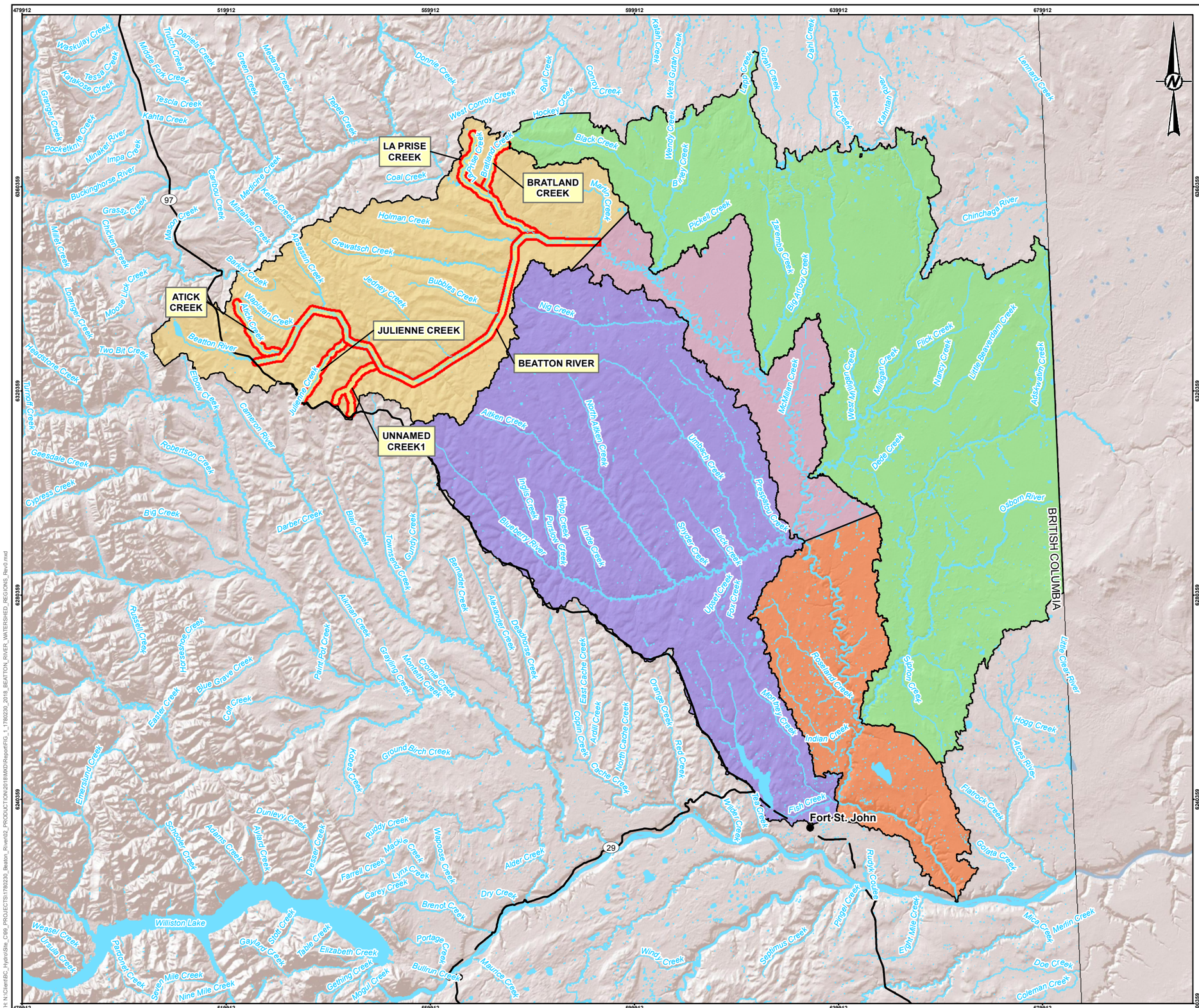
2.2 Sampling Chronology

Field work for the assessment was initially scheduled for the fall of 2017; however, the survey was cancelled due to an oil spill at the upstream end of the study area immediately prior to the onset of sampling. Sampling in 2018 occurred from 14 to 16 September 2018 and represents the first year of sampling as part of the assessment. Sampling is also tentatively scheduled to be conducted in 2019 and once every five years from Operation Years 1 to 30.

2.3 Index Site Sampling

Sampling focused on index sites that were documented to have high and moderate suitability (low turbidity, riffle/run habitat that contain coarse substrates; as defined during the literature review) during the 2017 reconnaissance survey (Golder 2018). Backpack electrofishing surveys targeting Arctic Grayling were conducted at selected index sites (Figure 2). Each survey crew consisted of one crew member operating a backpack electrofisher and one netter. The crew sampled approximately 100 to 300 m of shoreline habitat at each site in an upstream direction, focusing on portions of the site with high quality Arctic Grayling habitat. After sampling was complete, a site form was completed. Site habitat conditions, the effort expended, settings used during backpack electrofishing, and the number and species of fish observed (but not captured by the field crew) were recorded.

The methodology that was used during this program is widely used for researching freshwater fish species and was not anticipated to affect Arctic Grayling productivity within the study area.



LEGEND

- STUDY AREA

REGION NAME

- EAST INPUTS
- WEST INPUTS
- UPPER MAINSTEM
- LOWER MAINSTEM
- MIDDLE MAINSTEM

BASE MAP FEATURES

- HIGHWAY
- CITY
- WATERCOURSE
- WATERBODY
- PROVINCIAL BOUNDARY

REFERENCES

1. ROAD, WATERCOURSE AND WATERBODY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. WATERSHED DATA OBTAINED FROM THE GOVERNMENT OF BRITISH COLUMBIA
3. BASEDATA SOURCES: ESRI, HERE, DELORME, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESR I JAPAN, METI, ESRI CHINA (HONG KONG), SWISSTOPO, MAPMYINDIA, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY.

CLIENT
BC HYDRO

PROJECT
BEATTON RIVER ARCTIC GRAYLING STATUS ASSESSMENT
(Mon-2, Task 2F)

TITLE
BEATTON RIVER WATERSHED REGIONS

CONSULTANT
GOLDER

YYYY-MM-DD	2019-05-02
DESIGNED	BH
PREPARED	JG
REVIEWED	BH
APPROVED	SR

PROJECT NO.	CONTROL	REV.	FIGURE
1780230	2018	0	1

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520635 550635 580635

6371892 6341892

N

Tepee Creek

SIKANNI CHIEF CANYON PARK

SIKANNI CHIEF RIVER WATERSHED

Medicine Creek

Kettle Creek

Misahae Creek

Coal Creek

Holman Creek

Grewatsch Creek

Apsassin Creek

Barker Creek

Wapistan Creek

Atick Creek

ATICK CREEK

ATICK CREEK 1

BEATTON RIVER 11

BEATTON RIVER 10

JULIENNE CREEK

Julienne Creek

Cypress Creek Road

Cameron River

HALFWAY RIVER WATERSHED

PDR-169

Townsend Creek

Highway 97

UNNAMED CREEK 1

UNNAMED CREEK1

BEATTON RIVER 5

135 Road

BEATTON RIVER 9

BEATTON RIVER 8

BEATTON RIVER 6

JULIENNE CREEK 1

126 Road

Jedney Creek

Bubbles Creek

BEATTON RIVER WATERSHED

LA PRISE CREEK 2

LA PRISE CREEK

La Prise Creek

Bratland Creek

BRATLAND CREEK

BRATLAND ACCESS 1

Black Creek

Martin Creek

HOLMAN CREEK 1

BEATTON RIVER 1

BEATTON RIVER

Nig Creek

Beatton Airport Road

North Aitken Creek

Aitken Creek

PATH: N:\Client\BC_Hydro\Site_C\99_PROJECTS\1780230_Beaton_River\02_PRODUCTION\2018\MXD\Report\FIG_2_1780230_2018_SITE_LOCATION_Rev0.mxd

LEGEND

- SAMPLE LOCATION (2018)
- STUDY AREA

BASE MAP FEATURES

- HIGHWAY
- ROAD
- WATERCOURSE
- WATERBODY
- MAJOR WATERSHED
- PARK / PROTECTED AREA

0 5 10

1:240,000 KILOMETRES

REFERENCES

1. ROAD, WATERCOURSE AND WATERBODY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. WATERSHED DATA OBTAINED FROM THE GOVERNMENT OF BRITISH COLUMBIA
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CLIENT
BC HYDRO

PROJECT
BEATTON RIVER ARTIC GRAYLING STATUS ASSESSMENT
(Mon-2, Task 2F)

TITLE
UPPER BEATTON RIVER ARCTIC GRAYLING MONITORING SERVICES INDEX SITE LOCATIONS, SEPTEMBER 2018

CONSULTANT
GOLDER

YYYY-MM-DD	2019-05-02
DESIGNED	BH
PREPARED	JG
REVIEWED	BH
APPROVED	SR

PROJECT NO.	CONTROL	REV.	FIGURE
1780230	2018	0	**2**

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25mm

0

2.4 Fish Handling and Processing

Fish collected during sampling were kept in a large bucket until the site survey was complete. Fresh water was routinely added to the bucket to maintain oxygen levels and water temperature within the bucket. After the site survey was completed, the field crew processed each captured fish and released them back into the stream.

The following life history parameters, ageing structures, and tag information was collected from each captured Arctic Grayling:

1) Length – fork length (FL) to the nearest 1 mm
2) Weight – the weight of the fish to the nearest 1 g
3) Scales – for ageing, taken from the left side of the fish near the dorsal fin, above the lateral line
4) Otoliths – collected from any fish that succumbed to the sampling procedure
5) Tag Type – the type of tag applied (only PIT tags were applied) or present at capture
6) Tag Number – the number of the tag applied or present at capture
7) Tag Scar – the presence of a scar from a previous tag application
8) Fin Clip – the presence of an adipose fin clip
9) Condition – the general condition of the fish (i.e., alive, dead, unhealthy, etc.)
10) Comments – any additional comments regarding the fish

For all other species of fish collected, the species, fork length or total length (depending on the species) to the nearest 1 mm, weight to the nearest 1 g, and overall condition (i.e., healthy, injured, mortality) were recorded.

All Arctic Grayling that were 80 mm in length or greater and in good condition following processing were marked with a half-duplex (HDX) PIT tag (ISO 11784/11785 compliant) (Oregon RFID, Portland, OR, USA). Depending on the size of the fish, tags were implanted within the left axial muscle below the dorsal fin origin and oriented parallel with the anteroposterior axis. All tags and tag applicators were immersed in an antiseptic (Super Germiphene™) and rinsed with distilled water prior to insertion.

The size of PIT tag applied was based on the fork length of the fish:

1) Fish between 80 and 199 mm FL were marked with 12 mm tags (12.0 mm x 2.12 mm HDX+)
2) Fish between 200 and 299 mm FL were marked with 23 mm tags (23.0 mm x 3.65 mm HDX+)
3) Fish greater than 299 mm FL were marked with 32 mm tags (32.0 mm x 3.65 mm HDX+)

Tag sizes were consistent with other monitoring programs, including the Peace River Large Fish Indexing Survey (Mon-2, Task 2a) and the Site C Reservoir Tributaries Fish Population Indexing Survey (Mon-1b, Task 2c). HDX tags were used for compatibility with other monitoring programs currently underway in the Peace River that require PIT tags to be detected by fixed arrays. PIT tags were read using a Datamars DataTracer FDX/HDX handheld reader (Oregon RFID, Portland, OR, USA).

2.5 Ageing

All Arctic Grayling were aged by scale analysis. Scales were aged by counting the number of growth annuli present on the fish scale following methods outlined in Mackay et al. (1990) and RISC (1997). Scales were temporarily mounted between two slides and examined using a trinocular microscope equipped with a digital camera. If needed, several scales were examined and the highest quality scale was photographed using the integrated 3.1-megapixel digital macro camera and saved as a JPEG-type picture file. All scales were examined independently by two experienced individuals and ages assigned. For each scale sample, the analysts had access to the species and the date of capture but no other information about the sampled fish (e.g., fork length or capture history). If the two assigned ages did not agree, a third analyst assigned an age. If two out of three analysts agreed on the age, then this age was used for analysis. If two out of three analysts did not agree on an age, then the sample was not used for analysis purposes.

2.6 Data Analysis

All data collected during field surveys were entered and stored in a custom MS-Access© database that conforms to BC Hydro's established Site C data standards. Data on field sheets were entered into spreadsheet format and the digital data were verified and checked by a second person before uploading the data to the database. Before data analysis, Quality Control / Quality Assurance (QA/QC) included checks of the range and format of all variables and graphical methods to check for possible errors including histograms and bivariate plots.

Catch was summarized by sample method, species, life stage, watercourse, and section (where applicable) and presented in tabular format. Catch-per-unit-effort (CPUE) for electrofishing was calculated by dividing the summed total number of fish captured by the sum of effort at each site. Sampling effort was measured in seconds of electrofisher operation and CPUE was expressed as the number of fish per hour. Length of site was not used to represent sampling effort for CPUE because sampling focused only on high quality habitats and the entire site length was not always sampled.

Fulton's body condition index (*K*; Murphy and Willis 1996) was calculated as follows:

$$K = (\frac{W_t}{L^3}) \times 100,000$$

where W_t was a fish's weight (g) and *L* was a fish's fork length (mm). Body condition was plotted by stream and age cohort. Mean condition values were also estimated for each stream and age cohort, along with their respective 95% confidence intervals.

Length-frequency histograms were plotted by stream, where sample sizes of fish captured were sufficient. Age-frequency histograms were plotted (all streams pooled). The weight-length relationship was described using

linear regression where both weight and length transformed using the natural logarithm. Estimates of model parameters, *a* and *b*, are presented on the back-transformed scale for the equation:

$$Weight = a \times Length^{b}.$$

To describe growth of Arctic Grayling, length-at-age data were used to fit three-parameter von Bertalanffy models as follows:

$$L(t) = L_{\infty}(1 - e^{-K(t-t0)}),$$

where L_{∞} is the asymptotic length, *K* is the rate at which the fish approaches the asymptotic size (i.e., growth rate coefficient), and *t0* is the theoretical time when a fish has length zero. Non-parametric bootstrapping was used to calculate 95% confidence intervals (CIs) for von Bertalanffy model parameters.

3.0 RESULTS

3.1 Physical Parameters

Water temperatures ranged from 2.5°C in Bratland Creek on 15 September 2018 to 5.7°C in the Unnamed Creek (Watershed Code 233-791200) on 16 September 2018. Conductivity was highest in the Unnamed Creek at 420 µS on 16 September 2018, while La Prise and Atick Creeks had the lowest conductivity, 70 µS on 15 and 16 September 2018, respectively. Instream velocity ranged from <0.5 m/s to approximately 1.0 m/s over the course of the program and was highest in the Beatton River mainstem. The amount and type of available cover were variable among sites, with small woody debris, interstices, and deep water being the most common type encountered. Detailed summaries of sampling effort and habitat data collected are provided in Appendix A.

3.2 Index Site Sampling

During the three days of index site sampling, 18,497 seconds (5.14 hours) of backpack electrofishing were expended at 11 sites within the study area. In total, 390 fish from 12 species were captured in 2018 (Table 1). Detailed sample and life history information for all sampling effort and fish captured is provided in Appendix A.

Table 1: Fish species encountered during the Beatton River Arctic Grayling Status Assessment, September 2018.

Category	Species	Scientific Name	Species Code[a]	Number Caught	Percent of Total Catch (%)
Sportfish	Arctic Grayling	*Thymallus arcticus*	GR	32	8.2
Non-sportfish	Trout-perch	*Percopsis omiscomaycus*	TP	49	12.6
	Brook Stickleback	*Culaea inconstans*	BSB	2	0.5
	Largescale Sucker	*Catostomus macrocheilus*	CSU	1	0.3
	Longnose Sucker	*Catostomus catostomus*	LSU	29	7.4
	White Sucker	*Catostomus commersonii*	WSU	22	5.6
	Spoonhead Sculpin	*Cottus ricei*	CRI	6	1.5

Category	Species	Scientific Name	Species Code[a]	Number Caught	Percent of Total Catch (%)
	Sculpin species	*Cottus* species	CC	1	0.3
	Flathead Chub	*Platygobio gracilis*	FHC	1	0.3
	Lake Chub	*Couesius plumbeus*	LKC	213	54.6
	Redside Shiner	*Richardsonius balteatus*	RSC	25	6.4
	Longnose Dace	*Rhinichthys cataractae*	LNC	9	2.3

[a] As defined by the BC *Ministry of Environment*.

In total, 32 Arctic Grayling were captured in four of the 11 index sites sampled in 2018, including sites in La Prise, Bratland, and the Unnamed creeks, and in the Beaton River mainstem (Table 2). Of the 32 Arctic Grayling captured, PIT tags were implanted in 11 individuals. All remaining Arctic Grayling were not tagged because they were too small to receive a PIT tag (i.e., less than 80 mm FL; *n* = 21). Tagged Arctic Grayling were not recaptured during the sample program.

During sampling, CPUE for Arctic Grayling was similar in both the Unnamed Creek (CPUE = 6.75 fish/hour) and Beatton River 10 (CPUE = 6.98 fish/hour) index sites. CPUE was higher in La Prise Creek at 17.17 fish/hour, whereas the highest CPUE at an index site was documented in Bratland Creek (CPUE = 44.59 fish/hour; Table 2).

Table 2: Beatton River Arctic Grayling Status Assessment sample effort and catch, August 2018.

Date	Stream	Site Name	Site Length (m)	Effort (s)	Arctic Grayling		
					Number Caught	Number Tagged	CPUE (fish/hour)
14-Sep-18	Beatton River	BR5	311	3,356	0	0	0.00
15-Sep-18	La Prise Creek	LP2	196	2,725	13	3	17.17
15-Sep-18	Bratland Creek	BC1	113	1,211	15	5	44.59
15-Sep-18	Julienne Creek	JC1	140	487	0	0	0.00
15-Sep-18	Beatton River	BR6	290	1,599	0	0	0.00
15-Sep-18	Beatton River	BR8	220	911	0	0	0.00
15-Sep-18	Beatton River	BR9	250	1,555	0	0	0.00
16-Sep-18	Beatton River	BR1	150	1,262	0	0	0.00
16-Sep-18	Holman Creek	HC1	100	1,531	0	0	0.00
16-Sep-18	Unnamed Creek	UC1	250	533	1	0	6.75
16-Sep-18	Beatton River	BR11	250	1,300	0	0	0.00
16-Sep-18	Beatton River	BR10	260	1,547	3	3	6.98
16-Sep-18	Atick Creek	AC1	125	480	0	0	0.00
Totals			**2,655**	**18,497**	**32**	**11**	**6.23**

3.3 Assessment of Biological Indices

In the mainstem Beatton River index sites, fish captured (*n* = 3) were between 190 and 230 mm (Figure 3), corresponding to the age-2 and age-3 cohorts (Figure 4). Within tributaries to the Beatton River (i.e., Bratland, La Prise, and Unnamed creeks [*n* = 29]), fish captured were typically smaller and were predominantly between 60 and 100 mm. In Bratland Creek, length frequency of captured fish (*n* = 15) exhibited three separate groupings; 60–80 mm (age-0 cohort: *n* = 10), 120–130 mm (age-1 cohort: *n* = 1), and 180–200 mm (age-2 [*n* = 1] and age-3 cohorts [*n* = 3]) (Figure 3 and Figure 4). With all captured fish combined, length frequency was bimodal, with peaks at 60–70 mm (age-0 cohort) and 190–200 mm (age-2 and age-3 cohorts; Figure 3 and Figure 4). The majority of fish captured during the program were age-0 (Figure 4).

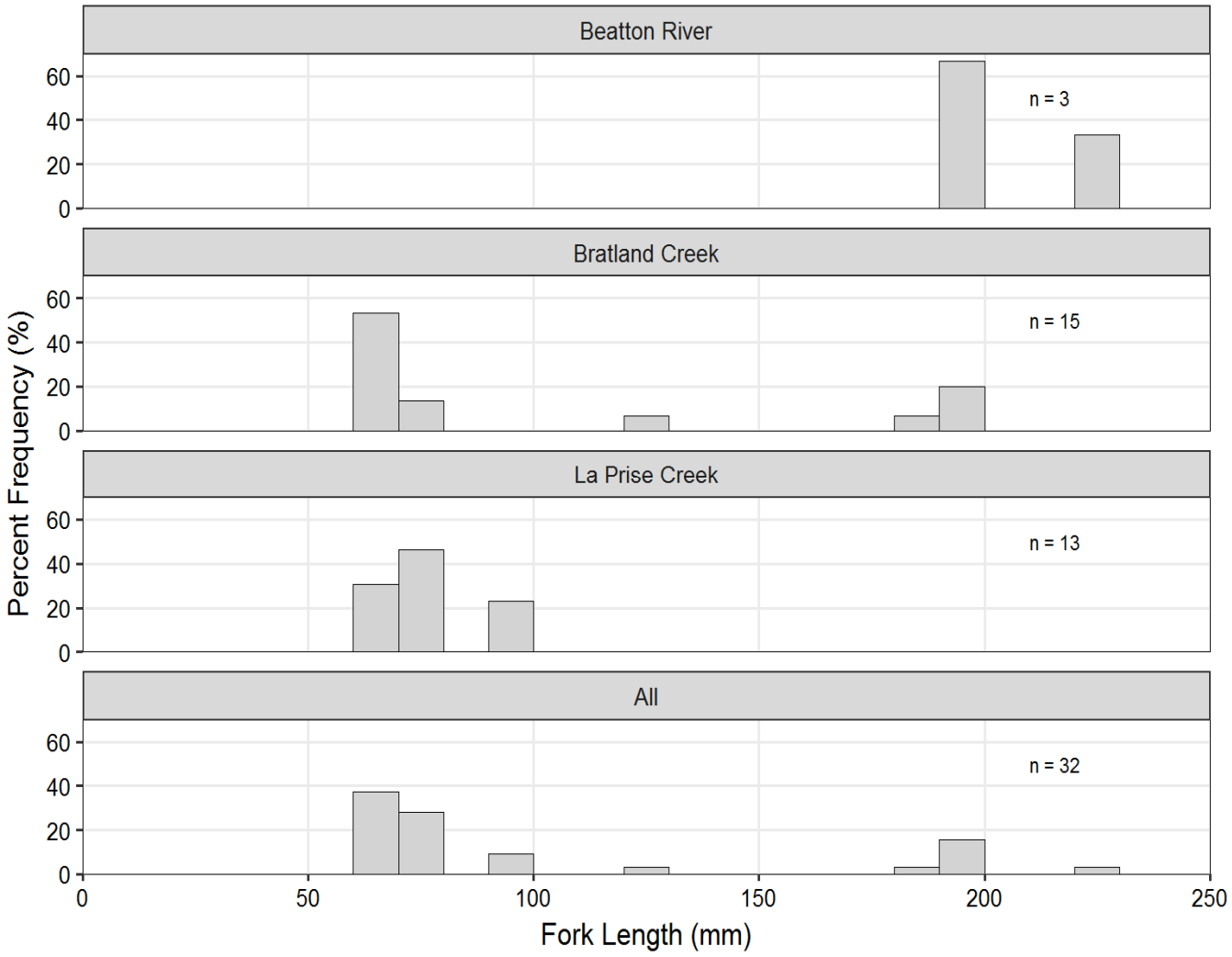

Figure 3: Length frequencies of Arctic Grayling by stream, September 2018. Note: Graph for single capture from the Unnamed Creek index site (length = 75 mm) not shown, this individual was included in the combined graph.

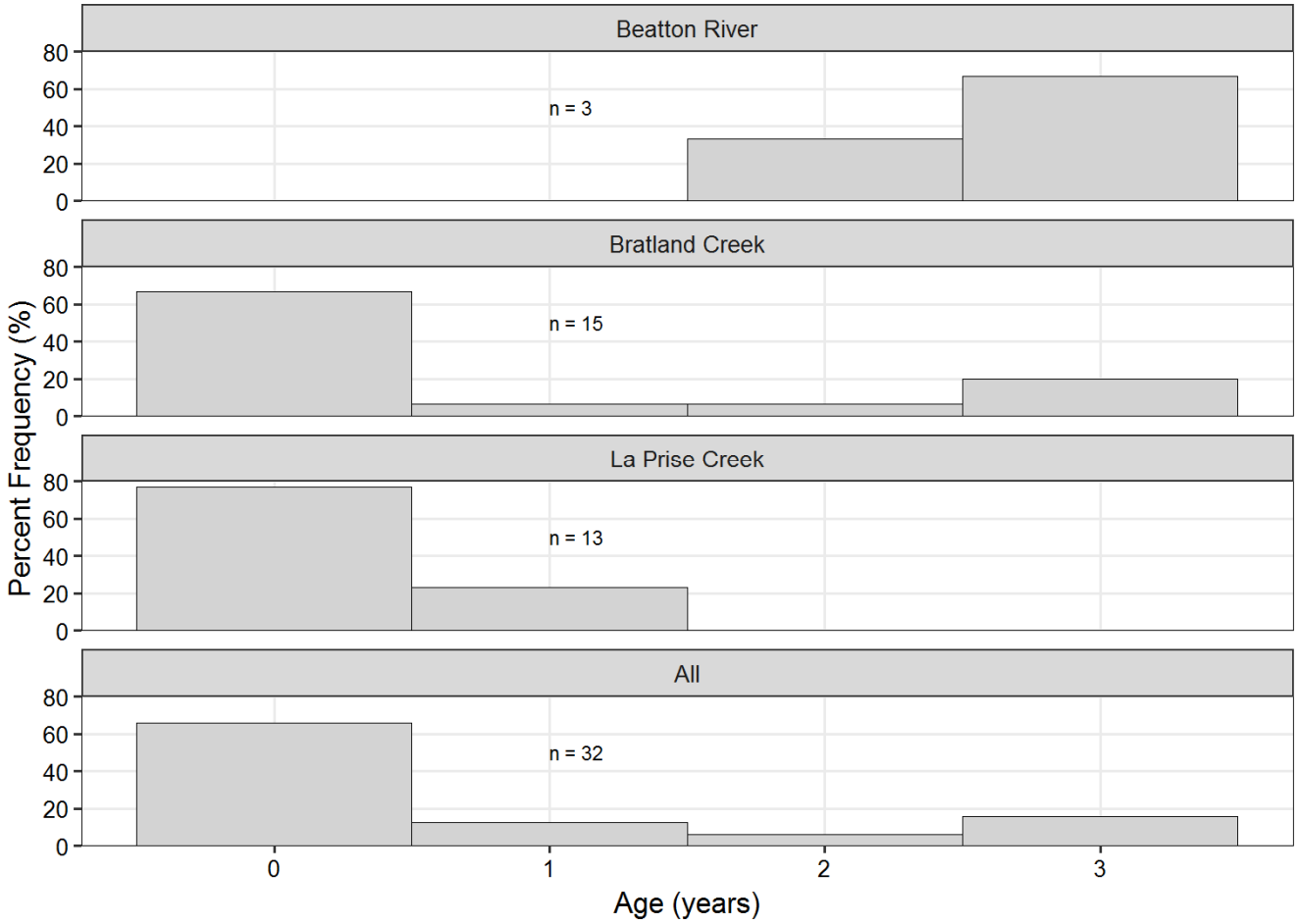

Figure 4: Age distribution of Arctic Grayling by stream, September 2018. Note: Graph for single capture from the Unnamed Creek index site (length = 75 mm) not shown, this individual was included in combined graph.

For all Arctic Grayling captured, the mean lengths, weights and condition (with standard deviation, range and sample size) for each age cohort is presented in Table 3. The numbers of Arctic Grayling by age-class (Table 3) and length-frequencies (Figure 3) indicate that both juvenile (age-0 and age-1) and older (age-2+) age-classes were present in the study area. The body condition (K) of Arctic Grayling captured in 2018 ranged from 0.6 to 1.2 (Table 3).

Table 3: Average fork length, weight and body condition by age for Arctic Grayling captured in the Upper Beatton River, September 2018.

Age	Fork Length (mm)			Weight (g)			Fulton's Condition Factor (K)		
	Mean ± SD	Range	*n*[a]	Mean ± SD	Range	*n*[a]	Mean ± SD	Range	*n*[a]
0	68 ± 5	63 - 77	21	3 ± 1	2 - 5	21	0.9 ± 0.2	0.6 - 1.2	21
1	105 ± 16	96 - 129	4	12 ± 5	9 - 19	4	1.0 ± 0.1	0.9 - 1.1	4
2	186 ± 8	180 - 191	2	71 ± 19	57 - 84	2	1.1 ± 0.2	1.0 - 1.2	2
3	202 ± 13	191 - 224	5	89 ± 27	70 - 135	5	1.1 ± 0.1	0.9 - 1.2	5

[a] Number of individuals sampled.

The exponent in the length-weight relationship (3.2) is larger than that expected for isometric growth (*a*=3) (Figure 5) indicating that body condition increased with size in Arctic Grayling. The estimated growth coefficient, K, was 0.07 (CI: 0.01–0.30) and indicated near linear growth over the range of ages in the dataset (age-0 to 3). The estimated asymptotic fork length was 816 mm, but the confidence interval was large (293 to 3925 mm) and not realistic for Arctic Grayling (Figure 6). The values for growth coefficient and asymptotic length were poorly defined by the data because of the absence of fish older than age-3.

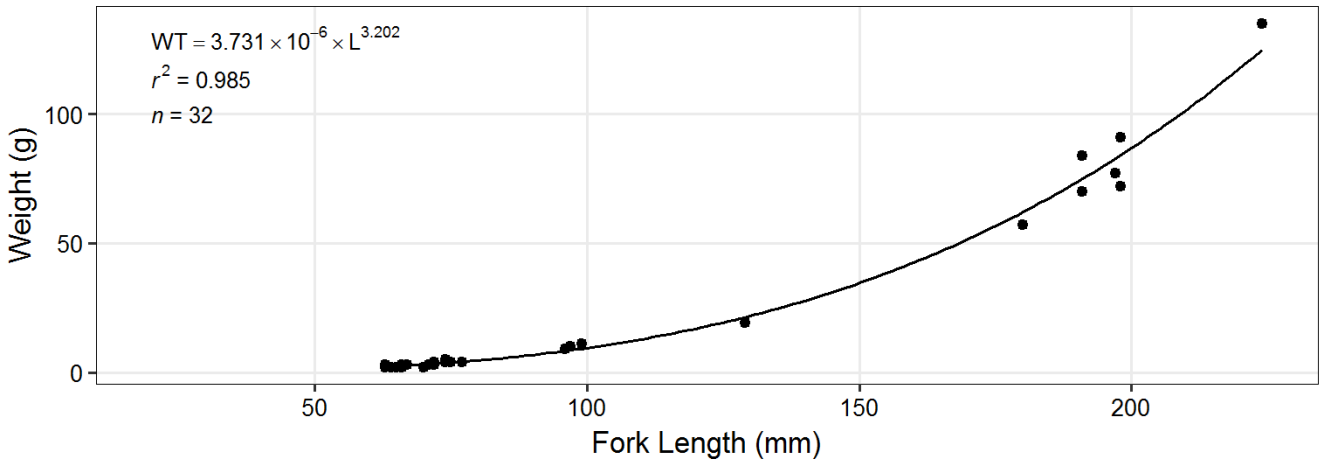

Figure 5: Length-weight regression for Arctic Grayling captured in the Upper Beatton River, September 2018.

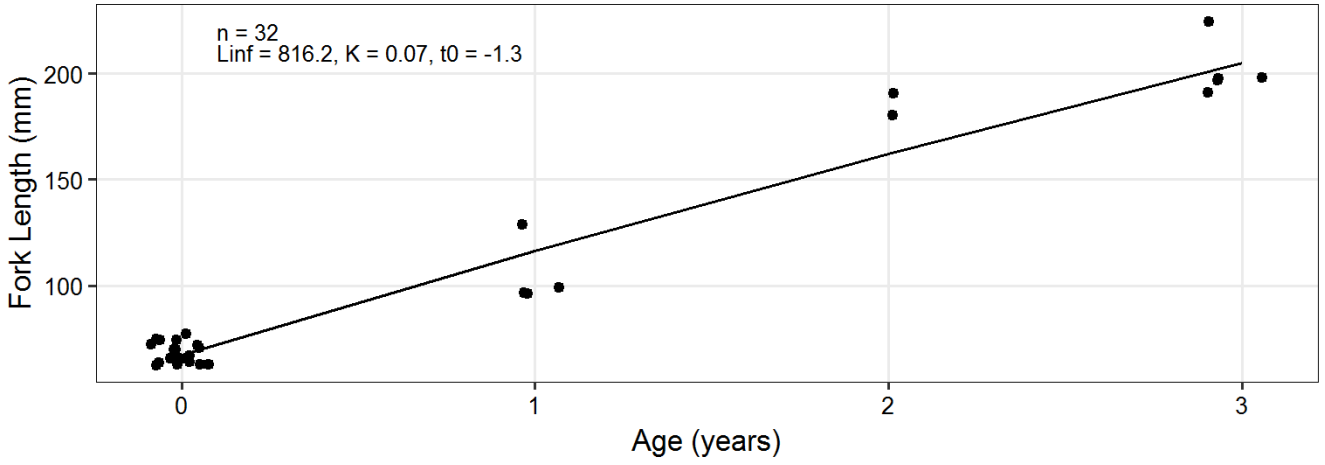

Figure 6: von Bertalanffy growth curve for Arctic Grayling captured in the Upper Beatton River, September 2018.

4.0 DISCUSSION

Sampling in 2018 represented the second year of a multi-year assessment of Arctic Grayling in the Beatton River. The primary objectives of Mon-2, Task 2f are to:

- Fill data gaps on Arctic Grayling in British Columbia (BCCF 2015).
- Provide *Complementary Measures* for offsetting through "*investments in data collection and scientific research related to maintaining or enhancing the productivity of commercial, recreational and Aboriginal fisheries*" (BC Hydro 2015).
- Help guide the management of Arctic Grayling in the Peace River Basin through the BC Conservation Framework.

Mon-2, Task 2f also aims to compare data to metrics assessed in other Arctic Grayling populations elsewhere in the Peace River Basin (e.g., Moberly River and Halfway River through Mon-1b, Task 2c) that may be affected by the Project.

The literature review in 2017 (Golder 2018) found that due to the abundance of suitable spawning, rearing, and summer feeding habitat present, the Upper Beatton River could support a substantial resident population of Arctic Grayling (i.e., does not leave the drainage; Diversified 1999 and AMEC and LGL 2009). Telemetry survey results support the presence of a resident population of Arctic Grayling in the Upper Beatton River (AMEC and LGL 2009, AMEC and LGL 2010). Microsatellite DNA analyses conducted by Taylor and Yau (2012) found that Arctic Grayling from the Beatton River were fundamentally more distinct than other populations in the major tributaries to the Peace River, which also supports the presence of a resident population within the Beatton River. Habitat availability and suitability do not appear to be limiting in the Upper Beatton River, as high abundance of potentially suitable Arctic Grayling habitat has been documented in the region (Diversified 2001 and Mainstream 2012).

Data collected in 2018 confirmed the presence of an Arctic Grayling population in the Upper Beatton River. Condition is a measure of energy reserves, and growth and reproduction are indicators of the ability of fish to use the food resources (i.e., energy) available to them (Environment Canada 2012). Fulton's body condition index and length-weight regression analysis in 2018 indicated that body condition increases with size for Arctic Grayling in the Upper Beatton River. Growth rates (length-at-age relationship) of Arctic Grayling in 2018 indicated nearly linear growth over the range of ages in the dataset. This finding has limited certainty based on low sample numbers and the absence of older fish (age 4+) in the dataset. The young age cohorts captured (age-0 and age-1) by backpack electrofishing in 2018 indicated that recruitment and rearing is occurring in the Upper Beatton River. The high variability in catch rates suggests that strong recruitment may be limited to a small number of streams. Older Arctic Grayling (age 4+) were not captured in 2018, which may be the result of sampling related biases (i.e., older individuals occupying habitats/areas not effectively sampled or targeted during backpack electrofishing).

Previous studies documented that Arctic Grayling spawning migrations occur on an annual basis (Scott and Crossman 1973; Ford et. al. 1995; McPhail 2007). Specific to the Peace River Basin, upstream migrations from the Peace River and Beatton River mainstems into tributary spawning habitats occur during the spring (P & E 2002; AMEC 2008; AMEC and LGL 2008, 2009). In the summer season after spawning, adult Arctic Grayling have been documented migrating downstream to summer feeding habitats (AMEC and LGL 2008; Mainstream 2010; Stantec 2012). Summer downstream migrations were also documented for juveniles (AMEC and LGL 2008; Stantec 2012). Previous studies have also found that the majority of Arctic Grayling spend their first summer in habitats that were chemically similar to their natal streams (Earthtone and Mainstream 2013). Non-spawning related upstream migrations have been documented in previous studies and may occur as Arctic Grayling move into smaller tributaries as a refugia from high turbidity levels (Diversified 1997).

Assessment of Arctic Grayling length-frequency distributions in 2018 indicate that by late summer, mainly age-0 and age-1 Arctic Grayling are using the habitat in tributaries of the Beatton River. The majority of age-2 and age-3 Arctic Grayling were captured in the Beatton River mainstem, suggesting that by late summer, most older individuals have moved downstream from the tributary spawning habitats to deeper, higher velocity habitats in the Beatton River mainstem.

As the current dataset consists of only one year of data collection and sample sizes were low, an additional year of sampling is required before comparisons with other populations in the Peace River Basin can be made.

5.0 CLOSURE

We trust that this report meets your current requirements. If you have any further questions, please do not hesitate to contact the undersigned.

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https://golderassociates.sharepoint.com/sites/12789g/deliverables/issued to client/1780230-003-r-rev0/1780320-003-r-rev0-year 2 arctic grayling monitoring 2may_19.docx

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APPENDIX A

September 2018 Data Summaries

Table C1: Summary of Beatton River Arctic Grayling Status Assessment Fish Collection Sampling Effort and Site Habitat Data, September 2018.

Date	Waterbody	Site Name	UTM Zone	Start Waypoint	Start Easting	Start Northing	End Waypoint	End Easting	End Northing	Site Length (m)	Sample Method[a]	Effort (seconds)	Water Temp (°C)	Conductivity (µS/cm)	Instream Velocity (m/s)	Cover Types[b]									Dominant Substrate	Sub-Dominant Substrate	Mean Depth (m)	Max Depth (m)
																INT	SWD	LWD	TURB	AV	TV	CB	SW	DW				
14-Sep-18	Beatton River	Beatton River 5	10V	273	552285	6324070	274	552245	6324377	311	EF	3356	5.6	160	<0.5	65	10	1	15	0	0	0	0	9	Cobble	Gravel	none	1.1
15-Sep-18	La Prise Creek	La Prise Creek 2	10V	286	566202	6362047	287	566144	6362311	196	EF	2725	2.7	70	<0.5	5	30	5	5	0	10	15	10	20	Gravel	Silt	0.4	0.7
15-Sep-18	Bratland Creek	Bratland Access 1	10V	275	571279	6359158	276	571224	6359261	113	EF	1211	2.5	120	<0.5	10	55	5	0	0	10	5	0	15	Gravel	Silt	0.5	1
15-Sep-18	Julienne Creek	Julienne Creek 1	10V	168	543514	6330645	164	543597	6330691	140	EF	487	5.3	340	<0.5	25	10	5	5	0	0	0	55	0	Sand	Gravel	0.15	0.7
15-Sep-18	Beatton River	Beatton River 6	10V	166	543589	6330753	165	543814	6330679	290	EF	1599	3	140	0.5-1.0	20	10	5	10	0	0	0	40	15	Gravel	Cobble	0.5	1.2
15-Sep-18	Beatton River	Beatton River 8	10V	163	542708	6333714	162	542608	6333543	220	EF	911	3	140	0.5-1.0	40	1	0	15	0	0	0	39	5	Cobble	Gravel	0.4	0.7
15-Sep-18	Beatton River	Beatton River 9	10V	161	541747	6334994	160	541862	6335038	250	EF	1555	3	140	0.5-1.0	30	5	0	10	0	0	0	35	20	Cobble	Gravel	0.3	1
16-Sep-18	Beatton River	Beatton River 1	10V	290	592868	6349109	291	592662	6349036	150	EF	1262	2.7	220	<0.5	5	30	20	25	0	0	5	0	15	Silt	Gravel	0.5	1.1
16-Sep-18	Holman Creek	Holman Creek 1	10V	288	577133	6350174	289	577022	6350120	100	EF	1531	2.6	225	<0.5	5	10	10	5	0	0	0	10	60	Silt	Gravel	0.6	1
16-Sep-18	Unnamed Creek	Unnamed Creek 1	10V	176	548157	6325155	175	548363	6325216	250	EF	533	5.7	420	<0.5	30	3	2	0	0	5	5	50	5	Gravel	Cobble	0.15	0.6
16-Sep-18	Beatton River	Beatton River 11	10V	171	525728	6326201	172	525517	6326142	250	EF	1300	3	110	0.5-1.0	30	3	2	10	0	0	0	15	40	Cobble	Gravel	0.5	1
16-Sep-18	Beatton River	Beatton River 10	10V	170	526086	6326199	169	526340	6326177	260	EF	1547	3	110	<0.5	25	4	1	15	0	0	5	20	30	Cobble	Gravel	0.5	1
16-Sep-18	Atick Creek	Atick Creek 1	10V	174	527034	6328461	173	527107	6328385	125	EF	480	3.6	70	<0.5	10	0	0	5	0	5	5	65	10	Gravel	Sand	0.4	0.9

[a] EF = Backpack Electrofishing.

[b] Int = Interstices, SWD = Small Woody Debris, LWD = Large Woody Debris, TURB = Turbidity, AV = Aquatic Vegetation, TV = Terrestrial Vegetation, CB = Cut Bank, SW = Shallow Water, DP = Deep Water.

Table C2: Biological data for fish captured during the Beatton River Arctic Grayling Status Assessment, September 2018.

Date	Site Name	Fish Number	Species Code[a]	Length (mm)	Weight (g)	Tag Type	Tag Number	Age (years)
14-Sep-18	Beatton River 5	1	RSC	76	4	-	-	-
		2	RSC	76	5	-	-	-
		3	RSC	81	6	-	-	-
		4	LKC	76	4	-	-	-
		5	LKC	64	2	-	-	-
		6	LKC	69	3	-	-	-
		7	LKC	64	3	-	-	-
		8	LKC	55	2	-	-	-
		9	WSU	80	6	-	-	-
		10	TP	55	2	-	-	-
		11	TP	55	2	-	-	-
		12	TP	63	3	-	-	-
		13	RSC	72	5	-	-	-
		14	RSC	43	1	-	-	-
		15	TP	45	1	-	-	-
		16	TP	52	1	-	-	-
		17	LKC	43	1	-	-	-
		18	LSU	138	31	-	-	-
		19	CRI	80	5	-	-	-
		20	RSC	76	5	-	-	-
		21	RSC	80	6	-	-	-
		22	RSC	78	6	-	-	-
		23	RSC	76	5	-	-	-
		24	LKC	83	6	-	-	-
		25	LKC	49	1	-	-	-
		26	LKC	49	1	-	-	-
		27	LKC	49	1	-	-	-
		28	TP	58	2	-	-	-
		29	TP	57	2	-	-	-
		30	TP	46	1	-	-	-
		31	RSC	74	4	-	-	-
		32	RSC	75	4	-	-	-
		33	LKC	89	6	-	-	-
		34	LKC	69	4	-	-	-
		35	LKC	78	6	-	-	-
		36	LKC	63	3	-	-	-
		37	LKC	65	3	-	-	-
		38	LKC	63	3	-	-	-
		39	LKC	62	3	-	-	-
		40	LKC	58	2	-	-	-
		41	LKC	60	3	-	-	-
		42	LKC	51	2	-	-	-
		43	TP	52	2	-	-	-
		44	WSU	56	2	-	-	-
		45	TP	59	3	-	-	-
		46	TP	54	2	-	-	-

[a] See Table 1 in Section 3.2 for Species Codes.

Table C2: Biological data for fish captured during the Beatton River Arctic Grayling Status Assessment, September 2018.

Date	Site Name	Fish Number	Species Code[a]	Length (mm)	Weight (g)	Tag Type	Tag Number	Age (years)
14-Sep-18	Beatton River 5	47	TP	46	1	-	-	-
		48	TP	49	1	-	-	-
		49	TP	55	2	-	-	-
		50	LNC	74	4	-	-	-
		51	RSC	74	5	-	-	-
		52	LKC	89	7	-	-	-
		53	CRI	86	6	-	-	-
		54	LKC	69	4	-	-	-
		55	LKC	65	4	-	-	-
		56	LKC	63	3	-	-	-
		57	LKC	62	3	-	-	-
		58	TP	66	3	-	-	-
		59	TP	44	1	-	-	-
		60	TP	27	0	-	-	-
		61	CC	84	6	-	-	-
		62	TP	55	2	-	-	-
		63	LSU	105	15	-	-	-
		64	WSU	90	8	-	-	-
		65	TP	53	2	-	-	-
		66	LNC	57	2	-	-	-
		67	LKC	43	1	-	-	-
		68	RSC	78	5	-	-	-
		69	WSU	76	5	-	-	-
		70	LKC	83	6	-	-	-
		71	RSC	93	9	-	-	-
		72	CRI	83	4	-	-	-
		73	LSU	57	3	-	-	-
		74	CRI	82	5	-	-	-
		75	LNC	55	2	-	-	-
15-Sep-18	Beatton River 8	76	LKC	66	2	-	-	-
		77	LNC	49	2	-	-	-
		78	BSB	64	2	-	-	-
		79	LSU	181	68	-	-	-
		80	LSU	162	50	-	-	-
		81	LSU	159	46	-	-	-
		82	LSU	140	33	-	-	-
		83	LSU	105	14	-	-	-
		84	WSU	115	16	-	-	-
		85	LSU	106	16	-	-	-
		86	LSU	100	12	-	-	-
		87	WSU	95	7	-	-	-
		88	WSU	96	9	-	-	-
		89	LNC	64	1	-	-	-
		90	LSU	94	11	-	-	-
		91	WSU	91	8	-	-	-
		92	LSU	93	9	-	-	-

[a] See Table 1 in Section 3.2 for Species Codes.

Table C2: Biological data for fish captured during the Beatton River Arctic Grayling Status Assessment, September 2018.

Date	Site Name	Fish Number	Species Code[a]	Length (mm)	Weight (g)	Tag Type	Tag Number	Age (years)
15-Sep-18	Beatton River 8	93	LKC	95	9	-	-	-
		94	LKC	86	7	-	-	-
	Beatton River 6	95	LKC	71	5	-	-	-
		96	LKC	76	5	-	-	-
		97	LKC	55	2	-	-	-
		98	LKC	46	1	-	-	-
		99	RSC	78	5	-	-	-
		100	RSC	44	1	-	-	-
		101	WSU	84	6	-	-	-
		102	WSU	88	8	-	-	-
		103	LKC	72	4	-	-	-
		104	LKC	61	3	-	-	-
		105	LNC	65	2	-	-	-
		106	TP	70	4	-	-	-
		107	LKC	65	3	-	-	-
		108	LKC	51	2	-	-	-
		109	LKC	60	2	-	-	-
		110	LKC	51	1	-	-	-
		111	LKC	56	2	-	-	-
		112	LKC	69	4	-	-	-
		113	LKC	51	1	-	-	-
		114	LKC	73	4	-	-	-
		115	LKC	48	1	-	-	-
		116	RSC	75	4	-	-	-
		117	LKC	86	6	-	-	-
		118	LKC	63	3	-	-	-
		119	LKC	65	3	-	-	-
		120	WSU	78	6	-	-	-
		121	LKC	48	2	-	-	-
		122	TP	54	2	-	-	-
		123	TP	65	3	-	-	-
		124	LKC	60	3	-	-	-
		125	LKC	60	3	-	-	-
		126	LKC	69	3	-	-	-
		127	WSU	74	4	-	-	-
		128	LSU	95	10	-	-	-
		129	LKC	43	1	-	-	-
		130	LKC	46	1	-	-	-
		131	LKC	64	3	-	-	-
		132	LKC	67	3	-	-	-
	Julienne Creek 1	133	LSU	164	45	-	-	-
		134	LSU	106	11	-	-	-
		135	LKC	68	3	-	-	-
		136	LKC	45	1	-	-	-
		137	LKC	69	4	-	-	-
		138	LKC	61	2	-	-	-

[a] See Table 1 in Section 3.2 for Species Codes.

Table C2: Biological data for fish captured during the Beatton River Arctic Grayling Status Assessment, September 2018.

Date	Site Name	Fish Number	Species Code[a]	Length (mm)	Weight (g)	Tag Type	Tag Number	Age (years)
15-Sep-18	Julienne Creek 1	139	LKC	46	1	-	-	-
		140	LKC	64	3	-	-	-
		141	LKC	66	3	-	-	-
		142	LKC	42	1	-	-	-
		143	LSU	104	10	-	-	-
		144	LKC	44	1	-	-	-
		145	LKC	62	2	-	-	-
		146	LSU	48	1	-	-	-
	Bratland Creek 1	147	AG	198	72	PIT	900226000980923	3
		148	AG	191	70	PIT	900226000980890	3
		149	AG	197	77	PIT	900226000980759	3
		150	AG	180	57	PIT	900226000980606	2
		151	AG	129	19	PIT	900226000980547	1
		152	AG	67	3	-	-	0
		153	WSU	187	61	-	-	-
		154	LKC	87	8	-	-	-
		155	LKC	95	9	-	-	-
		156	LKC	84	6	-	-	-
		157	WSU	116	17	-	-	-
		158	AG	65	2	-	-	0
		159	AG	63	2	-	-	0
		160	AG	64	2	-	-	0
		161	LKC	96	12	-	-	-
		162	AG	64	2	-	-	0
		163	AG	63	2	-	-	0
		164	AG	71	3	-	-	0
		165	AG	66	2	-	-	0
		166	BSB	65	2	-	-	-
		167	AG	70	2	-	-	0
		168	AG	63	2	-	-	0
		169	LKC	95	9	-	-	-
		170	LSU	107	15	-	-	-
	La Prise Creek 2	171	AG	67	3	-	-	0
		172	AG	70	2	-	-	0
		173	AG	72	4	-	-	0
		174	AG	99	11	PIT	900226000980683	1
		175	AG	96	9	PIT	900226000255500	1
		176	AG	97	10	PIT	900226000980738	1
		177	AG	74	5	-	-	0
		178	AG	77	4	-	-	0
		179	AG	66	3	-	-	0
		180	AG	74	4	-	-	0
		181	AG	66	3	-	-	0
		182	LKC	88	8	-	-	-
		183	LKC	71	4	-	-	-
		184	LKC	76	5	-	-	-

[a] See Table 1 in Section 3.2 for Species Codes.

Table C2: Biological data for fish captured during the Beatton River Arctic Grayling Status Assessment, September 2018.

Date	Site Name	Fish Number	Species Code[a]	Length (mm)	Weight (g)	Tag Type	Tag Number	Age (years)
15-Sep-18	La Prise Creek 2	185	LKC	67	2	-	-	-
		186	AG	72	3	-	-	0
		187	AG	63	3	-	-	0
16-Sep-18	Beatton River 9	188	LKC	64	3	-	-	-
		189	LKC	78	5	-	-	-
		190	LKC	79	5	-	-	-
		191	WSU	114	18	-	-	-
		192	WSU	131	26	-	-	-
		193	WSU	91	8	-	-	-
		194	LKC	84	7	-	-	-
		195	WSU	94	10	-	-	-
		196	RSC	82	6	-	-	-
		197	LKC	65	3	-	-	-
		198	TP	60	3	-	-	-
		199	TP	58	2	-	-	-
		200	LKC	61	2	-	-	-
		201	LKC	65	2	-	-	-
		202	LKC	71	3	-	-	-
		203	LKC	60	2	-	-	-
		204	LKC	69	3	-	-	-
		205	LKC	54	2	-	-	-
		206	RSC	81	6	-	-	-
		207	LKC	70	4	-	-	-
		208	LKC	65	3	-	-	-
		209	LKC	74	4	-	-	-
		210	TP	51	1	-	-	-
		211	RSC	71	4	-	-	-
		212	LKC	60	2	-	-	-
		213	RSC	41	1	-	-	-
		214	LKC	64	3	-	-	-
		215	TP	49	1	-	-	-
	Beatton River 10	216	AG	198	91	PIT	900228000591160	3
		217	AG	224	135	PIT	900230000079591	3
		218	AG	191	84	PIT	900226000255549	2
		219	LKC	120	20	-	-	-
		220	LKC	87	7	-	-	-
		221	WSU	73	5	-	-	-
		222	LKC	68	4	-	-	-
		223	LKC	63	2	-	-	-
		224	LKC	65	3	-	-	-
		225	LKC	48	1	-	-	-
		226	LKC	60	3	-	-	-
		227	TP	54	2	-	-	-
		228	LSU	140	37	-	-	-
		229	LSU	109	16	-	-	-
		230	LSU	86	8	-	-	-

[a] See Table 1 in Section 3.2 for Species Codes.

Table C2: Biological data for fish captured during the Beatton River Arctic Grayling Status Assessment, September 2018.

Date	Site Name	Fish Number	Species Code[a]	Length (mm)	Weight (g)	Tag Type	Tag Number	Age (years)
16-Sep-18	Beatton River 10	231	LSU	93	10	-	-	-
		232	LKC	79	5	-	-	-
	Beatton River 11	233	LKC	74	5	-	-	-
		234	LKC	66	3	-	-	-
		235	LKC	65	3	-	-	-
		236	TP	71	5	-	-	-
		237	TP	56	2	-	-	-
		238	LNC	72	4	-	-	-
		239	WSU	83	7	-	-	-
		240	LSU	113	19	-	-	-
		241	LSU	91	10	-	-	-
		242	LKC	64	3	-	-	-
		243	LKC	72	4	-	-	-
		244	LKC	70	4	-	-	-
		245	LSU	94	10	-	-	-
		246	LSU	86	5	-	-	-
		247	TP	70	4	-	-	-
	Atick Creek 1	248	LKC	80	6	-	-	-
		249	LKC	93	9	-	-	-
		250	LKC	90	7	-	-	-
		251	LKC	82	6	-	-	-
	Unnamed Creek 1	252	RSC	74	3	-	-	-
		253	LKC	75	4	-	-	-
		254	LKC	73	4	-	-	-
		255	LKC	72	4	-	-	-
		256	LKC	76	5	-	-	-
		257	LKC	85	6	-	-	-
		258	WSU	125	17	-	-	-
		259	LKC	74	3	-	-	-
		260	LKC	93	9	-	-	-
		261	LKC	74	4	-	-	-
		262	LKC	75	5	-	-	-
		263	LKC	83	6	-	-	-
		264	LKC	80	6	-	-	-
		265	LKC	73	4	-	-	-
		266	LKC	80	5	-	-	-
		267	LKC	74	4	-	-	-
		268	LKC	100	10	-	-	-
		269	LKC	44	1	-	-	-
		270	LKC	90	9	-	-	-
		271	LKC	82	6	-	-	-
		272	LKC	71	4	-	-	-
		273	LKC	68	4	-	-	-
		274	LKC	71	4	-	-	-
		275	LKC	73	4	-	-	-
		276	LKC	69	4	-	-	-

[a] See Table 1 in Section 3.2 for Species Codes.

Table C2: Biological data for fish captured during the Beatton River Arctic Grayling Status Assessment, September 2018.

Date	Site Name	Fish Number	Species Code[a]	Length (mm)	Weight (g)	Tag Type	Tag Number	Age (years)
16-Sep-18	Unnamed Creek 1	277	LKC	81	6	-	-	-
		278	LKC	70	4	-	-	-
		279	LKC	68	4	-	-	-
		280	LKC	80	6	-	-	-
		281	LKC	68	3	-	-	-
		282	LKC	76	5	-	-	-
		283	LKC	78	5	-	-	-
		284	LKC	54	2	-	-	-
		285	AG	75	4	-	-	0
	Holman Creek 1	286	LKC	71	4	-	-	-
		287	LKC	70	3	-	-	-
		288	LKC	58	2	-	-	-
		289	LKC	54	2	-	-	-
		290	LKC	59	2	-	-	-
		291	LKC	68	2	-	-	-
		292	LKC	71	3	-	-	-
		293	WSU	69	3	-	-	-
		294	LKC	60	2	-	-	-
		295	LKC	50	1	-	-	-
		296	LKC	68	4	-	-	-
		297	LKC	61	2	-	-	-
		298	LKC	53	1	-	-	-
		299	LKC	62	3	-	-	-
		300	LKC	73	4	-	-	-
		301	LKC	60	2	-	-	-
		302	LKC	56	2	-	-	-
		303	LKC	55	2	-	-	-
		304	LKC	71	3	-	-	-
		305	LKC	59	2	-	-	-
		306	LKC	55	1	-	-	-
		307	LKC	59	2	-	-	-
		308	LKC	43	1	-	-	-
		309	LKC	58	2	-	-	-
		310	LKC	40	1	-	-	-
		311	LKC	58	2	-	-	-
		312	LKC	77	5	-	-	-
		313	LKC	76	4	-	-	-
		314	LKC	58	2	-	-	-
		315	LKC	57	2	-	-	-
		316	LKC	80	5	-	-	-
		317	LKC	65	3	-	-	-
		318	LKC	59	2	-	-	-
		319	TP	56	2	-	-	-
		320	TP	57	2	-	-	-
		321	TP	48	2	-	-	-
		322	TP	49	1	-	-	-

[a] See Table 1 in Section 3.2 for Species Codes.

Table C2: Biological data for fish captured during the Beatton River Arctic Grayling Status Assessment, September 2018.

Date	Site Name	Fish Number	Species Code[a]	Length (mm)	Weight (g)	Tag Type	Tag Number	Age (years)
16-Sep-18	Holman Creek 1	323	LKC	65	3	-	-	-
		324	LSU	78	5	-	-	-
		325	LKC	56	1	-	-	-
		326	CRI	77	4	-	-	-
		327	CRI	66	3	-	-	-
		328	LKC	57	2	-	-	-
		329	LKC	65	2	-	-	-
		330	LKC	76	3	-	-	-
		331	LKC	53	2	-	-	-
		332	LKC	78	5	-	-	-
		333	TP	58	3	-	-	-
		334	TP	59	2	-	-	-
		335	LKC	52	1	-	-	-
		336	LKC	70	3	-	-	-
		337	LKC	92	8	-	-	-
		338	LKC	61	2	-	-	-
		339	LKC	76	4	-	-	-
		340	LKC	77	3	-	-	-
		341	LKC	57	2	-	-	-
		342	LKC	50	1	-	-	-
		343	LKC	80	6	-	-	-
		344	LKC	59	3	-	-	-
		345	LKC	60	2	-	-	-
		346	LKC	68	3	-	-	-
		347	LKC	77	4	-	-	-
	Beatton River 1	348	CSU	260	179	-	-	-
		349	FHC	153	39	-	-	-
		350	LSU	87	7	-	-	-
		351	LKC	53	1	-	-	-
		352	LKC	45	1	-	-	-
		353	LKC	45	1	-	-	-
		354	LKC	49	1	-	-	-
		355	LKC	47	1	-	-	-
		356	LKC	56	2	-	-	-
		357	LKC	56	2	-	-	-
		358	RSC	77	5	-	-	-
		359	RSC	96	9	-	-	-
		360	RSC	78	4	-	-	-
		361	TP	45	1	-	-	-
		362	LKC	19	0	-	-	-
		363	LKC	45	1	-	-	-
		364	TP	45	1	-	-	-
		365	TP	57	1	-	-	-
		366	LKC	67	2	-	-	-
		367	LKC	55	2	-	-	-
		368	LKC	45	1	-	-	-

[a] See Table 1 in Section 3.2 for Species Codes.

Table C2: Biological data for fish captured during the Beatton River Arctic Grayling Status Assessment, September 2018.

Date	Site Name	Fish Number	Species Code[a]	Length (mm)	Weight (g)	Tag Type	Tag Number	Age (years)
16-Sep-18	Beatton River 1	369	TP	48	1	-	-	-
		370	TP	48	1	-	-	-
		371	LKC	64	3	-	-	-
		372	TP	44	1	-	-	-
		373	TP	50	1	-	-	-
		374	TP	54	1	-	-	-
		375	LKC	44	1	-	-	-
		376	LKC	20	0	-	-	-
		377	LKC	70	4	-	-	-
		378	TP	43	1	-	-	-
		379	LNC	58	3	-	-	-
		380	LKC	48	2	-	-	-
		381	TP	20	0	-	-	-
		382	LSU	54	2	-	-	-
		383	TP	48	1	-	-	-
		384	LKC	71	33	-	-	-
		385	LKC	52	1	-	-	-
		386	LKC	21	0	-	-	-
		387	LNC	40	1	-	-	-
		388	TP	47	1	-	-	-
		389	LKC	78	4	-	-	-
		390	TP	54	2	-	-	-

[a] See Table 1 in Section 3.2 for Species Codes.

APPENDIX B

Photographic Plates

Plate 1 Downstream view of Beatton Access 5 index site, 14 September 2018.

Plate 2 Upstream view of Unnamed Creek 1 index site, 16 September 2018.

Plate 3 Upstream view of Julienne Creek index site, 15 September 2018.

Plate 4 Dowsntream view of Beatton River 8 index site, 15 September 2018.

Plate 5 Beaver Dam at Bratland Creek 1 index site, 15 September 2018.

Plate 6 Upstream view of La Prise Creek 2 index site, 15 September 2018.

Plate 7 Arctic Grayling captured at Bratland Creek 1 index site, 15 September 2018.

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