Fisheries and Aquatic Habitat Monitoring and Follow-up Program Annual Report: Jan 1, 2018 to Dec 31, 2018

Site C Clean Energy Project

March 1, 2019

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Acronyms

EAC	Environmental Assessment Certificate
EAO	BC Environmental Assessment Office
EIS	Environmental Impact Statement
FAHMFP	Fisheries and Aquatic Habitat Monitoring and Follow-up Program
FLNRO	BC Ministry of Forests, Lands and Natural Resource Operations
MOE	BC Ministry of Environment

1.0 Introduction

1.1 Background

The Fisheries and Aquatic Habitat Monitoring and Follow-up Program (FAHMFP) monitors potential changes in physical habitat, lower trophic levels, fish abundance, and community composition during the construction and operation of the Site C Clean Energy Project (the Project), as required by Condition 7 of the Project's Environmental Assessment Certificate (EAC), Schedule B. Baseline studies conducted for the environmental assessment of the Project were developed with future monitoring in mind such that the sample sites and methodologies could be repeated to monitor potential changes to fish and fish habitat. The FAHMFP includes 18 monitoring programs and one follow-up program that are spatially and logistically distinct. Each program's monitoring plan includes a series of fisheries management questions and hypotheses that reflect uncertainties in predictions of the potential changes as a result of the Project, as described in the Project's Environmental Impact Statement. Each program includes a number of specific monitoring tasks.

A final version of the FAHMFP was submitted on December 22, 2015, and is available on the Project's website[1]. All references to the FAHMFP in this report refer to this version of the FAHMFP.

1.2 Summary

This report is being submitted in compliance with Condition 7 of the EAC, Schedule B. This annual report documents that all components of the FAHMFP that were scheduled to be implemented in 2018 were implemented (see Tables 1 to 3), in accordance with the implementation schedules in the FAHMFP.

The Project is in an early stage of construction; as a result the FAHMFP is in an early stage of implementation. Additional components of the FAHMFP are scheduled to be implemented as construction of the Project progresses. For example, the Site C Fishway Effectiveness Monitoring Program (Mon-13) is scheduled to begin when operation of the temporary upstream fish passage facility begins during the river diversion stage of construction. Annual reporting will continue to document the implementation of the FAHMFP.

2.0 Fisheries and Aquatic Habitat Monitoring and Follow up Program

2.1 Background

The Conditions in the EAC contemplate three plans and programs that relate to fish and fish habitat. These are summarized below to provide context for the FAHMFP.

1) **Fisheries and Aquatic Habitat Management Plan:** Fisheries and Aquatic Habitat Management Plan (submitted to the Canadian Environmental Assessment Agency [CEAA] and the BC Environmental Assessment Office [EAO] in June 2015) in accordance with EAC Condition 4 and Federal Decision Statement Condition 8 includes standard mitigation measures (e.g., erosion and sediment control measures) described in the Project's Construction Environmental Management Plan[2] and project-specific mitigation measures (e.g. reservoir shoreline habitat enhancement works and capping of dam site material relocation site with fish habitat features).

[1] Available at: https://www.sitecproject.com/document-library/environmental-management-plans-and-reports
[2] Available at: https://www.sitecproject.com/document-library/environmental-management-plans-and-reports

2) **Fisheries and Aquatic Habitat Monitoring and Follow-up Program:** The FAHMFP is a requirement of Condition 7 of the EAC, Schedule B. Condition 7 requires the development and implementation of a FAHMFP that provides for: a) monitoring fish and fish habitat during the construction and operation of the Project, and b) an outline for a procedure to evaluate and implement future mitigation and compensation options during operation of the Project.

3) **Fish Passage Management Plan:** The Fish Passage Management Plan included in the EIS (Volume 2 Appendix Q) describes the approach to manage fish passage at the Project. Following Condition 6 of the EAC, Schedule B, a Fish Passage Management Plan, which will include updates since submission of the EIS, will be prepared by Qualified Environmental Professionals and submitted prior to Project activities that may affect upstream fish passage. The EIS (Volume 2 Section 12) identified the river diversion phase of construction as the first construction activity that is expected to affect upstream fish passage. The planned monitoring for fish movement and fish passage is described in the FAHMFP.

2.2 Overview of Fisheries and Aquatic Habitat Monitoring and Follow-up Program

The FAHMFP consists of 18 monitoring programs and one follow-up program.

The 18 monitoring programs are organized in space and time such that the section of Peace River that transitions to the Site C Reservoir is monitored under the programs titled 'Peace River' prior to reservoir filling, and programs titled 'Site C Reservoir' following reservoir filling. Table 1 summarizes these monitoring programs.

Table 1. Summary of Monitoring Programs

Monitoring Program ID	Monitoring Program Name and Description
Mon-1a	**Site C Reservoir Fish Community Monitoring Program** Monitor the effects of river to reservoir transformation on the fish community in Site C Reservoir and associated tributaries.
Mon-1b	**Site C Reservoir Tributaries Fish Community and Spawning Monitoring Program** Monitor fish populations in Peace River and Site C reservoir that migrate to tributaries to determine effects of the Project and the effectiveness of mitigation measures for fish and fish habitat.
Mon-2	**Peace River Fish Community Monitoring Program** Monitor fish populations in the Peace River to determine effects of the Project and the effectiveness of mitigation measures for fish and fish habitat.
Mon-3	**Peace River Physical Habitat Monitoring Program** Monitor the effects of the Project on physical habitat.
Mon-4	**Site C Reservoir Riparian Vegetation Monitoring Program** Monitor the effectiveness of planned riparian planting adjacent to Site C Reservoir.
Mon-5	**Peace River Riparian Vegetation Monitoring Program** Monitor how the construction and operation of the Project affects the quality and quantity (species composition, biological productivity, spatial area) of riparian vegetation along the Peace River downstream of Site C.

Monitoring Program ID	Monitoring Program Name and Description
Mon-6	**Site C Reservoir Fish Food Organisms Monitoring Program** Monitor the effects of Site C Reservoir formation on the production of fish food organisms.
Mon-7	**Peace River Fish Food Organisms Monitoring Program** Monitor the effects of Project construction and operations on the biomass of invertebrates and the availability of fish food organisms downstream of Site C.
Mon-8	**Site C Reservoir Water and Sediment Quality Monitoring Program** Monitor the effects of reservoir formation on water and sediment quality.
Mon-9	**Peace River Water and Sediment Quality Monitoring Program** Monitor the effects of the Project on water and sediment quality downstream of Site C.
Mon-10	**Site C Fish Entrainment Monitoring Program** Monitor entrainment rates and survival rates of entrained fish during the operation of Site C.
Mon-11	**Site C TDG Monitoring Program** Monitor Total Dissolved Gas (TDG) supersaturation and potential effects to downstream fish populations resulting from Gas Bubble Disease (GBD) during Site C Project construction and operation.
Mon-12	**Site C Fish Stranding Monitoring Program** Monitor Project construction and operation effects associated with flow fluctuations and fish stranding on the Peace River fish community.
Mon-13	**Site C Fishway Effectiveness Monitoring Program** Monitor the performance of the temporary and permanent fishways at the Project.
Mon-14	**Site C Trap and Haul Fish Release Location Monitoring Program** Monitor the movements following release of fish collected at Site C fishways and transported and released several upstream release locations.
Mon-15	**Site C Small Fish Species Translocation Monitoring Program** Monitor small fish species populations in the Peace River to determine effects of the project on genetic structure, movement, and genetic exchange.
Mon-16	**Site C Reservoir Constructed Shallow Water Habitat Areas Sediment and Vegetation Monitoring Program** Monitor the suitability of benthic substrates in constructed shallow water habitats of Site C Reservoir for aquatic plants and monitor the natural colonization of aquatic plants in these habitats.
Mon-17	**Peace River Water Level Fluctuations Monitoring Program** Investigate the effects of water level fluctuations on the catchability of Peace River fish and the biomass and production of periphyton, downstream of Site C.

There is one follow-up program in the FAHMFP, the Tributary Mitigation Opportunities Evaluation Program.

2.3 Development of the Plan and Reporting Requirements

Construction of the Project began on July 27, 2015. The final FAHMFP was submitted to the EAO on December 22, 2015 in accordance with:

- EAC Schedule B, Condition 7: "The EAC Holder must file the final Fisheries and Aquatic Habitat Monitoring and Follow-up Program with EAO, FLNR, MOE and Aboriginal Groups within 150 days following the commencement of the construction and operations phases."

BC Hydro committed to providing reports on the implementation of the FAHMFP to the EAO annually by March 1 of the year following data collection. This reporting timing is consistent with conditions for reporting under the *Fisheries Act* authorizations for the Project[3]. This report is being submitted by March 1, 2019, to fulfill the reporting requirements for the calendar year 2018.

Note that the FAHMFP refers to calendar 'Construction Years' that correspond to Construction Year 1 (2015), Construction Year 2 (2016) etc. (see Fig. 5 of the FAHMFP). The FAHMFP describes that monitoring under the FAHMFP begins in Construction Year 2 (2016; see Fig. 5 of the FAHMFP).

3.0 Summary of Implementation Status: Monitoring Follow-up Programs

All monitoring programs scheduled to take place in 2018 were implemented. Table 2 summarizes the implementation.

Table 2. Monitoring tasks implemented in 2018, as per the schedule in the Fisheries and Aquatic Habitat Monitoring and Follow-up Program

Monitoring Program ID	Description	Data Collection Tasks Implemented	Status of Analysis and Reporting [a]
Mon-1a: Site C Reservoir Fish Community Monitoring Program	Monitor the effects of river to reservoir transformation on the fish community in Site C Reservoir and associated tributaries.	N/A (Monitoring begins during Project operations)	N/A (Monitoring begins during Project operations)
Mon-1b: Site C Reservoir Tributaries Fish Community and Spawning Monitoring Program	Monitor fish populations in Peace River and Site C Reservoir that migrate to tributaries to determine effects of the Project and the effectiveness of mitigation measures for fish and fish habitat.	2b – Peace River Bull Trout Spawning Assessment	Ongoing
		2c – Site C Reservoir Tributaries Fish Population Indexing Survey	Ongoing
Mon-2 Peace River Fish Community Monitoring Program	Monitor fish populations in the Peace River to determine effects of the Project and the effectiveness of mitigation measures for fish and fish	2a – Peace River Large Fish Indexing Survey	Ongoing
		2d – Offset Effectiveness Monitoring	Ongoing

[3] Available at: https://www.sitecproject.com/document-library/permits-and-authorizations

Monitoring Program ID	Description	Data Collection Tasks Implemented	Status of Analysis and Reporting [a]
	habitat.	2f – Beatton River Arctic Grayling Status Assessment	Ongoing
Mon-3 Peace River Physical Habitat Monitoring Program	Monitor the effects of the Project on physical habitat.	2c – Offset Effectiveness Monitoring	Ongoing
Mon-4 Site C Reservoir Riparian Vegetation Monitoring Program	Monitor the effectiveness of planned riparian planting adjacent to Site C Reservoir.	N/A (Monitoring occurs in subsequent years)	N/A (Monitoring occurs in subsequent years)
Mon-5 Peace River Riparian Vegetation Monitoring Program	Monitor how the construction and operation of the Project affects the quality and quantity (species composition, biological productivity, spatial area) of riparian vegetation along the Peace River downstream of Site C.	N/A (Monitoring occurs in subsequent years)	N/A (Monitoring occurs in subsequent years)
Mon-6 Site C Reservoir Fish Food Organisms Monitoring Program	Monitor the effects of Site C Reservoir formation on the production of fish food organisms.	2a – Biomass and Production of Fish Food Organisms	Ongoing
		2b – Ecosystem Attributes	Ongoing
Mon-7 Peace River Fish Food Organisms Monitoring Program	Monitor the effects of Project construction and operations on the biomass of invertebrates and the availability of fish food organisms downstream of Site C.	2a – Biomass and Production of Fish Food Organisms	Ongoing
		2b – Ecosystem Attributes	Ongoing

Monitoring Program ID	Description	Data Collection Tasks Implemented	Status of Analysis and Reporting [a]
Mon-8 Site C Reservoir Water and Sediment Quality Monitoring Program	Monitor the effects of reservoir formation on water and sediment quality.	2a - General Water and Sediment Quality Monitoring	Ongoing
		2b - Temperature Monitoring	Ongoing
		2c - Turbidity Monitoring	Ongoing
Mon-9 Peace River Water and Sediment Quality Monitoring Program	Monitor the effects of the Project on water and sediment quality downstream of Site C.	2a - General Water and Sediment Quality Monitoring	Ongoing
		2b - Temperature Monitoring	Ongoing
		2c – Turbidity Monitoring	Ongoing
Mon-10 Site C Fish Entrainment Monitoring Program	Monitor entrainment rates and survival rates of entrained fish during the operation of Site C.	N/A (Monitoring occurs in subsequent years)	N/A (Monitoring occurs in subsequent years)
Mon-11 Site C TDG Monitoring Program	Monitor Total Dissolved Gas (TDG) supersaturation and potential effects to downstream fish populations resulting from Gas Bubble Disease (GBD) during Site C Project construction and operation.	N/A (Monitoring occurs in subsequent years)	N/A (Monitoring occurs in subsequent years)
Mon-12 Site C Fish Stranding Monitoring Program	Monitor Project construction and operation effects associated with flow fluctuations and fish stranding on the Peace River fish community.	Task 2a - Identification of Monitoring Sites	Ongoing
		Task 2b - Monitoring Stranding Sites	Ongoing
Mon-13 Site C Fishway Effectiveness Monitoring Program	Monitor the performance of the temporary and permanent fishways at the Project.	N/A (Monitoring occurs in subsequent years)	N/A (Monitoring occurs in subsequent years)
Mon-14 Site C Trap and Haul Fish Release Location Monitoring Program	Monitor the movements following release of fish collected at Site C fishways and transported and released several upstream release locations.	N/A (Monitoring occurs in subsequent years)	N/A (Monitoring occurs in subsequent years)
Mon-15 Site C Small Fish	Monitor small fish species populations in the Peace	N/A (Monitoring occurs in subsequent years)	N/A (Monitoring

Monitoring Program ID	Description	Data Collection Tasks Implemented	Status of Analysis and Reporting [a]
Species Translocation Monitoring Program	River to determine effects of the project on genetic structure, movement, and genetic exchange.		occurs in subsequent years)
Mon-16 Site C Reservoir Constructed Shallow Water Habitat Areas Sediment and Vegetation Monitoring Program	Monitor the suitability of benthic substrates in constructed shallow water habitats of Site C Reservoir for aquatic plants and monitor the natural colonization of aquatic plants in these habitats.	N/A (Monitoring occurs in subsequent years)	N/A (Monitoring occurs in subsequent years)
Mon-17 Peace River Water Level Fluctuations Monitoring Program	Investigate the effects of water level fluctuations on the catchability of Peace River fish and the biomass and production of periphyton, downstream of Site C.	3a – Catchability	Ongoing
		3b – Benthos and Periphyton	Ongoing
		3c – Daily Growth	Ongoing
		3d – Fish Community Composition	Ongoing
		3e – Fish Recruitment	Ongoing

[a] Status of Analysis and Reporting: As of Feb 15, 2018, 'Ongoing' refers to analysis and reporting of 2018 data collection that continues or is in draft form.

Table 3. Follow-up tasks implemented in 2018, as per the schedule in the Fisheries and Aquatic Habitat Monitoring and Follow-up Program.

Follow-up Program	Description	Data Collection Tasks Implemented	Status of Analysis and Reporting
Site C Tributary Mitigation Opportunities Evaluation Program	Identify enhancement opportunities for stream dependent indicator species described in the EIS including Arctic Grayling, Bull Trout, Burbot, Goldeye, Mountain Whitefish, Rainbow Trout, and Walleye.	2a – Initial Mitigation Project Identification	Ongoing
		2b – WSEP Tier 1 Assessments 2c – Identification of Additional Candidate Watersheds	

The following sections summarize the 2018 data collection for the monitoring programs and tasks that were implemented (Table 2).

3.1 Mon-1b Site C Reservoir Tributaries Fish Community and Spawning Monitoring Program

Task 2b: Peace River Bull Trout Spawning Assessment

In 2018, the Peace River Bull Trout Spawning Assessment occurred in the upper portion of the Halfway Watershed. Trained observers conducted aerial and ground surveys over a four-week period to visually enumerate Bull Trout redds (i.e., a nest in the gravel that is excavated during spawning) in six spawning tributaries: the Chowade River, Cypress Creek, Fiddes Creek, Turnoff Creek, Needham Creek, and the upper Halfway River. Data were collected for estimating observer efficiency and survey life of redds by marking and re-sighting redds during aerial and ground surveys.

To supplement the aerial and ground survey approach, electronic counters paired with video validation equipment, and PIT arrays were operated in the Chowade River and Cypress Creek from mid-August to early October. Equipment was remotely powered by solar panels and battery banks, and sites were visited weekly throughout the monitoring period to conduct detailed testing and calibration of the equipment. Data will be used to estimate the population abundance, migration timing, spawning duration and behaviour of Bull Trout in the Chowade River and Cypress Creek, and detect Bull Trout and Rainbow Trout PIT-tagged under other monitoring programs (Mon-1b, Task 2c and Mon-2, Task 2a). Data analysis and reporting of the data collected in 2018 are ongoing.

Task 2c: Site C Reservoir Tributaries Fish Population Indexing Survey

The Site C Reservoir Tributaries Fish Population Indexing Survey monitors the abundance of Arctic Grayling in the Moberly River, Bull Trout in the Chowade River and Cypress and Fiddes creeks, and Rainbow Trout in Colt, Farrell, and Kobes creeks. As part of a multi-year study, the results from 2018 intend to provide additional baseline data prior to subsequent phases of construction and operation.

For streams where sampling targeted Bull Trout, backpack electrofishing effort was focused on upstream reaches and locations that contained high quality rearing habitat for this species. Captured Bull Trout were implanted with Passive Integrated Transponder (PIT) tags to monitor these fish's movements through PIT tag detector arrays installed in the Chowade River and Cypress Creek as part of the Peace River Bull Trout Spawning Assessment (Mon-1b, Task 2b). These tagged fish may also be recaptured under other monitoring programs in the FAHMFP. Young of the Year (YOY) and immature Bull Trout (i.e., fish less than 250 mm FL that were not YOY) were recorded in all three systems. In 2018, 477 PIT tags were deployed into Bull Trout in these three systems.

For streams where sampling targeted Rainbow Trout, backpack electrofishing effort occurred at previously established sites, allowing changes to the Rainbow Trout population to be monitored over time. These locations included five sites on Colt Creek, four sites on Farrell Creek, and 5 sites on Kobes Creek. YOY and immature Rainbow Trout were recorded in all three systems. In 2018, 108 PIT tags were deployed into Rainbow Trout in these three systems.

The entire length of the Moberly River between Moberly Lake and the river's confluence with the Peace River was accessed by inflatable boat. Sample effort in 2018 included 42 backpack electrofishing sites, 27 small boat electroshocking sites, 34 angling sites, and 2 beach seining sites. Arctic Grayling were only encountered during backpack electrofishing (*n* = 4) and angling (*n* = 1) surveys. Three of five Arctic Grayling captured were large enough to be implanted with PIT tags. Analysis and reporting of the data collected in 2018 are ongoing.

3.2 Mon-2 Peace River Fish Community Monitoring Program

Task 2a: Peace River Large Fish Indexing Survey

Sampling under Mon-2, Task 2a was conducted in six different sections of the Peace River mainstem located between Peace Canyon Dam and the Many Islands area in Alberta. All large-bodied fish were monitored; however, the program focused on seven indicator species including Arctic Grayling, Bull Trout, Burbot, Goldeye, Mountain Whitefish, Rainbow Trout, and Walleye. During previous study years, sampling under this program was limited to the late summer to early fall period; however, in 2018, additional surveys were conducted at select locations in the late spring to early summer period to target Goldeye and Walleye prior to these species' downstream migrations out of the study area. For both surveys, fish were sampled by boat electroshocking within nearshore habitats (less than 2.0 m depth). Length, weight, and ageing structures were collected from all captured indicator species. Depending of fish size and sample session, captured indicator species were marked with passive integrated transponder (PIT) tags. Analysis and reporting of the data collected in 2018 are ongoing.

Task 2d: Offset Effectiveness Monitoring

In 2018, effectiveness monitoring of habitat offset areas (River Road rock spurs and Upper Site 109L)[1] focused on three components: physical habitat (see Mon-3, Task 2c), general fish use, and Mountain Whitefish spawning.

General fish use was assessed by conducting boat electroshocking surveys within each offset area. The potential for spawning by Mountain Whitefish was assessed at Upper Site 109L using artificial substrate mats designed to trap eggs released by spawning Mountain Whitefish. Egg collection mats were deployed during the potential spawning period from mid-October to mid-January. Analysis and reporting of the data collected in 2018 are ongoing.

Task 2f: Beatton River Arctic Grayling Status Assessment

The Beatton River Arctic Grayling Status Assessment aims to increase the current knowledge and understanding of the life history patterns of Arctic Grayling in the Beatton River Watershed. In 2018, Mon-2, Task 2f collected information on the age and size structure, growth, recruitment, and population abundance of Beatton River Arctic Grayling. Data will be compared to populations elsewhere in the Peace River Basin (e.g., Moberly and Halfway rivers through Mon-1b, Task 2c). Analysis and reporting of the data collected in 2018 are ongoing.

[1] These habitat offsets are listed in the Project's Fisheries Act Authorization for Site Preparation, and are described in 'Section 6.2.1 Mitigation Measures Downstream of Site C Dam Site' of the Project's Fisheries and Aquatic Habitat Management Plan.

3.3 Mon-3 Peace River Physical Habitat Monitoring Program

Task 2c: Offset Effectiveness Monitoring

Physical habitat was assessed at two habitat offset areas[3] that have been constructed: River Road rock spurs and Upper Site 109L. The elevation of the banks, riverbed, and water surface were surveyed using boat and wading surveys. The surveys employed a GPS and benchmark system, and an Acoustic Doppler Current Profiler. Cross sections of the main channel of the Peace River were surveyed. Overall, measurements of channel cross sections were recorded at nine cross sections of the main channel of the Peace River. Videography surveys and substrate grab samples were employed to categorize substrate sizes within Upper Site 109L. Analysis and reporting of the data collected in 2018 are ongoing.

3.4 Mon-6 Site C Reservoir Fish Food Organisms Monitoring Program and Mon-7 Peace River Fish Food Organisms Monitoring Program

Mon-6 and 7 monitor the same parameters but in different locations: the area of the future Site C Reservoir, and the Peace River downstream of the Project, respectively. For simplicity, the following section summarizes the 2018 implementation for both programs.

Task 2a: Biomass and Production of Fish Food Organisms

In 2018, periphyton and benthic invertebrate samples were collected during summer and fall sessions. The samples were collected from 12 sites established between Williston Reservoir and the Many Islands area in Alberta. Two of the sites are located within the Halfway River and the Moberly River.

Fish stomach samples from Mountain Whitefish, Arctic Grayling, Rainbow Trout and Longnose Sucker were also collected under the Peace River Fish Community Monitoring Program (Mon-2) and processed under Mon-6 and 7 (per Task 3a).

Task 2b: Ecosystem Attributes

Ecosystem attributes recorded in 2018 included the following:

- Habitat area – lotic habitat in the study area as measured using desktop mapping;
- Water column turbidity and suspended solids;
- Water temperature (continuous logging during the accrual periods);
- Water quality (DO, TDS, pH, total nitrogen, total phosphorus, total dissolved; phosphorus, ammonium, soluble reactive phosphorus);
- Periphyton; and
- Zooplankton from Dinosaur and Williston Reservoirs.

Analysis and reporting of the data collected in 2018 is ongoing.

[3]These habitat offsets are listed in the Project's Fisheries Act Authorization for Site Preparation, and are described in 'Section 6.2.1 Mitigation Measures Downstream of Site C Dam Site' of the Project's Fisheries and Aquatic Habitat Management Plan.

3.5 Mon-8 Site C Reservoir Water and Sediment Quality Monitoring Program and Mon-9 Peace River Water and Sediment Quality Monitoring Program

Mon-8 and 9 monitor the same parameters but in different locations: the area of the future Site C Reservoir, and the Peace River downstream of the Site C dam site, respectively. For simplicity, the following section summarizes implementation for both programs in 2018. These programs collect information and parameters focused on fish and fish habitat.

Task 2a: General Water and Sediment Quality Monitoring

Water quality monitoring was conducted to collect information on those parameters that may affect fish and fish habitat. Sampling occurred monthly between May and October. Sampling locations were located in the Peace River between Peace Canyon Dam and the Many Islands area in Alberta. Sampling locations were also located in Dinosaur and Williston Reservoirs to monitor water flowing into the Peace River.

Water quality sampling focused on measuring parameters that may change in concentration throughout the growing season. Parameters followed those measured during baseline studies including both field-based measured parameters (e.g., water conductivity, pH, and dissolved oxygen), and collection of samples for laboratory analysis of nutrients and general parameters.

Sediment samples were collected in October. Sediments were collected from within the near-shore littoral zones, and adjacent to the water sample locations, in Williston and Dinosaur Reservoirs. Sediments were collected from near-shore areas adjacent to river water sample locations. Samples were analyzed for particle size, nutrients, and total metals. Analysis and reporting of the data collected in 2018 is ongoing.

Task 2b: Temperature Monitoring

Continuous measurements of water temperature were recorded at Peace River sites between Williston Reservoir and the Pouce Coupe River in Alberta. Temperature loggers were checked for calibration, set to record temperature at hourly intervals and secured to the river bank or anchored to the river bed. Data loggers were downloaded approximately every three months. Analysis and reporting of the data collected in 2018 are ongoing.

Task 2c: Turbidity Monitoring

Continuous Peace River turbidity monitoring occurred at four monitoring sites in the Peace River in 2018. Two turbidity monitoring stations, Peace above Pine - Left Bank (PAP-LB) and Peace above Pine – Right Bank (PAP-RB), are located in the Downstream Reach between the Project and the Pine River. The two upstream monitoring stations, Peace above Moberly – Left Bank (PAM-LB) and Peace above Moberly – Right Bank (PAM-RB), are located on opposite banks of the Peace River immediately upstream of the Project and the Moberly River. Analysis and reporting of the data collected in 2018 are ongoing.

3.6 Mon-12 Site C Fish Stranding Monitoring Program

Mon-12 aims to determine the magnitude of baseline fish stranding along the Peace River, from the Diversion Headpond (upstream of Site C) to the Many Islands area in Alberta, and compare the baseline conditions to stranding in the construction and operation phases of the Project.

Ten days of sampling were undertaken in 2018, between August 11 and October 3, in the Diversion Headpond and Reach 1 (between the Project and the Taylor Bridge). Each trip was coordinated with BC Hydro Operations personnel at the Peace Canyon Dam to ensure sampling occurred following a reduction in discharge at Peace Canyon Dam and to account for the lag time between the reduction in flows upstream and the effects observed downstream. A total of 178 sampling events were completed using a combination of interstitial sampling of dewatered substrates and backpack electrofishing in isolated pools within a combination of targeted and randomly selected sampling sites. Analysis and reporting of the data collected in 2018 are ongoing.

3.7 Mon-17 Peace River Water Level Fluctuations Monitoring Program

Mon-17 provides information on potential changes to fish and fish habitat associated with changes to the daily hydrograph in the Peace River downstream of the Project that are predicted to occur during Project operations. Mon-17 is unique compared to other monitoring plans because it is an analysis-based plan. This information is integrated into the overall sampling design of the FAHMFP to address specific hypotheses related to Project operations.

In 2018, the **data collection tasks** that support Mon-17 included one from Mon-17, along with four tasks from other monitoring plans, described elsewhere.

Mon-17, Task 2b: Small Fish Otolith Collection
The width of daily circuli in otoliths were measured in the lab from otoliths collected from Arctic Grayling, Longnose Sucker, Mountain Whitefish, and Rainbow Trout. Analysis and reporting of the data collected in 2018 are ongoing.

Data collection tasks from other monitoring programs include Mon-2, Task 2a (Peace River Large Fish Indexing Survey), Mon-2, Task 2b (Peace River Fish Composition and Abundance Survey), Mon-2, Task 2d (Offset Effectiveness Monitoring Program), and Mon-2, Task 2f (Beatton River Arctic Grayling Status Assessment); and Mon-7 data collection tasks.

In 2018, all **data analysis tasks** were completed. In all cases, the performance measures are related to changes in the hydrograph, as measured through daily discharge data from Water Survey of Canada hydrometric stations.

The performance measures estimated include:

Task 3a: Catchability

Changes in the hydrograph, along with other changes to habitat conditions at the time of sampling, can lead to changes in electrofishing sampling efficiency or catchability (q). This has the potential to affect the results from fish surveys (Mon-2, Task 2a) if not accounted for.

In 2018, analysis on the effects of flow fluctuation on catchability on Mountain Whitefish, Bull Trout, and Arctic Grayling were assessed using Large Fish Index data collected in Mon-2. Analysis and reporting of the data collected in 2018 are ongoing.

Task 3b: Benthos and Periphyton

The potential effect of shifts in the timing of flow peaking on periphyton accrual and the biomass of benthos will be examined using within and among site variations for both periphyton accrual and the biomass of benthos. Models will be used to predict the effects of peak flow timing and will be validated using before and after comparisons at individual sites, supplemented by data from years that differ in seasonal average flows.

In 2018, data on benthos and periphyton that are required for these analyses were collected under Mon-6 and 7. Sampling occurred across a range of river bed elevations and corresponding river levels. Analysis and reporting of the data collected in 2018 are ongoing.

Task 3c: Daily Growth

The potential effect of shifts in the timing of flow peaking on daily growth will be examined using otolith samples from age-0 and age-1 fish among sites in the Peace River. This analysis task is tied to the data collection task for otolith collection (Mon-17, Task 2b).

Task 3d: Fish Community Composition

The potential effect of shifts in the timing of flow peaking on species-specific fish density will be examined using fish indexing data among sites in the Peace River. Analysis will use a species-diversity curve to determine if fish density is different depending on discharge.

Task 3e: Fish Recruitment

The potential effect of shifts in the timing of flow peaking on species-specific recruitment will be examined using an analysis of variation in cohort strength for Mountain Whitefish, and other species if sufficient data exists.

3.8 Follow-up Program: Site C Tributary Mitigation Opportunities Evaluation Program

The following summarizes the methods and work in 2018.

Task 2a: Initial Mitigation Project Identification

A review of existing information was used to establish the distributions and habitat requirements of target fish species, and to characterize existing potential habitat limitations in tributary fish habitats. An initial evaluation of the key limiting factors and likelihood of mitigation success by tributary and indicator species was conducted. This information will be used under Task 2b.

Task 2b: WSEP Tier 1 Assessment

A modified Watershed Status Evaluation Program (WSEP) Tier 1 assessment protocol was developed to assess watershed status and to identify factors that may impair ecological function, limit fish production, and may limit or enhance the success of potential mitigation. The modified WSEP Tier 1 Assessment workflow consisted of a comprehensive multi-stage GIS analysis and an iterative review of watershed indicator selection and ranking. The steps included:

- Initial delineation and description of the study area;

- Assembly of relevant available spatial data in a GIS framework;
- The definition and calculation of key watershed indicators, including habitat quantity, habitat pressure and habitat vulnerability indicators; and
- Summary roll-up of habitat pressure indicators into discrete habitat disturbance indicators.

Task 2c: Identification of Additional Candidate Watersheds

During summer 2018, the Project team undertook preliminary stream habitat assessment fieldwork as part of Task 2c, which included site inspections accessed by aerial overflights. Members of the Blueberry River First Nation participated in these site inspections. The goal of the field works was to evaluate opportunities identified during Tier 1 Assessment step. A total of 35 restoration opportunities were identified in 2018.

Analysis and reporting of the data collected in 2018 are ongoing.

4.0 Qualified Professionals

This report was prepared by the following Qualified Individuals:

Qualified Individual	Expertise
Brent Mossop, MRM, RPBio	Fisheries
Nich Burnett, MSc, RPBio	Fisheries