Fish Passage Management Plan

Site C Clean Energy Project

Revision 2: June 2, 2020

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Revision History

Version	Date	Comments
Rev 0	12-01-2012	Final Plan, Revision 0 – Site C Environmental Impact Statement, Volume 2 Appendix Q1
Rev 1	11-18-2019	Final Plan, Revision 1 – Issued for Review by First Nations, DFO, MOE and FLNRO
Rev 2	06-02-2020	Final Plan, Revision 2 – Issued for Implementation

Note: Section 2.0 of this Plan outlines the requirements for the current revision.

Acronyms

AWS	Auxiliary Water Supply
BCEAO	BC Environmental Assessment Office
CEAA	Canadian Environmental Assessment Act
CEMP	Construction Environmental Management Plan
CWL	Conditional Water Licence
DFO	Fisheries and Oceans Canada
EAC	Environmental Assessment Certificate
EIS	Environmental Impact Statement
FAHMP	Fisheries and Aquatic Habitat Management Plan
FAHMFP	Fisheries and Aquatic Habitat Monitoring and Follow-Up Program
FDS	Federal Decision Statement
FLNRO	Forests, Lands and Natural Resource Operations, or Forests, Lands, Natural Resource Operations and Rural Development
HVJ	High Velocity Jet
LAA	Local Assessment Area
MOE	Ministry of Environment or Ministry or Environment and Climate Change
MW	Megawatt
OPP	Operational Parameters and Procedures
PIT	Passive Integrated Transponder
QEP	Qualified Environmental Professional
SDM	Structure Decision Making

Definitions

Attraction flow	Flow that emanates from a fishway entrance with sufficient velocity and in sufficient quantity and location to attract upstream migrants into the fishway. Attraction flow consists of gravity flow from the fishway, plus any auxiliary water system flow added at points within the lower fishway.
Auxiliary water system	Hydraulic system that augments fishway flow at various points in the upstream passage facility. Typically, large amounts of auxiliary water flow are added in the fishway entrance pool to increase the attraction of the fishway entrance.
Conceptual design	Initial design concept based on the site conditions and biological needs of the species intended for passage. This is also sometimes referred to as preliminary design or functional design.
Crowder	Combination of static and/or movable picketed and/or solid leads installed in a fishway to move fish into a specific area for sampling, counting, broodstock collection, or other purposes.
Downstream fish passage	Fish passage relating to downstream migration of adult and/or juvenile fish.
Entrainment	Downstream movement of fish through the flow release structures of a dam (via spillways or low level outlets), a generating station (via the turbines) or diversion tunnels.
Fish lock	Mechanical and hydraulic component of an upstream passage system that provides fish passage by attracting or crowding fish into the lock chamber, activating a closure device to prevent fish from escaping, introducing flow into the enclosed lock, and raising the water surface to forebay level, and then opening a gate to allow the fish to exit.
Fishway	Set of facilities, structures, devices, measures, and project operations that together constitute, and are essential to the success of, an upstream fish passage system.
Fishway entrance	Component of an upstream passage facility that discharges attraction flow into the tailrace, where upstream migrating fish enter (and flow exits) the fishway.
Orifice	Opening through which fish can swim through.
Sorting facility	Facility where fish may be sorted, sampled and tagged. Sorting facilities are typically found in conjunction with a fishway.
Tailrace	Stream channel immediately downstream of an instream man-made structure.
Fish translocation	The capture, transport and release of fish from one location another.
Trap and haul	Fish passage facility designed to trap fish for upstream or downstream transport to continue their migration.
Upstream fish passage	Fish passage relating to upstream migration of adult and/or juvenile fish.
Weir	Obstruction over which water flows.

1.0 Background

The Site C Clean Energy Project (the Project) will be the third dam and generating station on the Peace River in northeast BC. The Project will provide 1,100 megawatts (MW) of capacity and about 5,100 gigawatt hours of energy each year to the province's integrated electricity system. The Project will be a source of clean, reliable and cost-effective electricity for BC Hydro's customers for more than 100 years.

The components of the Project are:

- an earthfill dam, approximately 1,050 metres long and 60 metres high above the riverbed;
- an 83 kilometre long reservoir that will be, on average, two to three times the width of the current river;
- a generating station with six 183 MW generating units;
- two new 500 kilovolt AC transmission lines that will connect the Project facilities to the Peace Canyon Substation, along an existing right-of-way;
- realignment of six segments of Highway 29 over a total distance of approximately 30 kilometers; and
- construction of a berm at Hudson's Hope.

The Project will also include the construction of temporary access roads, a temporary bridge across the Peace River, and worker accommodation at the dam site.

2.0 Regulatory Context

The environmental approvals for the Project contain conditions related to fish and fish habitat, and fish passage management. The purpose of the Fish Passage Management Plan (FPMP) is to describe the approach to manage fish passage for the Project. The current revision of the FPMP has been prepared in accordance with regulatory requirements as described below. Table A1 summarizes the licences, permits and authorizations related to fish passage management, including provincial permits required for the collection of fish.

Project Certification

In October 2014, the Provincial Ministers of Environment (MOE) and Forests, Lands and Natural Resource Operations (FLNRO) issued the Environmental Assessment Certificate (EAC) for the Project. In November 2014, the Federal Minister of the Environment issued a Federal Decision Statement (FDS) for the Project. Both the EAC and FDS set out conditions under which the Project can be constructed and operated, including conditions related to fish and fish habitat. These conditions require that BC Hydro prepare the following three mitigation, management and monitoring plans:

1. **Fisheries and Aquatic Habitat Management Plan** (FAHMP)[1]: The FAHMP was

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

submitted to the CEA Agency and BCEAO in June 2015 in accordance with EAC Condition 4 and FDS Condition 8. The FAHMP includes standard mitigation measures described in the Construction and Environmental Management Plan (CEMP), such as sediment and erosion control, as well as Project-specific mitigation measures, such as reservoir shoreline habitat enhancement works and capping of dam site material relocation site with fish habitat features. The FAHMP also describes mitigation for fish passage management, as described in Revision 0 of the FPMP, dated December 2012, submitted with the Project's Environmental Impact Statement (EIS)[2].

2. **Fisheries and Aquatic Habitat Monitoring and Follow-up Program** (FAHMFP)[3]: The FAHMFP was submitted to CEA Agency and EAO in December 2015 in accordance with EAC Condition 7 and FDS Conditions 8.4.3 and 8.4.4. The purpose of the FAHMFP is to (1) monitor fish and fish habitat during the construction and operation of the Project; (2) understand the effects of the Project and the effectiveness of mitigation measures; and (3) evaluate and implement future mitigation and compensation options. The FAHMFP describes the monitoring for fish passage management, in particular Mon-10 (Site C Fish Entrainment Monitoring Program), Mon-13 (Site C Fishway Effectiveness Monitoring Program), and Mon-14 (Site C Trap and Haul Fish Release Location Monitoring).

3. **Fish Passage Management Plan** (FPMP): As noted, the first version (Revision 0) of the FPMP, dated December 2012, was included in the EIS for the Project. Condition 6 of the EAC requires that BC Hydro respectively submit a draft and final FPMP to FLNRO, MOE, and Indigenous groups at least 90 and 30 days "prior to Project activities that may impact upstream fish passage."

   As diversion of the Peace River, scheduled for September 2020, is the first Project activity expected to affect fish movement in the Peace River, BC Hydro is now submitting this updated FPMP to FLNRO, MOE and Indigenous groups for review and comment. Table A2 describes how the FPMP has been developed in accordance with the requirements of EAC Condition 6.

   The FPMP also addresses FDS Conditions 8.4.2.3 and 8.4.2.5 regarding mitigation measures to minimize downstream fish entrainment past the dam site, as well as obstructed upstream fish passage for Bull Trout and, as appropriate and feasible, other migrating fish species (refer to Sections 4.0 and 5.3 of the Plan).

***Fisheries Act* Authorization**

In July 2016, Fisheries and Oceans Canada (DFO) issued an authorization under the *Fisheries Act* for the Project's Main Civil Works and Facility Operations. Condition 2.4 of the authorization requires BC Hydro to "mitigate effects on fish movement associated with the construction and operation of the Project" through a FPMP, described within the EIS, and with

[2] Available at: https://www.ceaa-acee.gc.ca/050/documents_staticpost/63919/85328/Vol2_Appendix_Q.pdf
[3] Available at: https://www.sitecproject.com/sites/default/files/Fisheries-and-Aquatic-Habitat-Monitoring-and-Follow-up-Program.pdf

any amendments approved by DFO. The *Fisheries Act* Authorization also authorizes the potential death of fish associated with upstream and downstream fish passage.

BC Hydro submitted Revision 1 of the FPMP to DFO for review and comment and is submitting Revision 2 in accordance with Condition 2.4 of the *Fisheries Act* Authorization. Entrainment and potential death of fish during river diversion and operations is described in Sections 5.3.2 and 5.3.3 of the Plan, respectively.

Water Licences

In February 2016, the Comptroller of Water Rights issued Conditional Water Licences (CWL) for the diversion, use and storage of water. The Water Licences include requirements for mitigation and monitoring plans, including for fish passage management, prior to construction of the Stage 2 Cofferdams and Diversion. The current revision of the FPMP has been prepared in accordance with the Water Licence requirements.

In January 2018, the Comptroller of Water Rights issued Conditional Water Licences for the temporary and permanent upstream fish passage facilities (hereafter, temporary and permanent facilities) for the Project. The Water Licences for the temporary and permanent facilities require BC Hydro to prepare a Manual of Operations Parameters and Procedures (OPP; McMillen Jacobs & Associates and BC Hydro 2020) and Operations Environmental Management Plan (OEMP; BC Hydro 2020) related to the operation of the facilities. The FPMP will form the basis of the OPP and OEMP.

3.0 Objective and Scope

The objective of the FPMP is to describe the measures that are planned to be used to mitigate the effects of the Project on fish movement, as required by EAC Condition 6. By doing so, the implementation of the FPMP will meet the biological objectives described in Sections 4.1, 5.1 and 6.1. The FPMP will also provide the information required under other regulatory conditions related to fish passage management, as described in Section 2.0.

3.1 Guiding Principles for Fish Passage Management

BC Hydro manages fish passage at existing facilities through the application of guiding principles, several of which are directly applicable to the FPMP. These principles guided the development of the approach to assessing fish passage alternatives during the alternatives assessment that was described in Revision 0 of the FPMP. These principles are also applicable to implementation of the FPMP and are reproduced here. Principles 1 to 3 are adapted from the BC Hydro, DFO and MOE Fish-Hydro Management Committee's Working Principles for the BC Hydro Entrainment Strategy (Fish-Hydro Management Committee, 2011)[4]. While these principles were originally developed specific to managing entrainment, they are also relevant to the management of upstream fish passage. The text in Principles 1 to 3 presented below have been minimally edited (as highlighted in the square brackets), to adapt

[4] Principle 4 from the Working Principles concerns legal certainty, which is not directly applicable in the context of the FPMP, and thus is not presented.

to the context of implementation of fish passage management at a new upstream fish passage facility.

Working Principles for the BC Hydro Entrainment Strategy
(Fish-Hydro Management Committee, 2011).

Principle 1: Impacts will be assessed taking into consideration Fisheries Management Objectives at the watershed scale

The purpose of this principle is to address the issue of assessing fish impacts at a watershed scale. Where Fisheries Management Objectives (FMO's) exist, they will be considered in developing appropriate mitigation options.

In some cases, impacts at the individual fish level will be an important consideration; this may be particularly true for the protection of SARA-listed species. In other cases, impacts at the fish population level may be of over-riding importance. In terms of ecosystem processes and linkages, assessments will need to consider, as necessary, such aspects as fish habitat, the dynamics of fish loss to upstream populations and fish recruitment to downstream populations, and food chain dynamics.

In the context of entrainment risk management, it is recognized that in some cases there might be a need to evaluate a range of potentially negative and positive effects across various ecosystem elements. For example, entrainment mitigation at a facility may reduce individual fish kills, but it may also reduce downstream recruitment.

Principle 2: **[Fish passage management]*– will be evaluated against environmental, social and financial objectives***

Through the provision of reliable, cost-effective energy, the operation of BC Hydro facilities provides a significant range of benefits to society. However, these benefits must be balanced against the potential risk to valued ecosystem components. In making entrainment management decisions, BC Hydro would like to balance, environmental, social and financial objectives.

On the environmental side, important objectives and attributes related to the conservation of fish and fish habitat will emerge. On the social side, there will be a clear focus on fisheries management objectives, which the regulatory agencies will identify. Finally, from a financial perspective, the estimated cost of [fish passage management decisions] *will be evaluated.*
Structured decision-making techniques will be used to evaluate [fish passage management].

Principle 3: Decisions will be based on the best available information

> *The best available information – broadly categorized to include both 'applied science' information and 'policy' information – should be applied to assess* [fish passage management decisions]*. Implicit in this is the need to determine what levels of risk will trigger mitigative action, and what level of action will be deemed sufficient from a regulatory perspective.*
>
> *Recognizing the existence of data gaps and uncertainties, proposals have been made on the basis of the best available information, with a commitment to improve information quality over time. Structured decision-making tools and techniques that are consistent with and build on DFO's Risk Management Framework (DFO, Undated) were used to support clear, consistent decision-making.*

Revision 0 of the FPMP included a principle to address approaches to adaptive management. This principle, presented below, is related to Principle 3 in the context of the development of a new facility and implementation of fish passage management.

Principle 4: Adaptive Management Approaches to Potentially Preferred Alternatives Will Be Considered

Although some technical and biological uncertainties may be resolved prior to the construction of the Project, it may not be possible to address all uncertainties. Adaptive management approaches should be explored to reduce uncertainties and guide implementation of the FPMP.

3.2 Scope

The FPMP has three major components:

- **Section 4.0: Upstream fish passage.** Describes the staged approach to the design, construction and operation of trap and haul facilities for mature Bull Trout (*Salvelinus confluentus*) as the primary target species. Monitoring upstream fish passage aims to reduce key uncertainties and inform ongoing operation of the trap and haul facilities.
- **Section 5.0: Downstream fish passage.** Describes the suite of integrated design features to maximize the survival of fish passing downstream of the Project. Monitoring downstream fish passage aims to reduce key uncertainties on potential effects on fish upstream and downstream of the Project.
- **Section 6.0: Small fish translocation.** Describes the plan to reduce uncertainty concerning the potential effects of the Project on gene flow among populations of small-bodied fish species upstream and downstream of the Project. If populations are currently connected by low levels of gene flow, they may become fragmented by the presence of the Project. The capture, transport and release of small-bodied fish

species could help to maintain gene flow.

3.3 Consultation

Consultation and engagement on the potential mitigation measures for fish and fish habitat, including fish passage management, began during the planning stages and Environmental Assessment for the Project (late 2007 to 2014).

As part of the Environmental Assessment, BC Hydro received input from Indigenous groups on the locations and fish species that are harvested and important to communities (through Traditional Land Use Studies) and on the potential mitigation measures for fish and fish habitat. The EIS (Volume 1, Section 9, Appendix H) provides a summary of the issues, concerns and interests received from Indigenous groups prior to the filing of the EIS and BC Hydro's responses and considerations. Additionally, Information Requests received from Indigenous groups on the EIS and BC Hydro's responses[5] were submitted to the CEA Agency and BC EAO on May 8, 2013. The input received prior to filing the EIS informed the development of Revision 0 of the FPMP.

An amended EIS was submitted to the Joint Review Panel in August 2013 and in November 2013 the Joint Review Panel announced that the Project would proceed to public hearings in December 2013 and January 2014. The Project received environmental approval from federal and provincial governments in October 2014. Following environmental approval, consultation and engagement with Indigenous groups continued, including for the conditions of the Project's EAC, FDS and the permits and authorizations required for construction.

BC Hydro shared information and responded to comments and concerns from Indigenous groups related to the design, construction and operation of the fish passage facilities, as well as the monitoring related to the facilities. BC Hydro also met directly with several Indigenous groups, at their request, to present information on the fish passage facilities. BC Hydro took this information into account in the design of the fish passage facilities, including attracting fish to the entrance of the facility through varying flows and reducing the potential of injury and mortality to fish.

Consultation on fish passage management with regulatory agencies and Indigenous groups named in the EAC and FDS conditions has continued since the submission of the EIS and the Environmental Assessment for the Project. Examples of this consultation are as follows:

- BC Hydro and Indigenous groups meet periodically to review the Project and other BC Hydro activities in the Peace Region. Information on fish passage management has been presented and provided, as requested, as part of these meetings;
- The Project's FAHMP (dated June 2015) includes information on fish passage

[5] Available at: https://www.projects.eao.gov.bc.ca/api/document/5887e175d876de1347b512d4/fetch/Letter%20dated%20May%208%2C%202013%20from%20Trevor%20Proverbs%20%28BC%20Hydro%29%20to%20Brian%20Murphy%20%28EAO%29%20regarding%20EIS%20comments%20on%20the%20proposed%20Site%20C%20Clean%20Energy%20Project.pdf

management. The draft FAHMP was submitted to Indigenous groups named in the EAC and FDS conditions for review and comment in October 2014;

- The monitoring programs tasked with assessing upstream and downstream fish passage, and small fish translocation at the Project formed a part of the FAHMFP (dated December 2015). BC Hydro consulted with Indigenous groups on the draft FAHMFP;
- BC Hydro provided information on fish passage management to support FLNRO's consultation with Indigenous groups for the following Water Licences: CWL #132990 and 132991 for the Project, and CWL #133986 and 133987 to construct and operate the temporary and permanent facilities;
- BC Hydro's application for an authorization under the *Fisheries Act* for Dam Construction, Reservoir Preparation and Filling was submitted to DFO in 2015. The application included information on the design and operation of the temporary facility, as well as design to increase the survival of fish that are entrained at the Project. DFO referred the information to Indigenous groups for consultation purposes. During consultation between DFO and Indigenous groups, clarifications were requested by Indigenous groups on several technical items. BC Hydro provided further information in response to these questions.
- BC Hydro hosted the Site C Environmental Forum #1 (May 2018) with Indigenous groups in Fort St John. The forum provided information and responded to questions from regulatory agencies and Indigenous groups on the topics of fish and fish habitat mitigation and monitoring, and fish passage management; and
- BC Hydro hosted the Site C Environmental Forum #5 (November 2019) with Indigenous groups in Fort St John. The forum provided information and responded to questions from regulatory agencies and Indigenous groups on the topic of fish passage management.
- BC Hydro sought feedback (in November 2019) from Indigenous groups on Revision 1 of the FPMP. The feedback received has been taken into account in this Rev 2 of the FPMP.
- BC Hydro sought feedback (in December 2019) from Indigenous groups on three documents[6] related to the operation of the temporary facility.
- BC Hydro hosted the Site C Environmental Forum #8 (March 2020) with Indigenous groups in Fort St John. The forum included a site visit to the temporary facility that was under construction.

BC Hydro is committed to ongoing consultation on fish passage management as the Project progresses. Below is a description of how input will continue to be sought and taken into account during the implementation of FPMP.

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[6] The documents were: 'Manual of Operations Parameters and Procedures', 'Operational Environmental Management Plan' and 'Plan for Measuring Flow of Water Diverted for the Temporary Fish Passage Facility'

3.4 Review and Revisions

BC Hydro has and will continue to take into account input on fish passage management from regulatory agencies and Indigenous groups; this input is anticipated to occur through several existing means that BC Hydro engages with these groups.

Revisions 1 and 2 of the FPMP constitute an update to Revision 0 that was released in December 2012. Revisions 1 and 2 reflect the following updates:

- Ongoing consultation with, and input from regulatory agencies and Indigenous groups;
- Updates to licences, permits and authorizations;
- Completed development of the monitoring programs related to fish passage management under the FAHMFP. Specifically, Mon-10 (Site C Fish Entrainment Monitoring Program), Mon-13 (Site C Fishway Effectiveness Monitoring Program), and Mon-14 (Site C Trap and Haul Fish Release Location Monitoring Program);
- Further understanding of the baseline conditions in the Peace River and its tributaries, as well as the refinement of sampling methods and data analysis from five (5) years of data collection under the FAHMFP (2015 to 2019);
- Five (5) years of progress on the construction of the Project;
- Design of the diversion tunnels and turbines – the structures that allow for downstream fish passage – is complete, and construction is currently underway;
- Design of the temporary and permanent facilities is complete, construction of the temporary facility is currently underway;
- Continued learning and incorporation of information from trap and haul operations in other regulated and unregulated rivers;
- Reformatting the FPMP to match the structure of other mitigation, management and monitoring plans for the Project[7]; and
- Input on Revision 1 of the FPMP from DFO, MOE, FLNRO and Indigenous groups that was provided to BC Hydro in January 2020.

In collaboration with DFO, MOE and FLNRO, BC Hydro established the Site C Fisheries and Aquatic Habitat Mitigation and Monitoring Technical Committee (the Committee). The role of the Committee includes a forum for technical review and input on those plans related to fish and fish habitat: FAHMP, FAHMFP, and the FPMP. Regulatory decision makers can request technical input from the Committee. The Committee has a scientific, technical advisory role and provides technical input on fish passage management, as was contemplated for a 'Technical Advisory Committee' referred to in the EIS (Volume 2, Appendix Q1).

Fish passage at the Project is grounded in adaptive management, whereby the approaches aim to reduce uncertainty through planned management actions and systematic monitoring. As such, fish passage management is expected to adapt to meet the biological objectives outlined in Sections 4.1, 5.1 and 6.1. BC Hydro may revise the FPMP based on lessons learned from implementing and monitoring fish passage management. Material revisions to the FPMP are expected to be shared with and reviewed by the Committee and Indigenous groups.

[7] Available at: https://www.sitecproject.com/document-library/environmental-management

4.0 Upstream Fish Passage

4.1 Objectives

Upstream fish passage at the Project aims to meet the requirements of EAC Condition 6 outlined in Section 2.0. In general, the intent is to achieve the following biological objectives with upstream fish passage at the Project:

1. Provide for ongoing upstream fish passage – to allow fish to fulfill portions of their lifecycles in the Site C Reservoir and its tributaries upstream of the Project – so long as it is proven to be technically feasible and biologically required.

'Biologically required' is defined using the MOE objectives and measures of maintaining population abundance, distribution, population structure and age structure (BC Government 2009, 2011). One key uncertainty, for example, relates to whether a portion of the Halfway River Bull Trout population will continue to move downstream of the Project[8]. If Halfway River Bull Trout reside in the Site C Reservoir and are able to maintain population abundance, distribution, population structure and age structure without moving downstream of the Project, there may not be a need to provide upstream fish passage for Bull Trout. Monitoring the population abundance, distribution, population structure and age structure of fish species in the Peace River and its tributaries under the FAHMFP will inform whether upstream fish passage is biologically required.

Below is a more detailed description of scenarios in which upstream fish passage may and may not be biologically required for Halfway River Bull Trout depending on the information from the FAHMFP. These two scenarios are summarized from information in the EIS (Volume 2, Appendix Q3 Single Species Population Models, Attachment B)

Scenario 1: Bull Trout from the Halfway River do not migrate downstream of the Project. Bull Trout may no longer exhibit downstream movements past the Project and instead remain in the Site C Reservoir (EIS, Volume 2, Section 12.6.3.2). In this case, upstream fish passage would not be biologically required, and upstream fish passage would not affect the population abundance, distribution, population structure and age structure of Bull Trout.

Scenario 2: A portion of the Bull Trout from the Halfway River continue to move upstream and downstream of the Project. If Bull Trout continue to make downstream movements and show motivation to move upstream past the Project, there is a biological need to provide for ongoing upstream fish passage.

Correctly characterizing the migratory response of Bull Trout (Scenario 1 vs. Scenario 2) following the conversion of river habitat to reservoir habitat will inform the need for maintaining upstream fish passage for the species. Observations to support Scenario 1 would consist of the following: Halfway River Bull Trout (population identified through genetic analyses) are no longer captured in sampling programs downstream of the Project (Sections 5, 6, 7 and 9 of the Peace River); and radio- and PIT-tagged fish do not make downstream movements past the Project or upstream movements towards the Project.

If Bull Trout continue to move downstream past the Project (as confirmed by sampling,

[8] Available at: EIS, Volume 2, Appendix Q3, Single Species Population Models, Attachment B

genetics and telemetry) and show motivation to move upstream past the Project (as confirmed through sampling and telemetry) (Scenario 2), there is biological benefit to provide for ongoing upstream fish passage.

2. Facilitate the safe and timely movement of fish upstream of the Project through trap and haul.

The 'safe' movement of fish is defined as maintaining fish health and maximizing survival during the trap and haul process. 'Timely' can be defined as ensuring that passage times are consistent with the known movement behaviour of fish species in the Peace River[9] to avoid excessive energy expenditure during upstream fish movement.

4.2 Overview

The following sections of the FPMP summarize the progress to date as well as future actions for upstream fish passage management. Summaries are provided for the main components, as follows: the assessment process, engineering design phases, facility construction, plans for facility operations, and effectiveness monitoring. In general, these components are presented in chronological order, however implementation of some components occurs concurrently.

Section 4.0 describes the purpose, rationale and adaptive approach to upstream fish passage management at the Project. In this context, Section 4.0 is a standalone plan for upstream fish passage management. The specific mechanical, biological and operational parameters and procedures required to achieve the objectives outlined in Section 4.1 is also further described in the OPP (McMillen Jacobs & Associates and BC Hydro 2020). Consistent reference is made to the OPP to direct the reader to more specific information on the mechanical and biological operation of the temporary facility. An OPP for the permanent facility is expected to be prepared in advance of operation of the permanent facility.

4.3 Options Assessment

BC Hydro undertook a structured approach to assess options for providing upstream fish passage at the Project. The approach took into account potential fish passage risks, technical and engineering feasibility, biological benefits, and capital and operating costs[10].

In 2012, BC Hydro identified and evaluated upstream fish passage options at the Project. The evaluation approach was to: (1) identify potential fish passage technologies; (2) perform suitability screening of the technologies; (3) conduct concurrent engineering and structured decision making (SDM) evaluations of the short-listed options; and (4) identify a preferred approach to fish passage management.

The alternatives assessment followed guidance from regulatory guiding documents relevant to fish passage management (e.g., Practitioner's Guide to Fish Passage for DFO Habitat Management Staff [DFO 2007] and Practitioners Guide to the Risk Management Framework for DFO Habitat Management Staff [DFO undated]). The assessment also took into account

[9] Available at: EIS, Volume 2, Appendix O, Fish and Fish Habitat Technical Data Report
[10] Available at: EIS, Volume 2, Appendix Q2, Fish Passage Alternatives Assessment, Attachment A

relevant provincial plans and policies, as well as the *Recommended Fish, Wildlife and Ecosystem Resources and Objectives for the Lower Peace River Watershed Site C Project Area* (BC Government 2011).

Four workshops in 2012 provided a forum for the fish passage alternatives assessment for the Project. Workshop participants included BC Hydro staff and consultants, representatives from DFO, FLNRO, MOE, and for the first workshop only, four fish passage experts from the United States and Canada. The workshops provided an effective means to exchange information and receive clarification from fisheries regulators regarding regulatory requirements. Information from the *Recommended Fish, Wildlife and Ecosystem Resources and Objectives for the Lower Peace River Watershed Site C Project Area* helped BC Hydro focus on more detailed information needs for the following indicator species: Rainbow Trout, Walleye, Bull Trout, Mountain Whitefish, Arctic Grayling, Goldeye and Burbot. BC Hydro asked for clarification from FLNRO and MOE on whether fish passage would help meet regional and provincial fish management objectives and the priority for fish passage information to inform the fish passage alternatives assessment (BC Government 2012). Responses from FLNRO and MOE helped guide the fish passage alternatives assessment and the preparation of the FPMP.

BC Hydro retained a panel of external fish passage experts from the United States and Canada to identify fish passage technologies proven to be effective at other hydroelectric facilities and help design a screening process to develop a short list of options to carry forward for more detailed consideration. Collectively, the expert panel concluded that upstream fish passage technologies should consist of components to collect, convey and release fish[11]. Based on these requirements, the following ten technologies were identified:

1. Baffled Chute (Denil/Steep-pass);
2. Pool and Weir Fishway;
3. Weir-Orifice Fishway;
4. Vertical Slot Fishway;
5. Pool and Chute – Hybrid Fishway;
6. Nature Type Fishway;
7. Rock Ramp Fishway;
8. Sill Type Fishway;
9. Fish Lift; and
10. Fish Lock.

During the initial screening phase, the pool and weir fishway, weir-orifice fishway and vertical slot fishway were carried forward for detailed engineering and SDM evaluations due to their ability to collect, convey and release fish and the successful implementation of these technologies at other facilities. BC Hydro then employed an SDM approach[12] to structure and compare upstream fish passage alternatives based on conservation, regulatory, sustainable use, and financial objectives for Bull Trout, Arctic Grayling, Mountain Whitefish and sucker species (Largescale Sucker, Longnose Sucker, White Sucker). Next, the SDM approach

[11] Available at: EIS, Volume 2, Appendix Q4, Fish Passage Expert Reports, Attachment C
[12] Available at: EIS, Volume 2, Appendix Q2, Fish Passage Alternatives Assessment, Attachment A

compared the following three alternatives for upstream fish passage: (1) no fish passage mitigation provided; (2) upstream trap and haul; and (3) a full height upstream fishway.

The SDM assessment highlighted that upstream trap and haul offers several advantages over a full height upstream fishway and other alternatives. Trap and haul facilitates sorting[13] and sampling of fish, allows transport of fish to target upstream locations, has a higher likelihood of passing target fish species, may pass a wider range of species (if desired), and has lower capital and operating costs. Upstream trap and haul was identified as the preferred approach for upstream fish passage management and was carried forward to the conceptual design phase.

Conceptual engineering designs were prepared for both a temporary facility that would operate during the river diversion stage of construction, and a permanent facility near the generating station that would operate once the Project is commissioned. These conceptual designs were provided in the EIS[14].

The assessment concluded that a trap and haul facility was the preferred approach to providing upstream fish passage at the Project.

4.4 Engineering Design

BC Hydro retained an engineering and design firm to advance the design of the facilities. Design of the facilities was coordinated with the design of the Project, particularly the design of the diversion outlet works, and the design of the generating station and tailrace. Design work involved initial steps to identify and compare upstream trap and haul design alternatives based on biological effectiveness, constructability, design flexibility and cost. Early design work involved extensive river hydraulic and computation fluid dynamic modelling of the future conditions in the diversion outlet channel and dam tailrace (e.g., tailwater elevation) to inform the basic design requirements of the facilities. An important consideration in upstream fish passage is the ability to attract fish into the fishway entrance. As a result, this modelling guided selection of the location and design of the fishway entrance to provide conditions to attract fish.

The engineering design progressed and developed detailed engineering drawings and technical specifications. The engineering design for the facilities has been provided as part of previous regulatory submissions[15].

4.5 Facility Construction

Construction of the temporary facility began in October 2018 and is ongoing at the time of writing for this Revision of the FPMP.

[13] The ability to sort fish and allow for the return some species downstream was an important design requirement identified for any upstream fish passage approach.
[14] Available at: EIS, Volume 2, Appendix Q5, Attachment D-1 Trap and Haul Conceptual Design
[15] Technical Memorandum No. T009 – Site C Clean Energy Project – Temporary Upstream Fish Passage Recommended Alternative Summary Status Update. Technical Memorandum No. P009 - Site C Clean Energy Project – Permanent Upstream Fish Passage Recommended Alternative Summary Status Update. Included in the Water Licence Application for the Site C Upstream Fish Passage Facilities.

4.6 Approach

4.6.1 Overview

BC Hydro is implementing a staged approach to upstream fish passage at the Project, whereby the temporary facility is scheduled to be operated during the river diversion phase of construction (2020 to 2023) on the north bank of the Peace River at the outlet of the diversion tunnels (Figure 1 and 2). Specifically, the temporary facility will be constructed inside the Stage 1 Diversion Outlet Cofferdam on the east side of the outlet of Diversion Tunnel #2. Following the closure of the diversion tunnels and reservoir filling in the fall of 2023, the permanent facility will be operated at the outlet of the generating station (Figure 1) to provide fish passage during the operation phase of the Project. Operation of the temporary facility is limited to the river diversion phase of construction, and as such, the temporary facility is scheduled to be decommissioned following the construction and commissioning of the permanent facility.

Migratory fish are naturally attracted to current (referred to as rheotaxis), and this innate behaviour leads upstream migrating fish to seek the most upstream areas of high flow. For this reason, the temporary and permanent facilities were located at the upstream terminus where flow is released. Siting the upstream fish passage facilities at these locations also permitted the space required for construction of the facilities and vehicle access during operations.

Figure 1. Location of the temporary and permanent facilities at Site C. Based on a rendering of the Project.

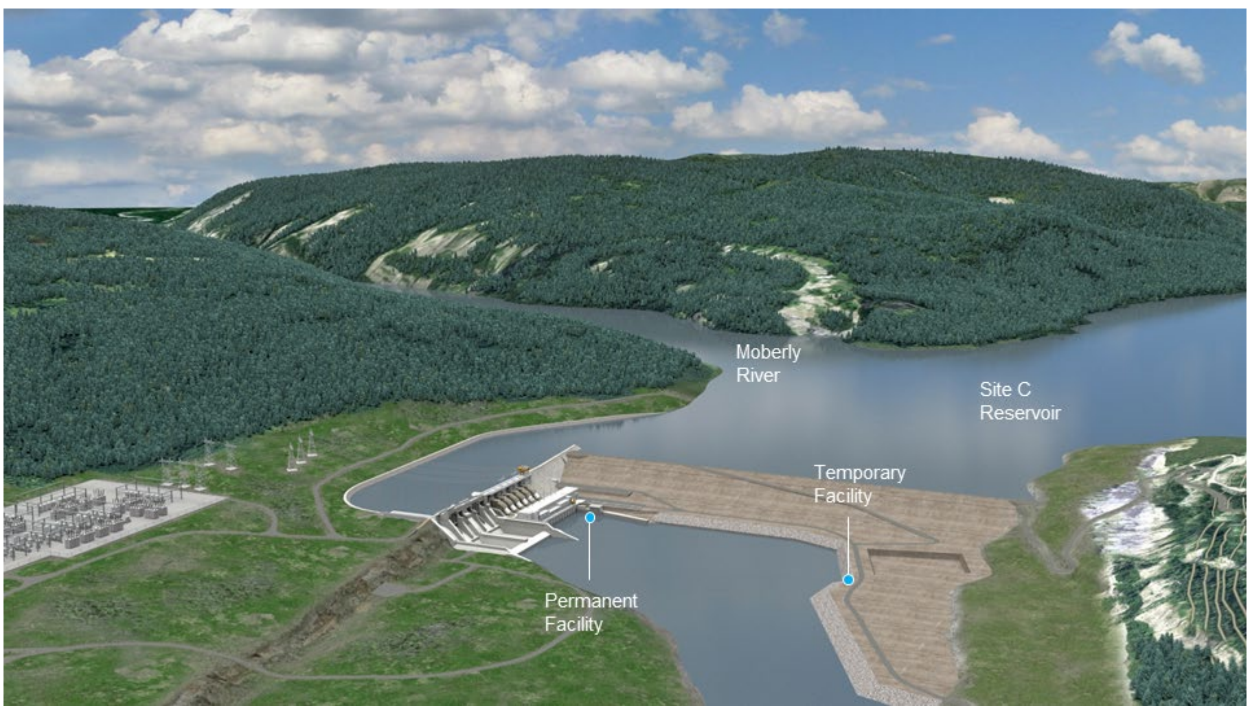
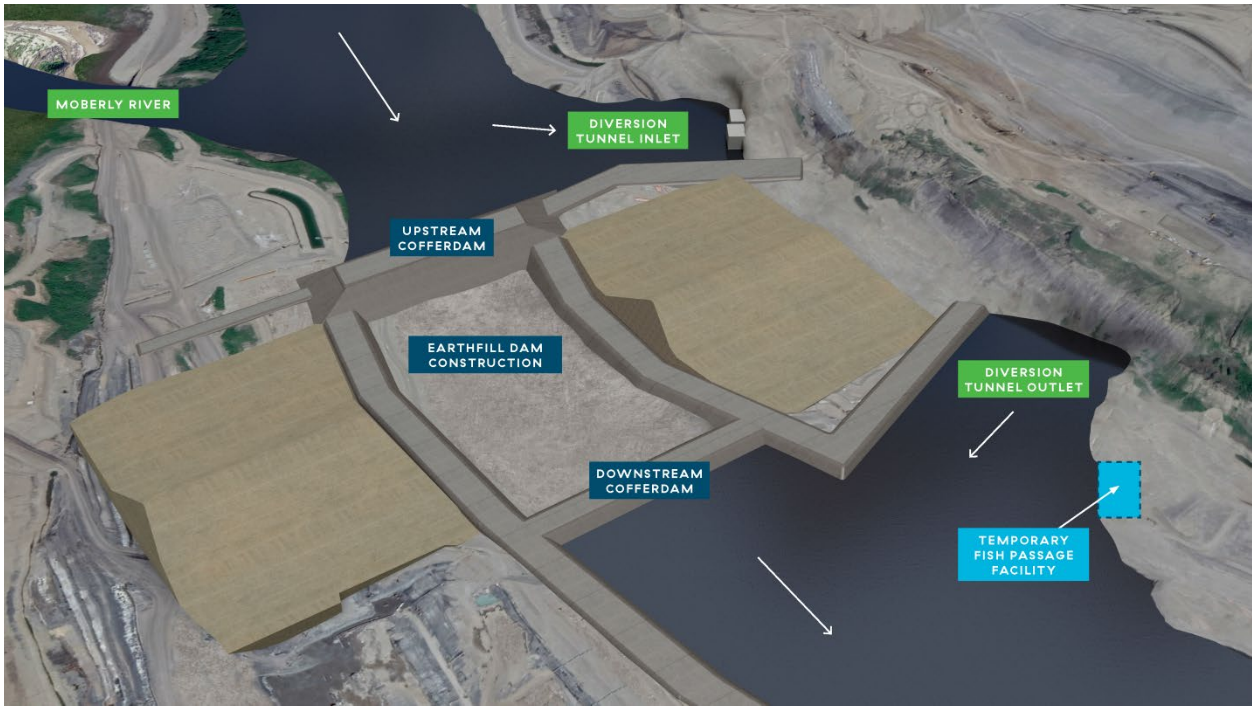


Figure 2. Location of the temporary facility at Site C. Based on a rendering of the diversion phase of construction.



Both the temporary and permanent facilities consist of the following components to collect, convey and release fish:

- Auxiliary water supply (AWS) to transport water from the diversion outlet channel (temporary facility) or dam tailrace (permanent facility) through the sorting facility and weir-orifice fishway;
- One (1) fishway entrance with two (2) entrance gates;
- Fishway entrance pool and Half Ice Harbor weir-orifice fishway with 10% grade;
    - Each pool has one weir and one orifice to facilitate passage (Figure 3);
- Pre-sort holding pool, rail-mounted mechanical fish crowder and fish lock;
- Sorting facility in an enclosed building;
- Fish transport pods that can control water temperature, permitting their use for recovery and transport purposes; and
- Vehicle access and parking.

To date, facility design and operations have been based on the number of fish expected to use the temporary and permanent facilities to ensure that the facilities have the capacity to collect, convey and release fish[16]. For example, the size of different fish species (length and weight) informed the dimensions of the pre-sort holding pool and subsequently the holding capacity (number of fish) of the pool. Each component of the weir-orifice fishway and sorting facility was designed using biological, water quality, hydraulic and hydrologic, fisheries engineering, and fish passage design criteria.

4.6.2 Trap and Haul Process

The intent is to operate the facilities daily from April 1 to October 31 due to the timing of fish

[16] EIS, Volume 2, Appendix O, Fish and Fish Habitat Technical Data Report

movements in the Peace River[3] and the challenges associated with operating facilities during the winter (ice and cold temperatures freezing mechanical components). Revision 0 of the FPMP predicted that up to 220 Bull Trout, 1,000 Arctic Grayling, 3,000 Mountain Whitefish, and 11,000 non-target species will require sorting and transport each year from April 1 to October 31. However, depending on the actual number of fish requiring sorting and transport and the timing of their movements, BC Hydro may need to revise the operational procedures and schedule to meet the objectives outlined in Section 4.1.

Upstream fish passage will consist of the following general steps (Figure 3):

1. Fish approach and enter the weir-orifice fishway through the fishway entrance;
2. Fish pass the fishway through the use of weirs and orifices;
3. Fish pass through a one-way vee-trap into a pre-sort holding pool;
4. Operators crowd fish from the pre-sort holding pool into a fish lock using a rail-mounted mechanical fish crowder;
5. Operators close a sluice gate and pump water into the lock to raise the water level;
6. Fish are raised to the elevation of the sorting facility through the use of a perforated metal (brail) floor in the lock;
7. Fish enter an overflow chute and move into an anaesthetic tank;
8. Fish are anaesthetized, sampled, tagged and sorted into transport pods; and
9. Fish are transported and released into the Peace River and its tributaries.

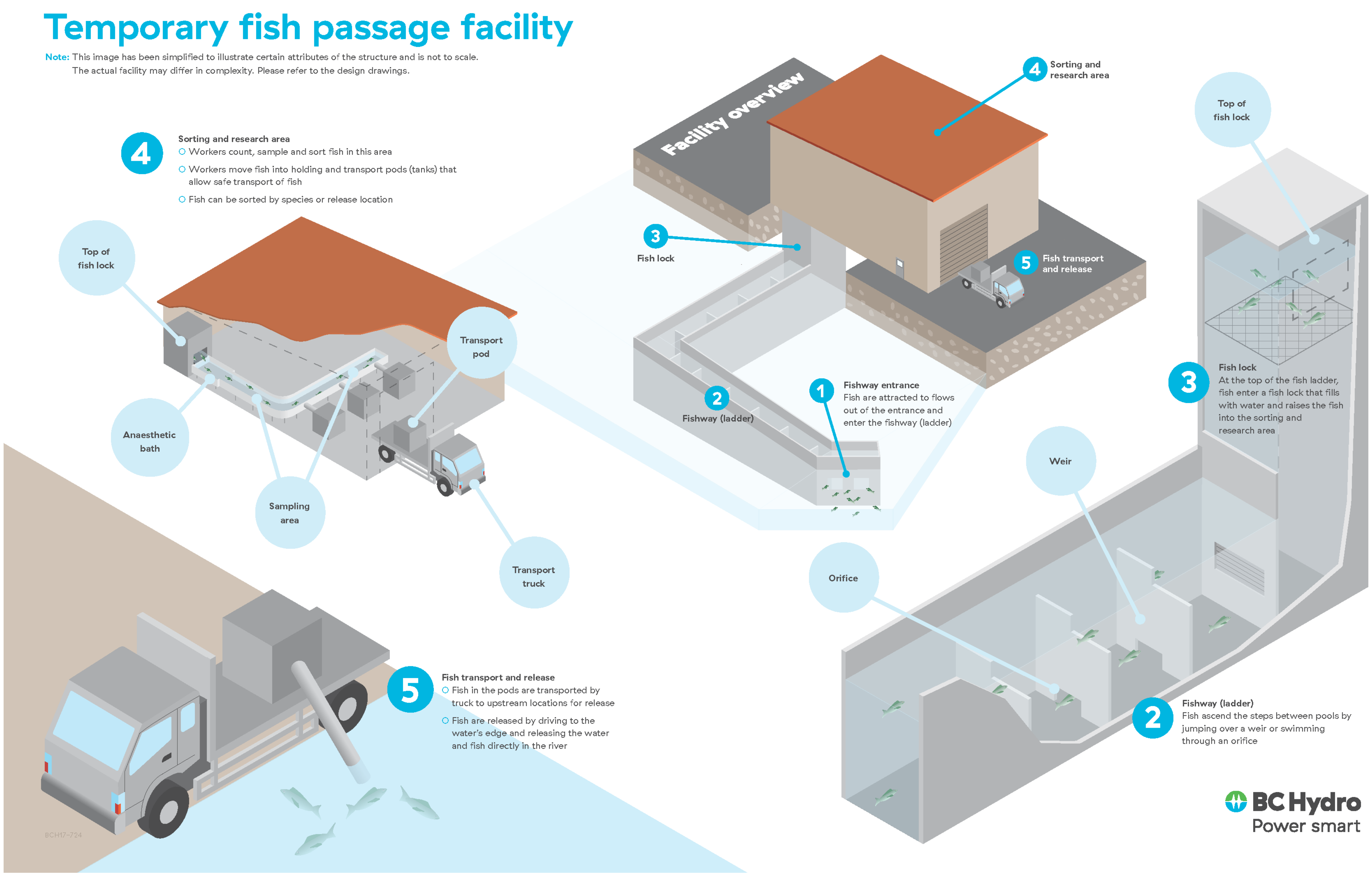
Passage is volitional until fish are crowded into the lock (Step 4). Section 3.0 of the OPP provides a detailed description of the steps listed above (McMillen Jacobs & Associates and BC Hydro 2020).

Based on the operation of trap and haul facilities elsewhere, BC Hydro anticipates that incidental mortality will not exceed 5% of the total number of fish captured by the temporary and permanent facilities on an annual basis. Incidental mortality will be monitored by the facility operator and reported to BC Hydro.

Fishway attraction flows – the flows designed to attract fish into the fishway – will be provided by the AWS (up to 10 $m^3 s^{-1}$) flowing through one or both entrance gates. Supplemental attraction may be provided by a high velocity jet (HVJ; up to 1.5 $m^3 s^{-1}$) located directly adjacent to the fishway entrance to attract fish from the Peace River (tens of meters away) to the area surrounding the fishway entrance (< 10 meters). Based on hydraulic modelling and lessons learned from hydroelectric facilities elsewhere, fish are expected to be naturally attracted to the fishway entrance through the operation of fishway attraction flows.

One key uncertainty in the operation of the temporary and permanent facilities involves the magnitude of attraction flows and HVJ required to facilitate passage. To address this, the intent is to experimentally manipulate the attraction flows and HVJ and monitor the flows that maximize passage. Section 3.3.1 of the OPP outlines the rationale and schedule to experimentally manipulate the attraction flows and HVJ in the first year of operating the temporary facility (McMillen Jacobs & Associates and BC Hydro 2020).

Figure 3. Simplified illustration of the temporary facility and the trap and haul process. Note that the permanent facility operates in the same manner as the temporary facility.



4.6.3 Sorting, Sampling and Tagging

Fish will be sorted, sampled and tagged in the sorting facility and will be handled in a manner consistent with the sampling and tagging conducted under the FAHMFP. Individual fish will be transferred from the anaesthetic tank onto a sorting table where operators will conduct, at minimum, base sampling to understand the basic biological characteristics of the fish. Operators will first conduct base sampling, which includes information such as species, length and weight, and presence of existing tags. Additional sampling may occur, depending on the information requirements for effectiveness monitoring, including: passive integrated transponder (PIT) tagging of certain species, and biological sampling (i.e., stable isotope, methylmercury, genetics, microchemistry) to support the FAHMFP and the Site C Methylmercury Monitoring Plan. Section 3.0 of the OPP provides a detailed account of the sorting, sampling and tagging procedures (McMillen Jacobs & Associates and BC Hydro 2020).

A sample of indicator fish species (Arctic Grayling, Bull Trout, Burbot, Mountain Whitefish and Rainbow Trout) that enter the sorting facility may be radio tagged to assess fishway effectiveness. Radio tags will be compatible with equipment deployed throughout the Peace Region as part of the Site C Fish Movement Assessment. Radio telemetry equipment may also be deployed in the weir-orifice fishway by the contractor tasked with monitoring the biological effectiveness of the facility (described in Section 4.7.1).

Operation of the temporary and permanent facilities may be adapted through time based on the lessons learned from effectiveness monitoring and operations. Following Clause p) of CWL #133987 and 133986, BC Hydro will revise the OPP each year to reflect the experience and knowledge gained from the operation of the temporary facility.

4.6.4 Transport and Release

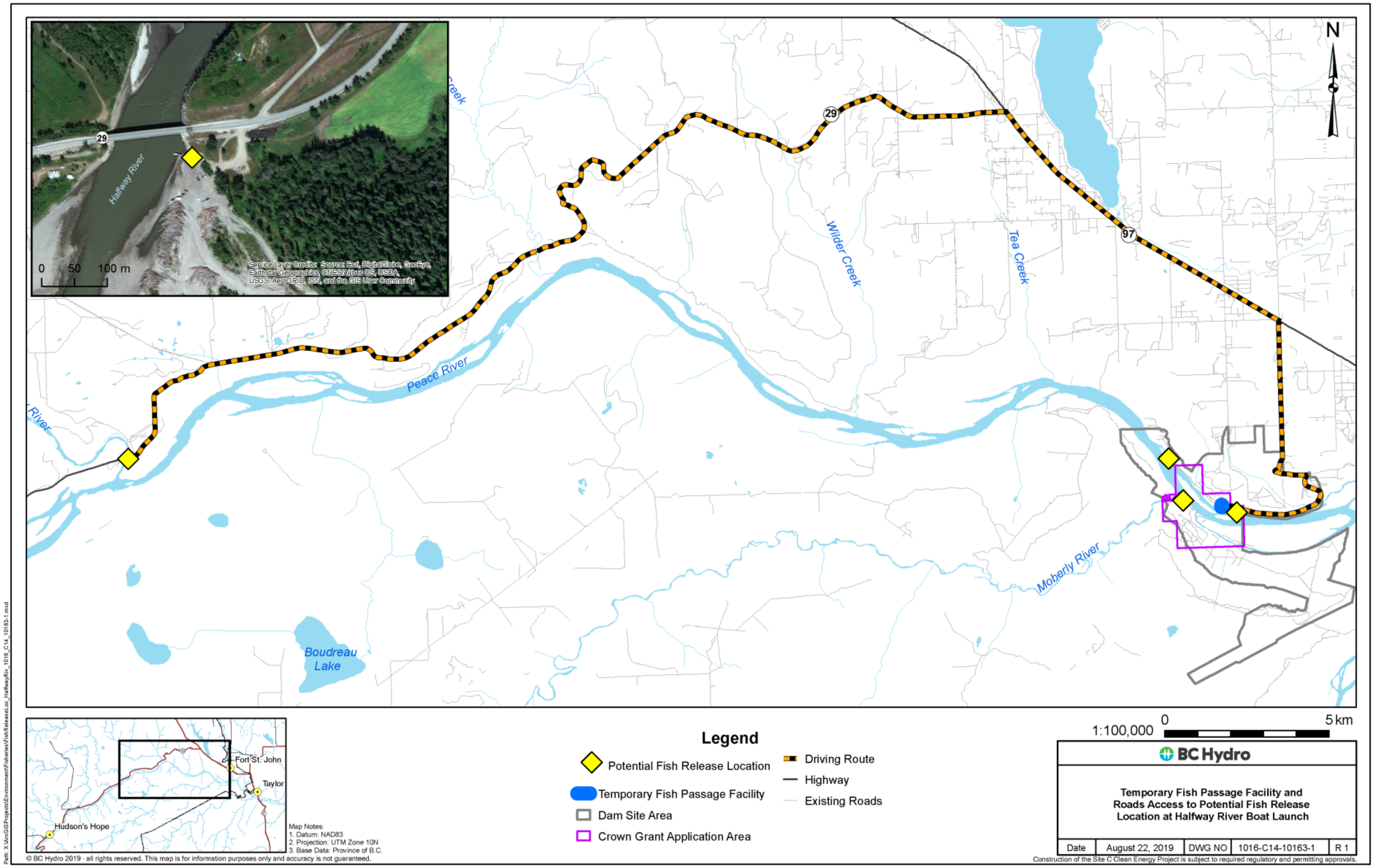
Fish captured in the temporary facility are planned to be transported to and released at the following locations (Figure 4):

1. Halfway River near the confluence of the Peace River (Bull Trout only);
2. Moberly River near the confluence of the Peace River (Arctic Grayling only);
3. Downstream of the temporary facility in the Peace River (Walleye and Goldeye); and
4. Upstream of the temporary facility in the Peace River (all other fish species).

Species-specific release locations are based on review of the ecology of the species, and discussions with regulatory agencies and Indigenous groups.

Release locations are expected to be updated for the operations phase of the Project based on lessons learned from fish released from the temporary facility and access following filling of the Site C Reservoir.

Figure 4. Proposed release locations for fish captured from the temporary facility during the river diversion phase of construction.



4.7 Effectiveness Monitoring

Section 4.7 summarizes the effectiveness monitoring associated with upstream fish passage. The FAHMFP provides a full description of these monitoring activities.

4.7.1 Fishway Effectiveness

Mon-13 – the Site C Fishway Effectiveness Monitoring Program[17] – is one component of the FAHMFP that is focused on monitoring the biological effectiveness of the temporary and permanent facilities to reduce key uncertainties and inform operations. Key uncertainties include the effectiveness of attracting fish from the Peace River into the facilities and the attraction flows required to do so. Fishways are ideal model systems for testing management options in the field (Memmott et al. 2010) through large-scale experiments (Walters and Holling 1990), as operators can readily control passage conditions and monitor the biological response (Burnett et al. 2017). The intent is to test a range of operations (i.e., magnitude, timing and duration of attraction flows and HVJ) to help identify the conditions that increase the approach, entry and passage of fish into the facilities.

Mon-13 will focus on monitoring Arctic Grayling, Bull Trout, Burbot, Mountain Whitefish and Rainbow Trout, as these species may continue upstream migrations in the Peace River, are identified as indicator species in provincial management objectives (BC Government 2009, 2011), and were identified during the environmental assessment process as important for Indigenous groups and recreational anglers.

Mon-13 aims to answer the following fisheries management questions:

1. Does the temporary fishway provide effective upstream passage for migrating Arctic Grayling, Bull Trout, Burbot, Mountain Whitefish and Rainbow Trout that are attempting to migrate upstream during the construction of the Project?
2. Does the permanent fishway provide effective upstream passage for migrating Arctic Grayling, Bull Trout, Burbot, Mountain Whitefish and Rainbow Trout that are attempting to migrate upstream during the operation of the Project?

Mon-13 will test the following hypotheses for the temporary and permanent facilities and for each species:

H_1: Arctic Grayling, Bull Trout, Burbot, Mountain Whitefish and Rainbow Trout locate and use the fishway.

H_2: Fishway attraction and passage efficiency are as predicted in the EIS (Volume 2, Appendix Q3[18]).

The monitoring schedule is described in the FAHMFP.

Upstream fish passage at the Project will require fish to approach, enter and pass the weir-orifice fishway. Each of these states – approach, entry and passage – is a discrete task that the fish undertake within a defined spatial area (Figures 5 and 6). Success or failure to advance through any one of these states may occur for a number of reasons. Probability of successful

[17] Appendix N, Fisheries and Aquatic Habitat Monitoring and Follow-Up Program
[18] Attraction efficiency of 80% and passage efficiency of 76%

fish passage is the product of the probability of passing through each of the three states (Castro-Santos and Haro 2010). Failure to differentiate the three states may result in falsely attributing passage success or failure to only one state (Silva et al. 2018). The intent is to monitor each state independently to attribute passage success or failure to its appropriate state and spatial area.

Monitoring each state will require the use of different technologies to address the fisheries management questions. Technologies may include: acoustic and/or radio transmitters, PIT tags, and if feasible, electronic fish counters. Pairing technologies is a cost-effective approach to evaluate fish passage that can: (1) help overcome some of the individual limitations of each technology; (2) provide complementary data (e.g., detection efficiency of technologies) and cross-validation; and (3) help determine if trends observed in individual animals scale up to the population level (Braun et al. 2016).

Approach and entry states will require the use of acoustic and/or radio transmitters to monitor the movement of tagged fish in the outlet of the diversion tunnels (temporary facility) and dam tailrace (permanent facility) in response to changes in operation of attraction flows and the HVJ. Acoustic and/or radio transmitters will be implanted into sexually mature fish to increase the likelihood of monitoring the movements of fish motivated to migrate upstream of the Project. Entry and passage states will require the use of acoustic, radio and/or PIT tags, electronic fish counters (if feasible), and collection of fish in the sorting facility.

Time-to-event (TTE) analyses will be used to assess the biological effectiveness of the temporary and permanent facilities. TTE analyses consider the instantaneous probability of passage for an individual tagged fish at a given location, which varies over time as the fish is exposed to different environmental conditions. TTE analyses therefore retain a high temporal resolution of positional data, while accounting for potential effects of time-varying covariates, variability in individual motivation, and entry into multiple states (approach, entry, passage) (Castro-Santos and Perry 2012). With this approach, a single tagged fish can generate multiple fish passage ‘events’ through transitioning into different states and experiencing variable environmental conditions. Consequently, TTE analyses will provide a robust and defensible approach to monitor the biological effectiveness of the temporary and permanent facilities.

BC Hydro understands that sample size is an important consideration in monitoring the biological effectiveness of a fish passage facility and incorporated this into the study design for Mon-13 and other components of the FAHMFP. For example, in 2019, BC Hydro radio tagged 329 fish (Bull Trout, Arctic Grayling, Rainbow Trout, Walleye and Burbot) as part of the Site C Fish Movement Assessment and intends to tag a similar number of fish (Bull Trout, Arctic Grayling, Rainbow Trout and Burbot) in 2020. Radio tagged fish will be monitored through the fixed radio telemetry array currently deployed in the Peace River and its tributaries, as well as additional stations that will be installed in and around the temporary facility as part of Mon-13.

From 2005 to 2019, 94,597 fish were PIT tagged in the Peace River and its tributaries under the FAHMFP. BC Hydro expects that a portion of these PIT tagged fish will generate data on the biological effectiveness of the temporary and permanent facilities. Monitoring programs will continue to PIT tag fish under the FAHMFP and the intent is to PIT tag fish captured in the sorting facility (Section 3.3.2 of the OPP; McMillen Jacobs & Associates and BC Hydro 2020).

Similar to radio telemetry, BC Hydro has integrated PIT telemetry throughout the FAHMFP. Fish can be captured, tagged and recaptured by monitoring programs tasked with sampling fish in the Peace River and its tributaries, and detected by arrays deployed in tributaries of the Halfway River and the temporary facility.

Considering the number of radio- and PIT-tagged fish currently in the Peace River and its tributaries, as well as the plan to continue to tag fish under the FAHMFP and in the sorting facility, there will be a sufficient number of tagged fish in the Peace River to monitor the biological effectiveness of the temporary and permanent facilities.

Figure 5. Monitoring fish passage at the temporary facility will involve assessments of the approach (1), entry (2) and passage (3) of the fish into the weir-orifice fishway. Information will be collected during sorting (4) and the fish will be monitored during transport (5) and following release.

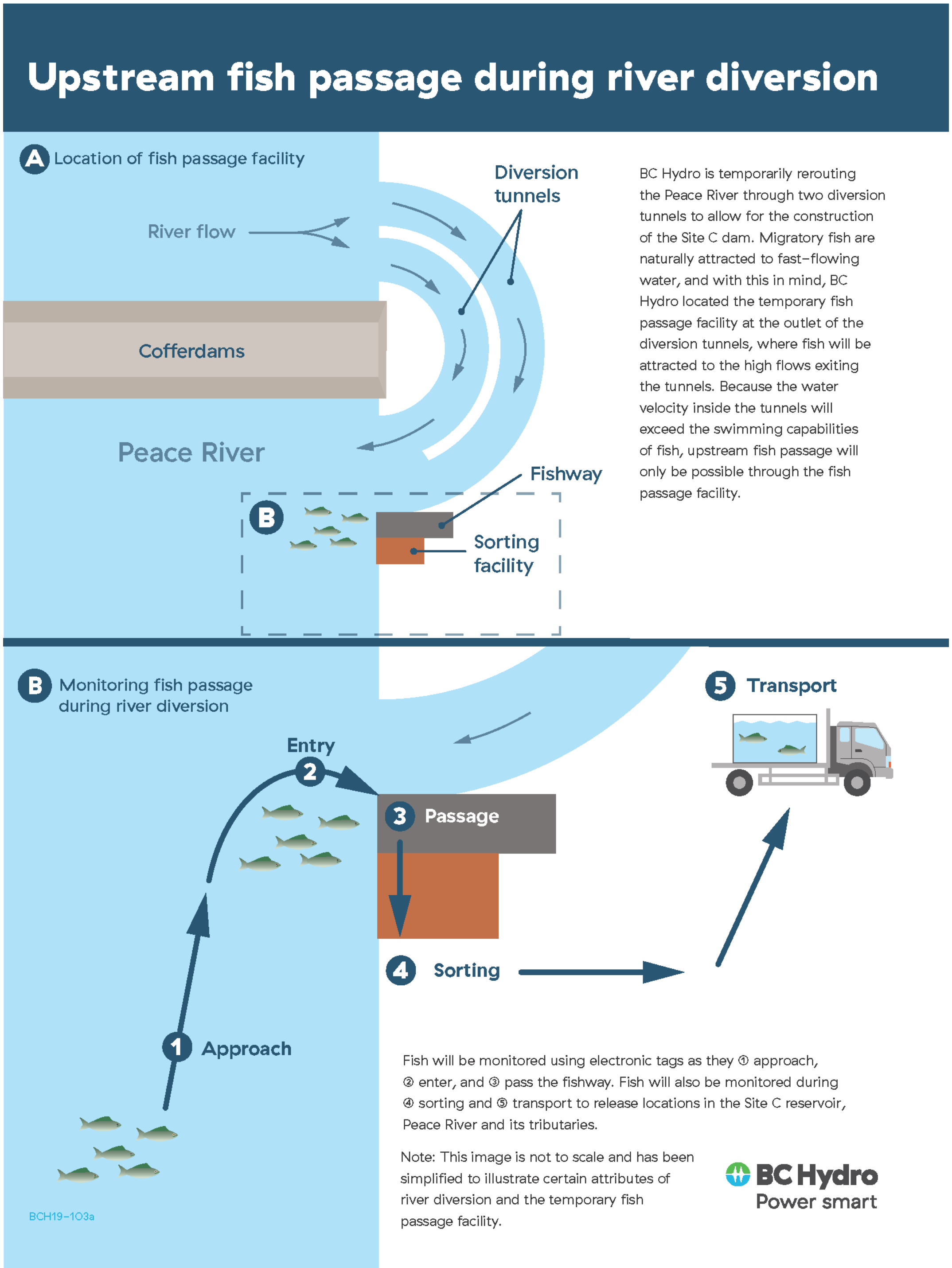
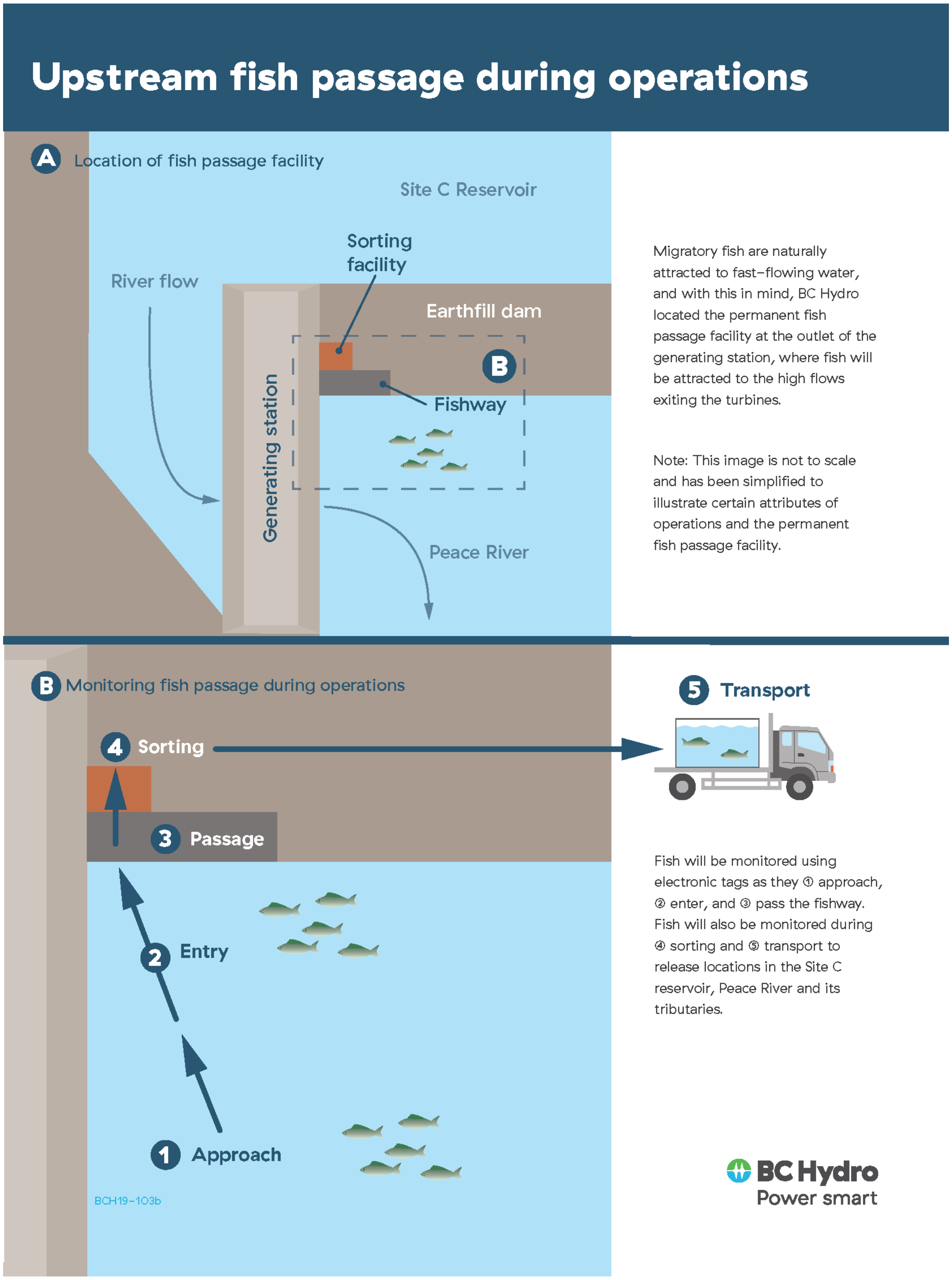


Figure 6. Monitoring fish passage at the permanent facility will involve assessments of the approach (1), entry (2) and passage (3) of the fish into the weir-orifice fishway. Information will be collected during sorting (4) and the fish will be monitored during transport (5) and following release.



4.7.2 Upstream Release Locations

Mon-14 – the Site C Trap and Haul Fish Release Location Monitoring Program[19] – focuses on monitoring the effectiveness of different fish release locations in the Site C Reservoir and its tributaries by tracking the movements of fish following transport and release from the temporary and permanent facilities. Figure 4 depicts the proposed release locations. Release locations used during river diversion may become inundated with the creation of Site C Reservoir (e.g., boat launch at the Halfway River), and as such, alternate release locations may be selected and used during the operations phase of the Project.

Selection of release locations for each species takes into account a number of considerations, including the safety of the operators, transport distance and duration (Portz et al. 2006), truck access using existing infrastructure, potential for predation following release, water quality and other habitat characteristics, and the ability of released fish to continue their upstream migrations (as described in the EIS, Volume 2, Appendix Q1). Release locations close to the Project will result in short transport times, which would likely reduce fish stress and the effort to transport fish. However, release locations too close to the Project (i.e., near the approach channel) may result in fall back. Fall back is defined as the behaviour of passing downstream through a dam shortly after upstream passage or transport, prior to reaching spawning or rearing areas (Reischel and Bjornn 2003, Schmetterling 2003). For Mon-14, fall back can be defined as passing downstream of the Project after release upstream. Fish that are entrained through the dam months after transport and release will not be classified as fall back. Fish release locations too far upstream from the Project may result in fish being inadvertently released upstream of their natal spawning tributary (e.g., releasing an Arctic Grayling destined for the Moberly River at a location closer to the Halfway River). Despite there being trade-offs among the considerations listed above, BC Hydro can adjust the release locations based on the information collected from the operators of the temporary and permanent facilities and Mon-14.

Mon-14 aims to answer the following fisheries management question:

> What are effective locations within Site C Reservoir and tributaries to release Arctic Grayling, Bull Trout, Burbot, Mountain Whitefish, and Rainbow Trout captured at the Site C Trap and Haul Facility?

Mon-14 will test the following hypotheses for the temporary and permanent facilities and for each species:

> H_1: Arctic Grayling, Bull Trout, Burbot, Mountain Whitefish, and Rainbow Trout migrants captured at the Site C Trap and Haul Facility and released into Site C Reservoir will continue their migration with no fall back through the dam or mortality (within 48 hours) after release.

> H_2: There will be no differences in the behavior or survival among Arctic Grayling, Bull Trout, Burbot, Mountain Whitefish, and Rainbow Trout released at different locations within Site C Reservoir or tributaries.

[19] Appendix O, Fisheries and Aquatic Habitat Monitoring and Follow-Up Program

The monitoring schedule is described in the FAHMFP.

The intent is to test the management hypotheses by spatially (different locations) and temporally (different times) stratifying the release of fish in the Site C Reservoir and its tributaries. Release locations and times associated with maximum survival, minimum fall back, and success of fish reaching spawning grounds will be selected for use during the operations phase of the Project.

4.8 Contingent Fish Capture, Upstream Transport and Release

Contingent mitigation measures for upstream fish passage could be implemented if required under certain scenarios that are judged to be creating a biological risk to target fish species and life stages. Potential scenarios over the short term would include technical issues during initial operation of the temporary facility and during the early stage of river diversion. Potential scenarios over the longer term could include the fishway effectiveness that is tracking lower than expected (e.g., fish are attempting to move upstream but are not attracted to the fishway entrance at the predicted rate).

BC Hydro reviewed alternative approaches to help meet the objectives (described in Section 4.1), and the most technically feasible alternative option to move fish upstream of the Project in a safe and timely manner is through capture in the Peace River downstream of the Project and transport and release upstream. The concept for this contingent fish capture would capture fish in the Peace River within a few kilometers of the dam site, and sample and transport upstream of the Project those fish species and life stages targeted for upstream fish passage. Sampling and transport procedures would be similar to those at the fish passage facilities (methods in the OPP; McMillen Jacobs & Associates and BC Hydro 2020). Fish species and life stages not targeted for upstream passage would be released at the capture location in the Peace River. Boat electrofishing is expected to be the most effective capture methods, using methods similar to those under the fish monitoring program (e.g., Golder and Gazey 2018). Sampling would be repeated at a frequency (estimated to be approximately weekly) that would allow for capture of target fish species and life stages to support their movements, while limiting the recapture of other fish species and life stages.

5.0 Downstream Fish Passage

5.1 Objectives

For fish that may pass downstream through the Project (commonly termed ‘entrainment’ of fish through the facility), BC Hydro is committed to meeting the requirements of the EAC conditions outlined in Section 2.1 by (1) reducing potential injury and mortality of fish that are entrained downstream of the Project, and (2) monitoring the potential effects of entrainment on the fish community.

5.2 Background

Fish entrainment occurs when a fish is drawn into a water intake and cannot escape (DFO 2007). Entrainment at hydroelectric facilities refers to any downstream movement of fish through the flow release structures of a dam (via spillways or low level outlets) or a generating station (via the turbines). Entrainment can provide for downstream fish passage with implications to fish populations upstream and downstream of a hydroelectric facility (reviewed in Harrison et al. 2019).

Similar to upstream fish passage, BC Hydro undertook a structured approach to assess options for providing downstream fish passage at the Project[20]. The approach identified and evaluated downstream fish passage options at the Project based on technical feasibility, biological benefits and capital and operating costs. The approach was to: (1) identify potential fish passage technologies; (2) perform suitability screening of the technologies; (3) conduct concurrent engineering and SDM evaluations of the short-listed options; and (4) identify a preferred approach to fish passage management.

Downstream fish passage options were reviewed in detail during the suitability screening phase of the assessment[21]. The expert panel concluded that there were few technologies that could safely collect or exclude fish from passing through the generating station. However, the following technologies were identified as being effective at collecting or excluding fish at other hydroelectric facilities around the world:

1. Bar Racks;
2. Exclusionary Nets;
3. Low Velocity Screens;
4. Penstock (Eicher) Screens;
5. High Velocity Screens Modular Inclined Screens;
6. Turbine Intake Bar Screens; and
7. Turbine Intake Traveling Screens.

During the initial screening phase, the expert panel identified that bar racks – the use of closely spaced vertical bars to exclude all but very small fish from turbine intakes – was the only technically feasible option to mitigate downstream fish passage at the Project. Bar racks were carried forward for detailed engineering and SDM evaluations.

Engineering feasibility review of the potential use of bar racks for downstream passage concluded that there are substantial technical limitations[22]:

- Technical challenges to meet the hydraulic criteria recommended to provide good bar rack performance;
- No existing examples of successfully implementing a bar rack of this magnitude – the largest installed angled bar rack is at a facility with a peak generating capacity of approximately 38 MW;
- Head loss across the bar rack would require significant supporting structures and result in lost power generation; and

[20] Available at: EIS, Volume 2, Appendix Q2, Fish Passage Alternatives Assessment, Attachment A
[21] Available at: EIS, Volume 2, Appendix Q4 Fish Passage Management Plan, Attachment C-2 Assessment of Downstream Fish Exclusion and Passage Technology
[22] EIS, Volume 2, Appendix Q5 Fish Passage Management Plan, Attachment D-1 Engineering Feasibility Of Angled Bar Racks for Downstream Fish Passage

- Debris is likely to accumulate on the bar rack, thereby increasing velocities and head differential across the bar rack and increasing the risk of fish impingement and injury.

SDM was then used to structure and compare downstream fish passage alternatives based on conservation, regulatory, sustainable use, and financial objectives. The SDM approach compared the following three alternatives for downstream fish passage: (1) passage through turbines; (2) bar racks in the approach channel to collect fish > 250 mm fork length and release them either upstream or downstream of the Project; and (3) collection of juvenile Arctic Grayling in the Moberly River and transport them downstream of the Project.

The SDM assessment highlighted that the conditions at the Project preclude the use of technologies to either prevent downstream passage via entrainment (bar racks), or to pass fish downstream through a means other than the turbines or spillways. Consequently, the intent is to address downstream fish passage through a suite of integrated design features to maximize fish survival. Sections 5.3.1, 5.3.2 and 5.3.3 outline the engineering design considerations that aim to maximize fish survival during the river channelization, river diversion and operations phases of the Project.

5.3 Approach

5.3.1 River Channelization

Conditions for downstream fish passage in the channelized section of the Peace River will be similar to natural river conditions[23]. River channelization, scheduled to occur from 2016 to 2020, effectively restricts the flow of the river to its main channel; the physical characteristics of the channel remain natural and unaltered during this phase of construction.

5.3.2 River Diversion

Starting in September 2020, the Peace River is scheduled to be diverted through two, 11-meter wide tunnels on the north bank to facilitate construction of the earthfill dam. The potential risk of descaling, pressure change, shear and strike on fish is low for the expected flows and tunnel design and configuration[21].

BC Hydro incorporated the following design features into the construction and operation of the diversion tunnels:

- Use large diameter diversion tunnels and associated hydraulics that provide low risk of fish mortality;
- Smooth and gradual transitions from the round tunnels to the square exits;
- Tunnel linings with a smooth concrete surface finish; and
- Reduce obstructions (e.g., boulders) in the outlet of the diversion tunnels.

5.3.3 Site C Operations

[23] EIS, Volume 2, Appendix Q4 Fish Passage Management Plan, Attachment C-4 Fish Mortality During River Diversion

During typical operations, water from the Site C Reservoir will flow through the approach channel, penstocks and turbines, exiting into the tailrace. To minimize the potential risk of descaling, pressure change, shear and strike on the fish, the following design features were integrated into the construction and operation of the dam and generating station:

- Use large, slow rotating Francis turbines to increase entrainment survival (see below);
- Smooth and gradual transitions along the approach channel, penstock entrances and tailrace exit structures;
- Design the orientation and size of all openings and exits to reduce hydraulic turbulence and subsequent fish injury;
- Ensure smooth surface finishing on the linings of the spillways; and
- Reduce obstructions (e.g., boulders) in the spillway and tailrace areas.

Fish entrainment is expected to occur primarily through the generating station because spilling is likely to be infrequent[24]. Entrainment rates for all species present in the Site C Local Assessment Area (LAA) were calculated using a heuristic model of entrainment risk[25]. Entrainment rate represents the proportion of the population that is entrained per year. The heuristic model was based on the Entrainment Risk Screening and Evaluation Methodology (BC Hydro 2006), however the model expanded on this methodology to provide quantitative estimates of entrainment rates measured as the proportion of the population entrained per year. The model is based on species-specific information of fish distribution, habitat preference, movement rates, response to velocity fields, swimming capability, the configuration and operation of the Project, and information on entrainment rates from other hydroelectric facilities. Annual entrainment rates estimated by the model are low (< 10% of the population) for all species except Bull Trout, Kokanee, Lake Whitefish, and Lake Trout[25]; these species are predicted to have higher entrainment rates due to their preference for offshore pelagic habitat.

Fish moving downstream will pass through the Francis turbines with a fish size-dependent survival rate calculated to be greater than 90% for small fish (100 mm fork length) and greater than 60% for the largest fish (750 mm fork length) (Table 1).

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[24] EIS, Volume 2, Section 11.4
[25] EIS, Volume 2, Appendix Q2

Table 1. Estimated survival rate of fish entrained at Site C[26]. Survival rate estimates are based on operating the turbines at their maximum flow of 423 $m^3 s^{-1}$.

Fork length (mm)	Survival rate estimates (+/- Range)	
	Salmonids	Non-Salmonids
100	92.1% (±3.9%)	93.9% (±3.7%)
250	81.9% (±9.1%)	85.5% (±8.7%)
500	68.9% (±15.5%)	73.8% (±15.7%)
750	61.1% (±19.5%)	64.9% (±21.1%)

Survival rates of entrained fish were estimated using a predictive equation developed under the U.S. Department of Energy's Advanced Hydro Turbine System Program (Franke et al. 1997). Survival rates were calculated using turbine characteristics, flow, head, mechanical efficiency, and fish length to estimate the probability that a fish of a given size will come near to, or be in contact with, a structural element as it passes through a turbine.

5.4 Effectiveness Monitoring

Section 5.4 summarizes the effectiveness monitoring associated with downstream fish passage. The FAHMFP provides a full description of these monitoring activities.

Mon-10 – the Site C Fish Entrainment Monitoring Program[27] – focuses on monitoring the entrainment rates and survival rates of entrained fish during the operation of the Project. Changing river habitat to reservoir habitat upstream of the Project may result in changes to fish distribution and relative abundance based on varying fish life history requirements. Mon-10 will monitor entrainment of this newly established fish community.

Entrainment monitoring is scheduled to occur during the operation of the Project to confirm the effectiveness of mitigation measures aimed at reducing entrainment effects, as described in Section 5.3.3, and to validate EIS predictions regarding survival and entrainment rates. Information collected by Mon-10 will be used to inform management decisions, particularly if entrainment rates or mortality rates of entrained fish are greater than predicted in the EIS.

Monitoring will target the following species:

Arctic Grayling
The Arctic Grayling in the Peace River primarily use the Moberly River for spawning, migration, and rearing. This species is a conservation priority in the LAA and is vulnerable to a decline in

[26] EIS, Vol 2 App Q4 Fish Passage Management Plan, Attachment C-3
[27] Appendix K, Fisheries and Aquatic Habitat Monitoring and Follow-Up Program

abundance.

Bull Trout

Bull Trout are represented in the LAA by a population that uses the Peace River for adult feeding and the Halfway River for spawning and early development. Bull Trout are piscivores that are expected to switch their forage from benthic, riverine prey (e.g., Mountain Whitefish) to pelagic fish species that are expected in the Site C Reservoir (e.g., Kokanee). Bull Trout's pursuit of prey in pelagic habitat exposes them to entrainment risk.

Kokanee

The EIS predicts that Kokanee will be a major component of the pelagic fish community in the Site C Reservoir[28]. Understanding entrainment trends for Kokanee is important as it can affect their productivity and age-structure. Kokanee use of pelagic habitat puts them at risk of entrainment.

Mon-10 aims to answer the following fisheries management questions:

1. What are the rates of entrainment for Arctic Grayling, Bull Trout, and Kokanee during the operation of the Project?
2. What are the rates of survival for Arctic Grayling, Bull Trout, and Kokanee that are entrained through the Project?

Mon-10 will test the following hypotheses:

H_1: Entrainment rates of Arctic Grayling, Bull Trout, and Kokanee through the Project will be similar to those predicted in the EIS.

H_2: Survival rates of Arctic Grayling, Bull Trout, and Kokanee that are entrained through the Project will be similar to those predicted in the EIS.

The monitoring schedule is described in the FAHMFP.

5.4.1 Monitoring Entrainment Rates

Entrainment rates will be estimated by tagging and releasing fish upstream of the Project and estimating the proportion of fish that are detected downstream of the Project. Experience from other hydroelectric systems has shown that in addition to this general study design, information on the presence of tagged fish in the forebay (from tracking tagged fish) provides supporting information for both the analyses and understanding entrainment risk. Monitoring entrainment rates has the following components:

1. Forebay Use Estimate: This component will quantify time spent by tagged fish in the forebay and in areas upstream of the forebay to calculate the probability of each of the target species being present in the forebay. Data will be collected from the Site C Fish Movement Assessment from radio tags deployed as part of other components of the FAHMFP.
2. Forebay Entrainment Estimate: This component will determine the likelihood of entrainment for fish in the forebay. Data will be collected by the Site C Fish Movement

[28] EIS, Volume 2, Section 12.4.4

Assessment and fish captured and tagged via angling and/or boat electroshocking in the Site C Reservoir.

5.4.2 Monitoring Survival Rates of Entrained Fish

Mortality associated with turbine passage is planned to be assessed using a mark-recapture design that involves tailrace netting of fish tagged with balloon tags. With this method, a balloon tag is attached to a fish, which is then introduced into the turbine intake and recovered in the tailrace. The balloon tag inflates after a given amount of time, causing the fish to float to the surface where it can be recaptured downstream of the Project and assessed for health and survival (OTA 1995). Use of balloon tags aids in the recovery of tagged fish compared to standard mark-recapture studies. Fish will be balloon-tagged as part of this assessment. Due to the conservation concerns for Bull Trout and Arctic Grayling in the Peace River, the assessment is expected to balloon tag other species, such as adult Rainbow Trout, Mountain Whitefish, Lake Whitefish, Lake Trout, or Kokanee, with the results from these species being extrapolated to target species.

6.0 Small Fish Translocation

6.1 Objectives

The FPMP has the following objectives: (1) reduce uncertainty concerning the potential effects of the Project on gene flow among populations of small-fish species upstream and downstream of the Project, and (2) if Project effects on gene flow are shown to be biologically important, mitigate for these effects if it is technically and economically feasible.

6.2 Background

The FPMP's approach to upstream fish passage (Section 4.0) targets large-bodied fish species (> 200 mm fork length at maturity) that undertake extensive migrations and movements. Small-fish species (< 200 mm fork length at maturity), such as shiner and dace species, do not undertake extensive migrations or movements. Ongoing upstream and downstream passage is not required to meet population abundance objectives for small-fish species[29]. Studies in other locations on the genetic effects of manmade barriers on fish populations have shown small-fish species were the least influenced (reviewed in Ruzich et al. 2019).

It is uncertain whether small-fish species residing in different locations have genetic differentiation, and whether small-fish species undertake movements that would provide for gene flow among different locations. Some movements may occur between upstream and downstream locations (e.g., downstream movements in the Peace River at the dam site, or downstream movements through entrainment when the Project is commissioned). If the locations are currently connected by low levels of gene flow, the populations may become fragmented when movement is hindered at the dam site or by the Site C Reservoir. Such fragmentation can lead to loss of genetic variation within populations. Construction of the Project may result in two separate (i.e., upstream and downstream) populations of small-fish

[29] EIS, Vol 2 App Q2 Fish Passage Management Plan, Attachment A

species.

6.3 Approach

To address the uncertainty regarding the Project's potential effects on the genetic structure, movement, and genetic exchange of small-fish species, Revision 0 of the FPMP described the investigations undertaken, at a conceptual level, for a small-fish translocation program. Translocation refers to the capture, transport and release of fish from one location to another. Based on available information, there is no precedent for a translocation program for small-fish species, although a recent program of capture and translocation for non-anadromous salmonids (large-bodied fish species) reflected this concept (Epifanio et al. 2003). Such a program would first study the population structure of small-fish species and determine whether facilitating genetic exchange between upstream and downstream populations could result in a conservation benefit. Contingent on identifying the potential for such a benefit, there would be an evaluation of the technical options for implementing a capture and translocation program in terms of feasibility, cost, and potential conservation benefit.

Species with local movement patterns (e.g., small-fish species) would not be affected by blocked upstream passage because these species can complete their entire life histories in habitats located downstream of the Project. The EIS (Volume 2, Appendix O) states the following regarding size distinction:

> *The rationale for size distinction relates to the relative difference between large fish species and small fish species in their ability to move extended distances. In fluvial systems like the regulated Peace River, adults of large fish species are capable of moving long distances upstream against the river current. Due to their small size, small fish species undertake shorter upstream movements compared to large fish species. Small fish species and younger age classes of large fish species can complete long distance movements during downstream dispersal.*

Patterns of habitat use by small-fish species currently fit the criteria for an isolation-by-distance model of genetic differentiation among populations. In this model, individuals move freely among local populations but the probability of movement declines with distance between sites. The pattern of genetic differentiation at neutral loci can be used to infer the probability of movement among geographic locations (e.g., Taylor et al. 2003). From a conservation perspective, artificial and natural barriers to movement have the potential to enhance the process of adaptation to local environmental conditions. However, barriers may also result in the loss of genetic variation in smaller local populations. This loss of variation may reduce the potential for the species to adapt to future environmental conditions. Ultimately the decision to move fish around a new barrier has to balance the likelihood of disrupting the current patterns of local adaptation by promoting excessive movement, against the likelihood of losing genetic variation within each population as a result of excessive restrictions on movement.

6.4 Effectiveness Monitoring

Data collection and monitoring for small-fish species is planned to occur under the FAHMFP. Using this information, potential management actions can be evaluated under the FPMP.

6.4.1 Monitoring

BC Hydro developed a monitoring program under the FAHMFP to reduce the uncertainties related to the genetics of small-fish species. The Site C Small Fish Translocation Monitoring Program (Mon-15) describes the monitoring of patterns of genetic variation among small-fish species through analysis of genetic samples. The monitoring approach uses genetic analyses as these methods are well suited to the management questions. Further, it is not technically feasible to track long distance movements of small-fish species in large river and reservoir environments.

Mon-15 is detailed in the FAHMFP. The following summary is provided for reference to address the following fisheries management question:

> How does Site C affect genetic structure, movement, and genetic exchange of small-fish species?

Mon-15 can be presented as a step-wise series of management questions and assessments; the questions could be investigated concurrently to provide weight-of-evidence to support the ultimate decision regarding initiating a small-fish translocation program:

1. Are there genetically distinguishable ‘local populations’ upstream and downstream of the Project?
2. Would the Project potentially affect the current pattern of genetic diversity?
3. Would a translocation program partially maintain this genetic exchange? If so, how effective would this genetic exchange program be at meeting provincial management objectives for conservation?

Sample collection will be conducted by other components of the FAHMFP at locations in tributaries immediately upstream of the inundation zone (e.g., Moberly River) and immediately upstream and downstream of the Project. Samples are scheduled to be collected between Construction Years 4 and 6 (2018 to 2020) to form a baseline dataset before river diversion. During operations, fish tissue samples are scheduled to be collected in Operation Years 1 (2024), 5 (2028), 10 (2033), 15 (2038), 20 (2043), 25 (2048) and 30 (2053). Only species that are currently present both upstream and downstream of the Project will be sampled. Focal species will include those that show little evidence of genetic divergence. Species that currently have patterns of strong differentiation upstream and downstream of the Project are not good candidates for translocation.

6.4.2 Management Actions

Information collected under Mon-15 will support decisions regarding potential management actions for small-fish translocation that would support conservation objectives. Taken together, Mon-15 aims to prevent the loss of genetic variation at the population level while preserving adaptive variation. However, a translocation program should not be implemented unless there is evidence of a loss of genetic material from a population or increasing divergence among populations.

7.0 Decision Making Process for Operations and Management

Developing a process to allow for adjustments to fish passage management will allow BC Hydro to respond to issues, challenges and uncertainties in an appropriate and timely manner.

Trap and haul operators in other regulated and unregulated rivers highlighted that following a clear decision making process is critical to providing successful upstream fish passage. For example, the initial operation of a new fish passage facility can involve an intensive period of adjustments to the day-to-day mechanical and biological operations to meet the objectives (outlined in Section 4.1). Some adjustments will require decisions to be made in near real-time (short term, on the order of hours to days); whereas other adjustments may be considered over a longer time period (long term, on the order of years) due to the effort required to review information from effectiveness monitoring and operations. Decisions such as which species should or should not be passed upstream or downstream of the Project involve biological, regulatory and value-based considerations.

Several parties are expected to be involved in implementing upstream fish passage at the Project. Clearly defining the role and responsibilities of each party will facilitate the successful implementation of fish passage management at the Project.

Long term decisions

Some adjustments may constitute a fundamental change to the trap and haul process that may require consultation with regulatory agencies and Indigenous groups. Decisions of this nature would require collating and analyzing data across an operational year to inform a potential adjustment. Information flows from the effectiveness monitoring contractor and facility operator to a fish passage manager[30] who then disseminates the information to regulatory agencies and Indigenous groups (Figure 7, top panel). BC Hydro will support the review of this information by regulatory agencies and Indigenous groups on potential adjustments to meet the objectives of the FPMP. During the review, BC Hydro will seek, but not require, consensus from the parties. Adjustments are intended to be those that all parties can accept without having to agree to all details. BC Hydro will document areas of consensus and non-consensus (as applicable) along with the perspectives of each participating party. BC Hydro will then inform the effectiveness monitoring contractor and facilitity operator of the adjustment that is required (Figure 7, top panel).

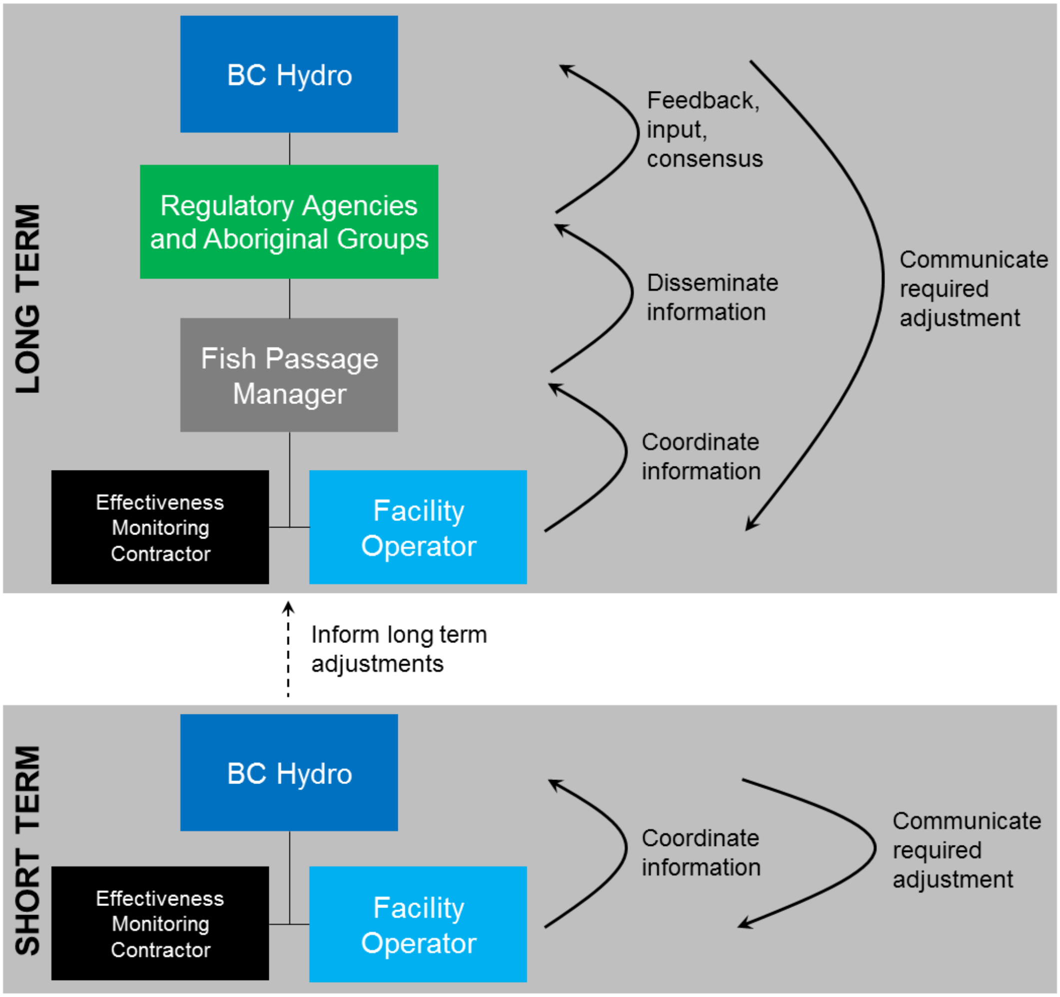
Examples of adjustments made over the long term may include, but not be limited to: changing the passage procedure of a species and changing the startup and shutdown dates of operations. BC Hydro anticipates that effectiveness monitoring and operational information will be reviewed at least annually with regulatory agencies and Indigenous groups. The reviews are expected to occur under the existing methods for collaboration with regulatory agencies (i.e., the Committee) and Indigenous groups (e.g., Environmental Forums). Long term adjustments would be reflected in a revision to the OPP.

[30] Fish passage manager is a general term used to describe a role that BC Hydro, as the Owner of the temporary and permanent facilities, would employ to coordinate fish passage management.

Short term decisions

BC Hydro will receive information from the effectiveness monitoring contractor and facility operator. BC Hydro will then review the information to gauge the operational effectiveness of the facility. If the operational effectiveness is tracking lower than expected (e.g., fish are not attracted to the fishway entrance at the predicted rate), BC Hydro may use the best available information to inform an in-season adjustment to operations (Figure 7, bottom panel). Examples of adjustments made over the short term may include, but not be limited to: changing the magnitude, timing and duration of attraction flows and HVJ, changing the frequency of sorting, and changing the species and/or size classes of fish that are PIT tagged. Information related to short term adjustments may feed into discussions around the rationale and technical feasibility of long term adjustments.

Figure 7. Flow of information to inform long term and short term decisions related to the operation of the temporary and permanent facilities.



8.0 Reporting

BC Hydro will report on implementation of fish passage management through the reporting associated with the following monitoring programs under the FAHMFP:

- Upstream fish passage: the effectiveness of attracting fish from the Peace River into the facilities and the attraction flows required to do so will be reported under Mon-13 (Site C Fishway Effectiveness Monitoring Program). The monitoring of released fish and their continued upstream migrations will be reported Mon-14 (Site C Trap and Haul Fish Release Location Monitoring Program);
- Downstream fish passage: The entrainment rates and survival rates of entrained fish during the operation of the Project will be reported under Mon-10 (Site C Fish Entrainment Monitoring Program); and
- Small fish translocation: the genetic structure and genetic exchange of small-fish

species will be reported under Mon-15 (Site C Small Fish Translocation Monitoring Program).

BC Hydro submits annual reports on the FAHMFP[31] to document that all components of the FAHMFP that were scheduled to be implemented in a given year were implemented, in accordance with the implementation schedules in the FAHMFP[32]. Implementation of the monitoring programs related to fish passage management (Mon-10, 13, 14 and 15) will be documented in these annual reports.

9.0 Qualified Professionals

Table 2 lists the qualified individuals who prepared Revisions 1 and 2 of the FPMP. As listed in Revision 0 of the FPMP, Revision 0 was prepared by Brent Mossop, MRM, RPBio, and Paul Higgins.

Table 2. Qualified Professionals.

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

[31] Available at: https://www.sitecproject.com/document-library/fisheries-and-aquatic-reports
[32] Available at: https://www.sitecproject.com/sites/default/files/fisheries-and-aquatic-habitat-management-plan-2018-annual-report.pdf

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11.0 Appendix

Table A1. List of Permits and Authorizations related to fish passage management.

Licence, Permit or Authorization	Component	Purpose	Status	Date Issued	Expiry Date
Conditional Water License #133986	Upstream	CWL #133986 permits the pumping of water from the Peace River to supply the permanent facility.	Issued	January 16, 2018	February 26, 2056
Conditional Water License #133987	Upstream	CWL #133987 permits the pumping of water from the Peace River to supply the temporary facility	Issued	January 16, 2018	Two years after the permanent facility commences operation
Fisheries Act Authorization 15-HPAC-01160	Upstream and downstream	Fish passage management is a mitigation measure listed in the conditions of the *Fisheries Act* Authorization for Main Civil Works and Facility Operation. The *Fisheries Act* Authorization for Main Civil Works and Facility Operation also authorizes incidental mortality of fish during upstream fish passage. Entrainment losses during river diversion (diversion tunnels), reservoir filling, and facility operations (generating station) are authorized under the *Fisheries Act* Authorization for Main Civil Works and Facility Operation.	Issued	July 27, 2016	December 31, 2064
Fish Collection Permits	Upstream	Collect fish, sample, transport and release fish during the operation of the temporary and permanent facilities	Future permit	N/A	N/A
Fish Collection Permits	Small Fish	Collect and transport small-bodied fish species	Future permit	N/A	N/A

Table A2. Fish Passage Management Plan – Concordance with EAC Condition 6.

EAC Condition 6.0 Fish Passage Management Plan	Plan Reference
The EAC Holder must implement mitigation measures, as detailed in a Fish Passage Management Plan. The Fish Passage Management Plan must be developed by a QEP.	The Plan has been prepared by QEPs, as listed in Section 8.0, Qualified Professionals.
The Fish Passage Management Plan must include at least the following:	
• Establish a periodic capture database/protocol/methodology for small-fish species to assess genetic exchange between upstream and downstream fish populations. Data must be provided annually to the relevant federal and provincial agencies. • Address genetic differences exceeding beyond a pre-defined threshold (to be determined through discussion with the agencies) by implementing a translocation program.	These requirements are addressed in Section 6.0, Small Fish Translocation.
• Design the installation and use of a trap and haul facility.	This requirement is addressed in Section 4.0, Upstream Fish Passage.
This draft Fish Passage Management Plan must be provided to FLNRO, MOE and Aboriginal Groups for review a minimum of 90 days prior to Project activities that may impact upstream fish passage.	BC Hydro's plans to meet this requirement and schedule is addressed in Section 2.4, Review and Revisions. Revision 1 of the FPMP was provided to FLNRO, MOE and Aboriginal groups in November 2019, more than 90 days prior to Project activities that may impact upstream fish passage.
The EAC Holder must file the final Fish Passage Management Plan with EAO, FLNRO, MOE and Aboriginal Groups a minimum of 30 days prior to Project activities that may impact upstream fish passage. The EAC Holder must develop, implement and adhere to the final Fish Passage Management Plan, and any amendments, to the satisfaction of EAO.	BC Hydro's plans to meet this requirement and schedule is addressed in Section 2.4, Review and Revisions.