

Columbia River Water Use Plan

Lower Columbia River Fish Management Plan

Monitoring Programs and Physical Works

Annual Report: 2023

Implementation Period: August 2022 to July 2023

- **CLBMON-42A Lower Columbia River Fish Stranding Assessment and Ramping Protocol**
- **CLBMON-42B Lower Columbia River Physical Habitat Recontouring**
- **CLBMON-43 Lower Columbia River Sculpin and Dace Life History Assessment**
- **CLBMON-44 Lower Columbia River Physical Habitat and Ecological Productivity Monitoring**
- **CLBMON-45 Lower Columbia River Fish Population Indexing Surveys**
- **CLBMON-46 Lower Columbia River Rainbow Trout Spawning Habitat Assessment**
- **CLBMON-47 Lower Columbia River Whitefish Spawning Ground Topographic Survey**
- **CLBMON-48 Lower Columbia River Whitefish Egg Monitoring & Life History Study**
- **CLBMON-49 Lower Columbia River Effects of Whitefish Flows on Great Blue Heron & Winter Use of Waldie by Great Blue Heron**

Conditional Water Licences for Kinbasket storage (27068 and 39432), Mica diversion (39431), Revelstoke diversion and storage (47215), and Arrow storage (27066)

August 31, 2023

BC Hydro Columbia River Project Water Use Plan Lower Columbia River Fish Management Plan Monitoring Programs and Physical Works Annual Report: 2023

1 Introduction

This document represents a summary of the status and the results of the Lower Columbia River Fish Management Plan of the Columbia River Water Use Plan (WUP) monitoring programs and physical works to July 31, 2023, as per the Columbia River Order under the *Water Act*, dated January 26, 2007. There are nine monitoring programs.

2 Status

The following table outlines the dates that Terms of Reference (TOR) for the Lower Columbia River Fish Management Plan of the Columbia River WUP monitoring programs and physical works were submitted to and approved by the Comptroller of Water Rights (CWR).

Table: 2-1: Dates of Lower Columbia River Fish Management Plan of the Columbia River WUP TOR Submissions and Approvals by the Comptroller of Water Rights

Monitoring Programs TOR	Order Clause	Original TOR Submission		Most Recent TOR Resubmission	
		Date Submitted	Date Approved	Date Submitted	Date Approved
CLBMON-42A Lower Columbia River Fish Stranding Assessment and Protocol	Schedule E.2.a	Sep 10, 2007	Oct 29, 2007	Nov 27, 2020	Dec 22, 2020
CLBMON-42B Lower Columbia River Physical Habitat Recontouring	Schedule E.2.a	Aug 22, 2016	Aug 25, 2016		
CLBMON-43 Lower Columbia River Sculpin and Dace Life History Assessment	Schedule E.2.b	Oct 25, 2007	Dec 03, 2007		
CLBMON-44 Lower Columbia River Physical Habitat and Ecological Productivity Monitoring	Schedule E.2.c	Oct 25, 2007	Dec 03, 2007	Oct 18, 2021	Nov 25, 2021
CLBMON-45 Lower Columbia River Fish Population Indexing Surveys	Schedule E.2.d	Sep 10, 2007	Oct 29, 2007	Jan 15, 2021	Feb 11, 2021
CLBMON-46 Lower Columbia River Columbia Rainbow Trout Spawning Habitat Assessment	Schedule E.2.e	Oct 25, 2007	Dec 03, 2007	Dec 20, 2018	Jan 08, 2019
CLBMON-47 Lower Columbia River Whitefish Spawning Ground Topographic Survey	Schedule E.2.f	Oct 25, 2007	Dec 03, 2007	Nov 22, 2017	Dec 04, 2017
CLBMON-48 Lower Columbia River Whitefish Egg Monitoring & Life History Study	Schedule E.2.g	Oct 25, 2007	Dec 03, 2007		
CLBMON-49 Lower Columbia River Effects of Whitefish Flows on Great Blue Heron and Winter Use of Waldie by Great Blue Heron	Schedule E.2.h	Oct 25, 2007	Dec 03, 2007	Oct 08, 2015	Nov 12, 2015

3 Schedule

The following table outlines the current schedule for the monitoring programs being delivered for the Lower Columbia River Fish Management Plan of the Columbia River WUP.

Table 3-1: Monitoring Programs Schedule as of July 31, 2023

Monitoring Programs	2007 WLR YR1	2008 WLR YR2	2009 WLR YR3	2010 WLR YR4	2011 WLR YR5	2012 WLR YR6	2013 WLR YR7	2014 WLR YR8	2015 WLR YR9	2016 WLR YR10	2017 WLR YR11	2018 WLR YR12	2019 WLR YR13	2020 WLR YR14	2021 WLR YR15	2022 WLR YR16	2023 WLR YR17
CLBMON-42A Lower Columbia River Fish Stranding Assessment and Protocol	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	u/w
CLBMON-42B Lower Columbia River Physical Habitat Recontouring										x	x	x	x	x	✓		
CLBMON-43 Lower Columbia River Sculpin and Dace Life History Assessment			✓	✓	✓	✓	✓F										
CLBMON-44 Lower Columbia River Physical Habitat and Ecological Productivity Monitoring		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	u/w
CLBMON-45 Lower Columbia River Fish Population Indexing Surveys	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	u/w
CLBMON-46 Lower Columbia River Columbia Rainbow Trout Spawning Habitat Assessment		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	u/w
CLBMON-47 Lower Columbia River Whitefish Spawning Ground Topographic Survey					✓	✓	✓F										
CLBMON-48 Lower Columbia River Whitefish Egg Monitoring & Life History Study		✓	✓	✓	✓	✓F											
CLBMON-49 Lower Columbia River Effects of Whitefish Flows on Great Blue Heron and Winter Use of Waldie by Great Blue Heron							✓	✓	✓F								
Legend:	<ul style="list-style-type: none"> ■ = Program to be undertaken/initiated in identified year u/w = Project is underway ✓ = Program completed for the year C = Conditional pending technical forum discussions ✓F = All field work for this project is complete. No further field work is planned. x = Program started, but encountered operational or other delays 																

4 Monitoring Programs Terms of Reference

The monitoring programs works being implemented under the Lower Columbia River (LCR) Fish Management Plan of the Columbia River WUP are described in Terms of Reference. These Terms of Reference can be found here:

https://www.bchydro.com/toolbar/about/sustainability/environmental_responsibility/water-use-plans/southern-interior/columbia-river/lower-columbia-fish.html

5 Status of Monitoring Programs

5.1 CLBMON-42 Lower Columbia River Fish Stranding Assessment and Ramping Protocol

CLBMON-42 is being reported on as two parts:

- CLBMON-42A LCR Fish Stranding Assessment and Ramping Protocol, and
- CLBMON-42B LCR Physical Habitat Recontouring.

5.1.1 CLBMON-42A Lower Columbia River Fish Stranding Assessment and Ramping Protocol

This monitoring program was initiated in May 2007 and will be carried out over 15 years. The year (2022-23) is the final year under the WUP schedule.

Discharge reductions and flow ramping from Hugh L. Keenleyside Dam/Arrow Lakes Generating Station (HLK/ALH) and Brilliant Dam/Expansion (BRD/X) can result in stranding of fish species of the lower Columbia and Kootenay rivers. This study

assesses fish stranding at pre-determined sites between HLK/ALH and the Canada/USA border.

In 2021, aerial photography and bathymetry surveys were completed for the Lower Columbia River (LCR). The hydrodynamic flow model was developed in spring 2022. The updated flow model will complement the ongoing database risk assessment modelling of past fish salvage data, allowing for continued refinement of stranding risk at different river stages and times of year. Ultimately, improved risk assessments should allow for more efficient use of fish salvage crew resources.

The Year 15 report dated October 19, 2022 is attached and the Year 16 report is in draft and will be sent in next year's Annual Report.

5.1.2 CLBMON-42B Lower Columbia River Physical Habitat Recontouring

As part of the CLBMON-42 TOR, physical works were proposed as potential mitigation for fish stranding. Three sites on the LCR were identified as high priority for recontouring to minimize the stranding risk:

- Genelle
- Kootenay River Left Upper Bank, and
- Tin Cup Rapids.

Kootenay River Left Upper Bank and Tin Cup Rapids recontouring work was cancelled due to significant concerns raised by First Nations during the First Nation engagement in spring 2017.

The recontouring work at Genelle was completed on March 18, 2021. The scope of the project was to improve the fish stranding issue at the Genelle Mainland Bar. Unfortunately, shortly after construction during normal high river flows the fish stranding pools started to re-form. We will include an engineering assessment/ lesson learned in the completion report.

5.2 CLBMON-43 Lower Columbia River (LCR) Sculpin and Dace Life History Assessment

This monitoring program was initiated in 2009 and carried out over five years. This project is complete.

The main objective of this study was to collect information on the life history, timing, and habitat use of four sculpins (Prickly, Torrent, Columbia, and Shorthead) and two dace (Umatilla and Longnose) species that may be affected by water level fluctuations resulting from daily and seasonal operations of Hugh L. Keenleyside (HLK) dam.

5.3 CLBMON-44 Lower Columbia River Physical Habitat and Ecological Productivity Monitoring

This monitoring program was initiated in 2008 and was completed in early 2019.

CLBMON-44 was a multi-year study of physical habitat and ecological productivity on the Lower Columbia River (LCR) between the outflow of the Hugh L. Keenleyside Dam (HLK) and the Birchbank gauging station. The aim of the study was to examine the influence of three different flow periods on select physical habitat and ecological productivity measures:

- January 1 – March 31, Mountain Whitefish (MWF);
- April 1 – June 30, Rainbow Trout (RBT); and
- September 1 – October 31, Fall fluctuating flows (FFF).

In April 2019, BC Hydro entered into an experimental approach to alternate the provision of the Rainbow Trout Spawning Protection Flows (RBTSPF; April 1 – June 30) over the next five years, with a commitment to reconvene after the first two years to confirm the experiment should continue (see Section 5.5 below for further information). The planned alterations to the RBTSPF may impact food production. Therefore, BC Hydro measured water levels over 2019 and 2020 and updated the model that estimates food availability as impacted by alterations to the RBTSPF. While the updates to this model are being performed through an extension of CLBMON-44, these updates only cover the model as it pertains to predicting food availability as impacted by the RBTSPF. The extension does not cover the other two flow regimes (i.e., MWF and FFF).

In October 2020, BC Hydro reconvened the Rainbow Trout Technical Forum to discuss the study results about whether the modified RBTSPF may have affected Rainbow Trout populations. An outcome of the Forum was confirmation that the experiment will continue for the remaining three years. The CLBMON-44 study was extended for two years (through 2023) to monitor any impacts to food production. The Technical Forum will be reconvened in autumn 2023 to discuss the study results and implications as the 2023 is the final field season of the extended CLBMON-44 study.

The report for Year 3 extension, dated April 2023 is attached. Field work for 2023 has been completed and the report is being drafted. It will be submitted with the next annual report.

5.4 CLBMON-45 Lower Columbia River Fish Population Indexing Surveys

This monitoring program was initiated in September 2007 and was initially scheduled to continue until 2019. CLBMON-45 gathers information on fish distribution, life history characteristics, and population abundance data for three index species (i.e., Mountain Whitefish, Rainbow Trout, and Walleye), and also monitors the effect of Mountain Whitefish and Rainbow Trout flows on these three species.

As mentioned above, in October 2020, BC Hydro reconvened the Rainbow Trout Technical Forum to discuss the study results about whether modified RBTSPF may have affected Rainbow Trout populations. An outcome of the Forum was confirmation that the experiment would continue for the remaining three years. The CLBMON-45 study was extended in 2021 for three years to monitor any impacts to Rainbow Trout adult populations. The Technical Forum will be reconvened in autumn 2023 to discuss the study results and implications as the 2023 is the final field season of the extended CLBMON-45 study.

The Year 15 report for the 2021, dated April 2023, field season is attached. The Year 16 report for the 2022 field season is in draft and under review.

5.5 CLBMON-46 Lower Columbia River Columbia Rainbow Trout Spawning Habitat Assessment

This monitoring program was initiated in 2008 and initial field work was completed in 2018. All the reports have been submitted for this monitoring period.

In April 2019, BC Hydro initiated the first year of a five year experimental flow regime to better understand the linkages between the Rainbow Trout Spawning Protection Flows (RBTSPF) and the abundance of the Rainbow Trout population in the Lower Columbia River. The experiment commenced in 2019 with an “Off” year, where RTSPF were not provided.

The TOR Addendum included a commitment to reconvene the Rainbow Trout Technical Forum after the first two years to confirm the experiment should continue. The Rainbow Trout Technical Forum was held in October 2020 and confirmed that the experiment should continue for the remaining three years. The Technical Forum will be reconvened in autumn 2023 to discuss the study results and implications as the 2023 is the final field season of the extended CLBMON-46 study.

Attached is the Year 4 extension report, dated January 4, 2023 that covers the 2022 field season.

5.6 CLBMON-47 Lower Columbia River Whitefish Spawning Ground Topographic Survey

This monitoring program was initiated in 2011 and was carried out over three years. This project completed in 2015; however, recent discussions regarding the Mountain Whitefish Spawning Protection Flows resulted in a request from the regulatory agencies to have an independent review of the Mountain Whitefish Egg Loss Model that was updated as a part of this study. The Egg Loss Model was reviewed in 2018 and presented at the September 2018 Columbia Operations Fish Advisory Committee (COFAC) meeting. The regulators at the meeting did not support further work on the egg loss model at this time, preferring to revert back to the agreed upon operations with DFO in 2004.

5.7 CLBMON-48 Lower Columbia River Whitefish Egg Monitoring & Life History Study

This monitoring program was initiated in 2008 and was carried out over five years. This project is complete.

The purpose of this monitoring program was to collect and refine data on the location, timing, and depth distribution of mountain whitefish spawning in the Lower Columbia River below Hugh L. Keenleyside Dam to improve the annual estimate of egg mortality. Specifically, the key objectives were to: a) improve the understanding of whitefish life history and reproductive ecology; b) document topographic characteristics of representative whitefish spawning locations; and c) improve the understanding of seasonal changes in the distribution of eggs in the river channel.

5.8 CLBMON-49 Lower Columbia River Effects of Whitefish Flows on Great Blue Heron (GBH) and Winter Use of Waldie by Great Blue Heron

This monitoring program was initiated in November 2013 and field work is complete.

CLBMON-49 changed from a count-based study to a habitat suitability study in the final two years of this project. GBH distribution and abundance, along with

physicochemical and other habitat and environmental parameters were monitored at a variety of sites throughout the Kootenays during the winter months. Surveys were completed prior to, during, and after flows related to management of Mountain Whitefish (generally November 1 to February 28) in the Castlegar area, encompassing varied water elevations and flow rates resulting from known dam operations.

6 Monitoring Programs Costs

The following table summarizes the Lower Columbia River Fish Management Plan of the Columbia River WUP monitoring programs costs approved by the Comptroller and the Actual Costs to July 31, 2023.

Table 6-1: Lower Columbia River Fish Management Plan WUP Monitoring Programs Costs

Monitoring Programs	Costs approved by CWR	Life to Date Actuals (LTD)	Estimated to Complete (Forecast)	Total Forecast (LTD and Forecast)	Variance Total to Approved	Explanation	Corrective Action
CLB MP8 Lower CR Fish Annual Report	\$16,466	\$16,758	\$4,492	\$21,251	(\$4,785)	With RBTSPF experiment studies have been extended	Request for funds to be submitted.
C08M42A LC: Fish Strand	\$1,704,651	\$1,597,005	\$77,558	\$1,674,563	\$30,088		
C08M42A LC: Fish Strand - OR DM	\$205,385	\$223,210	\$19,799	\$243,009	(\$37,624)		
C08M42A LC: Fish Strand - OR Imp	\$1,499,266	\$1,373,795	\$57,759	\$1,431,554	\$67,712		
C08M42B LC: Recontouring	\$455,799	\$320,533	\$25,000	\$345,533	\$110,266	Engineering assessment/lessons learned to be completed.	
C08M42B LC: Recontouring - OR DM	\$60,871	\$119,544	\$3,000	\$122,544	(\$61,673)		
C08M42B LC: Recontouring - OR Imp	\$394,928	\$200,989	\$22,000	\$222,989	\$171,939		
C08M43A LC:Sculpin&Dace	\$990,546	\$964,482	\$3,621	\$968,103	\$22,443	Project complete, completion report outstanding.	
C08M43A LC:Sculpin&Dace - OR DM	\$64,043	\$63,365	\$3,621	\$66,986	(\$2,943)		
C08M43A LC:Sculpin&Dace - OR Imp	\$926,503	\$901,117		\$901,117	\$25,386		
C08M44A LC:Phys Hab&Eco	\$2,448,604	\$2,259,839	\$87,495	\$2,347,333	\$101,271		
C08M44A LC:Phys Hab&Eco - OR DM	\$200,010	\$199,655	\$12,131	\$211,786	(\$11,776)		
C08M44A LC:Phys Hab&Eco - OR Imp	\$2,248,594	\$2,060,184	\$75,363	\$2,135,547	\$113,047		
C08M45A LC: Fish Pop	\$3,222,228	\$2,950,922	\$113,426	\$3,064,348	\$157,880		
C08M45A LC: Fish Pop - OR DM	\$169,139	\$139,739	\$11,941	\$151,680	\$17,459		
C08M45A LC: Fish Pop - OR Imp	\$3,053,089	\$2,811,183	\$101,485	\$2,912,668	\$140,421		
C08M46A LC: Rainbow Tro	\$1,796,681	\$1,594,263	\$208,235	\$1,802,497	(\$5,816)		
C08M46A LC: Rainbow Tro - OR DM	\$214,539	\$221,574	\$6,098	\$227,671	(\$13,132)		
C08M46A LC: Rainbow Tro - OR Imp	\$1,582,142	\$1,372,689	\$202,137	\$1,574,826	\$7,316		
C08M47A LC: Whitefish Spwn	\$292,267	\$284,652	\$3,621	\$288,273	\$3,994	Project complete, completion report outstanding.	
C08M47A LC: Whitefish Spwn - OR DM	\$38,246	\$22,343	\$3,621	\$25,964	\$12,282		
C08M47A LC: Whitefish Spwn - OR Imp	\$254,021	\$262,309		\$262,309	(\$8,288)		
C08M48A LC: Whitefish Egg	\$912,415	\$878,531	\$3,621	\$882,152	\$30,263	Project complete, completion report outstanding.	
C08M48A LC: Whitefish Egg - OR DM	\$62,520	\$49,791	\$3,621	\$53,412	\$9,108		
C08M48A LC: Whitefish Egg - OR Imp	\$849,895	\$828,741		\$828,741	\$21,154		
C08M49A LC:EFF WFish GBH	\$336,448	\$335,319	\$1,128	\$336,447	\$1	Project complete, completion report outstanding.	
C08M49A LC:EFF WFish GBH - OR DM	\$68,211	\$67,082	\$1,128	\$68,210	\$1		
C08M49A LC:EFF WFish GBH - OR Imp	\$268,237	\$268,237		\$268,237	\$0		

OR - Ordered Remissible
ONR - Ordered Non-Remissible

* Red values in parentheses denote overage.