

## **Bridge River Water Use Plan Monitoring Program and Physical Works**

**Annual Report: 2023**

**Implementation Period: February 2022 to January 2023**

- **BRGMON-1 Lower Bridge River Aquatic Monitoring**
- **BRGMON-2 Carpenter Reservoir Riparian Vegetation Monitoring**
- **BRGMON-3 Lower Bridge River Adult Salmon and Steelhead Enumeration**
- **BRGMON-4 Carpenter Reservoir and Middle Bridge Fish Habitat and Population Monitoring**
- **BRGMON-5 Downton Reservoir Riparian Vegetation Monitoring**
- **BRGMON-6 Seton Lake Aquatic Productivity Monitoring**
- **BRGMON-7 Downton Reservoir Fish Habitat and Population Monitoring**
- **BRGMON-8 Seton Lake Resident Fish Habitat and Population Monitoring**
- **BRGMON-9 Seton River Habitat and Fish Monitoring**
- **BRGMON-10 Carpenter Reservoir Productivity Model Validation and Refinement**
- **BRGMON-11A Lower Bridge River Riparian Vegetation Monitoring**
- **BRGMON-11B Lower Bridge River Riverine Wildlife Monitoring**
- **BRGMON-12 Bridge-Seton Metals and Contaminant Monitoring Program**
- **BRGMON-13 Seton Sockeye Salmon Smolts Monitoring Program**
- **BRGMON-14 Effectiveness of Cayoosh Flow Dilution, Dam Operation, and Fishway Passage on Delay and Survival of Upstream Migration of Salmon in the Seton-Anderson Watershed**
- **BRGMON-15 Seton Lake Erosion Mitigation Program**
- **BRGMON-16 Lower Bridge River Spiritual and Cultural Value Monitoring**
- **BRGWORKS-1 Carpenter Revegetation**
- **BRGWORKS-2 Seton Lake Erosion**

**For Water Licences FWL 126279, 126278, 126280, 126281, 126286, 126287, 126288, 126282, 126283, 12680, 126250 and 126259.**

**February 28, 2023**

## **BC Hydro Bridge River Project Water Use Plan Monitoring Programs and Physical Works Annual Report: 2023**

### **1 Introduction**

This document represents a summary of the status and the results of the Bridge River Water Use Plan (WUP) monitoring programs and physical works to January 31, 2023, as per the Bridge River Order under the *Water Act*, dated March 30, 2011. There are 17 monitoring programs and two physical works.

### **2 Status**

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

**Table: 2-1: Dates of Bridge River WUP TOR Submissions and Approvals by the CWR**

Monitoring Program & Physical Works TOR	Order Clause	Original ToR Submission		Most Recent ToR Resubmission	
		Date Submitted	Date Approved	Date Submitted	Date Approved
BRGMON-1 Lower Bridge River Aquatic Monitoring	Schedule A.9	Jan 30, 2012	Apr 12, 2012	Mar 29,2022	Apr 29,2022
BRGMON-2 Carpenter Reservoir Riparian Vegetation Monitoring	Schedule A.6	Jan 30, 2012	Jun 26, 2012	Mar 06, 2017	Mar 21, 2017
BRGMON-3 Lower Bridge River Adult Salmon and Steelhead Enumeration	Schedule A.10	Jan 30, 2012	Feb 07, 2012	Mar 29,2022	Jun 07, 2022
BRGMON-4 Carpenter Reservoir and Middle Bridge Fish Habitat and Population Monitoring	Schedule A.7	Jan 30, 2012	Jun 06, 2012	Mar 23, 2015	May 01, 2015
BRGMON-5 Downton Reservoir Riparian Vegetation Monitoring	Schedule A.2	Mar 30, 2012	Jul 11, 2012		
BRGMON-6 Seton Lake Aquatic Productivity Monitoring	Schedule A.14	Mar 14, 2014	Apr 23, 2014		
BRGMON-7 Downton Reservoir Fish Habitat and Population Monitoring	Schedule A.3	Jan 30, 2012	Jun 06, 2012	Mar 23, 2015	Jun 02, 2015
BRGMON-8 Seton Lake Resident Fish Habitat and Population Monitoring	Schedule A.15	Jan 30, 2012	Jun 07, 2012	Mar 23, 2015	May 01, 2015
BRGMON-9 Seton River Habitat and Fish Monitoring	Schedule A.16	Jan 30, 2012	Jun 07, 2012	May 20, 2020	May 29, 2020
BRGMON-10 Carpenter Reservoir Productivity Model Validation and Refinement	Schedule A.5	Mar 14, 2014	May 01, 2014	Oct 21, 2014	Nov 04, 2014
BRGMON-11 Lower Bridge River Riparian Vegetation Monitoring	Schedule A.8	Mar 30, 2012	Jun 27, 2012		
BRGMON-11A Lower Bridge River Riparian Vegetation Monitoring	Schedule A.8	Nov 30, 2018	Jan 25, 2019	Mar 29,2022	Apr 29,2022
BRGMON-11 B Lower Bridge River Riverine Wildlife Monitoring	Schedule A.8	Nov 30, 2018	Jan 25, 2019	Mar 29,2022	Apr 29,2022
BRGMON-12 Bridge-Seton Metals and Contaminant Monitoring Program	Schedule A.1	Mar 30, 2012	Jul 24, 2012		
BRGMON-13 Seton Sockeye Salmon Smolts Monitoring Program	Schedule A.17	Jan 30, 2012	Apr 05, 2012	Feb 07, 2020	Feb 21, 2020
BRGMON-14 Effectiveness of Cayoosh Flow Dilution, Dam Operation, and Fishway Passage on Delay and Survival of Upstream Migration of Salmon in the Seton-Anderson Watershed	Schedule A.18	Jan 30, 2012	Jun 26, 2012	Nov 30, 2017	Dec 15, 2017
BRGMON-15 Seton Lake Erosion Mitigation Program	Schedule A.13	Mar 30, 2012	Jul 13, 2012	Nov 09, 2020	Nov 20, 2020
BRGMON-16 Lower Bridge River Spiritual and Cultural Value Monitoring	Schedule A.11	Mar 30, 2012	Jul 26, 2012	Mar 19, 2013	Apr 08, 2013
BRGWORKS-1 Carpenter Reservoir Drawdown Zone Re-Vegetation Program	Schedule A.4	Mar 14, 2014	May 02, 2014	Mar 06, 2017	Mar 21, 2017
BRGWORKS-2 -Seton Erosion Management Projects: Site-Specific Mitigation Projects	Schedule A.12	Nov 29, 2019	Dec 10, 2019	Apr 22, 2020	May 12, 2020

### 3 Schedule

The following table outlines the current schedule for the monitoring programs and physical works being delivered for the Bridge River WUP.

**Table 3-1: Monitoring and Physical Works Schedule as of January 31, 2023**

Monitoring Programs	2012 WLR YR1	2013 WLR YR2	2014 WLR YR3	2015 WLR YR4	2016 WLR YR5	2017 WLR YR6	2018 WLR YR7	2019 WLR YR8	2020 WLR YR9	2021 WLR YR10	2022 WLR YR11	2023 WLR YR12	2024 WLR YR13	2025 WLR YR14	2026 WLR YR15	2027 WLR YR16	2028 WLR YR17	2029 WLR YR18	2030 WLR YR19	2031 WLR YR20
BRGMON-1 Lower Bridge River Aquatic Monitoring	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	■	■	■	■	■	■	■	■	■
BRGMON-2 Carpenter Reservoir Riparian Vegetation Monitoring		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓F									
BRGMON-3 Lower Bridge River Adult Salmon and Steelhead Enumeration	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	■	■	■	■	■	■	■	■	■
BRGMON-4 Carpenter Reservoir and Middle Bridge Fish Habitat and Population Monitoring		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓F									
BRGMON-5 Downton Reservoir Riparian Vegetation Monitoring		✓									x	■								
BRGMON-6 Seton Lake Aquatic Productivity Monitoring			✓	✓	✓	✓F														
BRGMON-7 Downton Reservoir Fish Habitat and Population Monitoring		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓F									
BRGMON-8 Seton Lake Resident Fish Habitat and Population Monitoring		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓F									
BRGMON-9 Seton River Habitat and Fish Monitoring		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓F									
BRGMON-10 Carpenter Reservoir Productivity Model Validation and Refinement				✓	✓	✓F														
BRGMON-11A Lower Bridge River Riparian Vegetation Monitoring	✓				✓					✓			■						■	■
BRGMON-11B Lower Bridge River Riverine Wildlife Monitoring	✓	✓	✓		✓		✓			✓	✓	■	■		■		■		■	■
BRGMON-12 Bridge-Seton Metals and Contaminant Monitoring Program		✓	✓	✓	✓F															
BRGMON-13 Seton Sockeye Salmon Smolts Monitoring Program	✓	✓	✓	✓	x	✓	✓	✓	✓	x	x	x								
BRGMON-14 Effectiveness of Cayoosh Flow Dilution, Dam Operation, and Fishway Passage on Delay and Survival of Upstream Migration of Salmon in the Seton-Anderson Watershed	✓	✓	✓	✓	✓	✓	✓F													
BRGMON-15 Seton Lake Erosion Mitigation Program		✓				x	✓	✓	✓	✓	✓	x								
BRGMON-16 Lower Bridge River Spiritual and Cultural Value Monitoring			✓	✓	✓	✓	✓F													
<b>Physical Works</b>																				
BRGWORKS-1 Carpenter Revegetation			✓	✓	✓	✓		✓	✓F											
BRGWORKS-2 Seton Erosion									✓	✓	✓	■	■							

Legend:

- = Program to be undertaken/initiated in identified year
- = Program to be extended (TOR to be submitted)
- ✓ = Program completed for the year
- x = Program delayed/postponed
- ✓F = All field work for this project is complete. No further field work is planned.

### 4 Monitoring Programs and Physical Works Terms of Reference

The monitoring programs and physical works being implemented under the Bridge River WUP are described in TOR. These TORs and the reports for work completed to date can be found here:

[http://www.BC Hydrodydro.com/about/sustainability/conservation/water\\_use\\_planning/lower\\_mainland/bridge\\_river.html](http://www.BC Hydrodydro.com/about/sustainability/conservation/water_use_planning/lower_mainland/bridge_river.html)

### 5 Status of Monitoring Programs

#### 5.1 BRGMON-1 Lower Bridge River Aquatic Monitoring

The objective of BRGMON-1 is to quantify the response of key physical and biological indicators in the Lower Bridge River to different instream flow regimes to better understand which variables explain changes observed in aquatic productivity.

This monitoring program was initiated in 2012 and has been implemented annually for ten years. Implementation was extended in 2022 for another ten years until 2032 to accommodate the monitoring of water management impacts until the Lajoie Dam is reconstructed.

From 2016 to 2018 BC Hydro implemented modified operations at Downton Reservoir for dam safety reasons and conducted major capital improvements at Bridge River 1 and Bridge River 2 powerhouses that required extensive planned outages. This resulted in having a variance approved by CWR to allow discharges down the Lower Bridge River during freshet that were higher than the WUP Ordered operations. To plan for and better assess the impact of these operations, additional monitoring complementary to BRGMON-1 WUP monitoring was added (not included in WUP expenditures) and the results of both programs are integrated into the same report.

BC Hydro operated Terzaghi Dam under a flow variance approved by the CWR between the spring of 2015 and the spring of 2021 with flows peaking above the WUP target (Note: the WUP target maximum peak flow is 15 m<sup>3</sup>/s) each year except for 2020. A flow Order dated April 29, 2022, supersedes previous flow variance from the CWR. The objective of the flow Order is to minimize the risk of a more impactful unplanned fall spill event by allowing higher flows during spring freshet. The conditions of the Order include using a set of Guiding Principles to inform the shape of the hydrograph and actual flow releases from Terzaghi Dam into the Lower Bridge River. The Guiding Principles are used in conjunction with BC Hydro's inflow forecasts annually in the springtime by the St'at'imc/BC Hydro Joint Planning Forum (JPF) to make flow recommendations to BC Hydro. Flow conditional monitoring along the Lower Bridge River is also implemented as a condition of the flow Order, and the data from this additional monitoring is incorporated into the BRGMON-1 monitoring report.

The monitoring reports for 2020 (Year 9, dated April 30, 2021) and 2021 (Year 10, dated April 30, 2022) are attached.

The monitoring report for 2022 (Year 11) and the 10-year program report will be submitted with the 2024 Annual Report.

## **5.2 BRGMON-2 Carpenter Reservoir Riparian Vegetation Monitoring**

The objectives of the BRGMON-2 monitoring program are:

- To monitor the effects of Carpenter Reservoir operations on vegetation response (including substrates and natural revegetation) within the drawdown zone of Carpenter Reservoir, and
- To monitor the effectiveness of revegetation treatments in the Gun Creek Fan and adjacent area, completed under the physical works program BRGWORKS-1.

This program was initiated in April 2013 and was carried out at intervals over ten years. The final monitoring year fieldwork was completed in 2022.

The final 10-year program report will be submitted with the 2024 Annual Report.

### **5.3 BRGMON-3 Lower Bridge River Adult Salmon and Steelhead Enumeration**

The main objective of the BRGMON-3 monitoring program is to provide rigorous estimates of the abundance and distribution of salmon and steelhead spawning in the Lower Bridge River. The BRGMON-3 program will also address data gaps associated spawning timing, spawning distribution, and spawning habitat quality and quantity.

This monitoring program was initiated in 2012 and has been implemented annually for ten years. Implementation was extended in 2022 for another ten years until 2032 to accommodate the monitoring of water management impacts until the Lajoie Dam is reconstructed.

From 2016 to 2018 BC Hydro implemented modified operations at Downton Reservoir for dam safety reasons and conducted major capital improvements at Bridge River 1 and Bridge River 2 powerhouses that required extensive planned outages. This resulted in having a variance approved by CWR to allow discharges down the Lower Bridge River during freshet that were higher than the WUP Ordered operations. To plan for and better assess the impact of these operations, additional monitoring complementary to BRGMON-3 WUP monitoring was added (not included in WUP expenditures) and the results of both programs are integrated into the same report.

BC Hydro operated Terzaghi Dam under a flow variance approved by the CWR between the spring of 2015 and the spring of 2021 with flows peaking above the WUP target (Note: the WUP target maximum peak flow is 15 m<sup>3</sup>/s) each year except for 2020. A flow Order dated April 29, 2022, supersedes previous flow variance from the CWR. The objective of the flow Order is to minimize the risk of a more impactful unplanned fall spill event by allowing higher flows during spring freshet. The conditions of the Order include using a set of Guiding Principles to inform the shape of the hydrograph and actual flow releases from Terzaghi Dam into the Lower Bridge River. The Guiding Principles are used in conjunction with BC Hydro's inflow forecasts annually in the springtime by the St'at'imc/BC Hydro Joint Planning Forum (JPF) to make flow recommendations to BC Hydro. Flow conditional monitoring is also implemented as a condition of the flow Order, and the data from this additional monitoring is incorporated into the BRGMON-3 monitoring report.

The monitoring reports for 2020 (Year 9, dated April 6, 2021) and 2021 (Year 10 dated August 30, 2022), are attached.

The 10-year program report will be included in the 2024 Annual Report.

### **5.4 BRGMON-4 Carpenter Reservoir and Middle Bridge Fish Habitat and Population Monitoring**

The objective of this monitoring program is to collect comprehensive information on the life history, biological characteristics, distribution, abundance, and composition of the fish community in Carpenter Reservoir and Middle Bridge River to determine whether there is a relationship between operating parameters and productivity.

This monitoring program was initiated in October 2012 with fieldwork starting in 2013 and was carried out annually over ten years. The first ten years of the project are complete; however, we anticipate the need to continue some of the

monitoring scope until water management challenges stabilize in the Bridge River-Seton system after the Lajoie Dam upgrade project is complete. The outcome of the WUP Order Review may also impact the need for this study. We plan on resubmitting a TOR revision in early spring 2023.

The monitoring report for 2021 (Year 9) dated October 6, 2022, is attached.

The 2022 (Year 10) monitoring final report (for first ten years) will be included with the 2024 Annual Report.

## **5.5 BRGMON-5 Downton Reservoir Riparian Vegetation Monitoring**

The objective of this monitoring program is to document the response of the riparian community on the Upper Bridge River Fan and in the immediate adjacent drawdown zone of Downton Reservoir to determine if reservoir operations have had a negative impact on riparian vegetation and the overall quality of the habitat for wildlife in the area.

This monitoring program was implemented in 2013 and was planned to implement again in 2022.

In 2016 for dam safety reasons, the normal maximum elevation of Downton Reservoir was lowered by 16 vertical metres from 750 m to 734 m and has been maintained since. In 2018, vegetation monitoring in the zone between 734m and 750m was implemented. This additional year was not included in the WUP expenditures and was covered in a separate report.

The 2022 monitoring program has been deferred until summer 2023. The project utilizes aerial photography captured in summer 2022. The 2023 study report will be submitted along with the Annual Report in 2024.

## **5.6 BRGMON-6 Seton Lake Aquatic Productivity Monitoring**

The objective of this monitoring program was to document the impacts of Carpenter Lake Diversion on the biological productivity of Seton Lake Reservoir. Sediment cores taken from the bottom of Seton Lake were analyzed for biological, physical, and chemical parameters to reconstruct past environmental conditions in the aquatic ecosystem, thereby informing whether future operational decisions might be made to potentially mitigate impacts of the diversion.

This monitoring program was initiated in 2014 and was carried out annually over three years. The final field season was completed in 2016.

This project is complete.

## **5.7 BRGMON-7 Downton Reservoir Fish Habitat and Population Monitoring**

The objective of this monitoring program is to collect comprehensive information on the life history, biological characteristics, distribution, abundance, and composition of the fish community in Downton Reservoir. The information collected is required to link the effects of reservoir operation on fish populations and inform future operational decisions.

This monitoring program was initiated in October 2012 with fieldwork starting in 2013 and was carried out annually over ten years. The first ten years of the project are complete; however, we anticipate the need to continue some of the monitoring scope until water management challenges stabilize in the Bridge

River-Seton system after the Lajoie Dam upgrade project is complete. The outcome of the WUP Order Review may also impact the future need for this study. We plan on resubmitting a TOR revision in early spring 2023.

In 2016 for dam safety reasons, the normal maximum elevation of Downton Reservoir was lowered by 16 vertical metres from 750 m to 734 m and has been maintained since. An annual assessment of fish access to creeks and tributaries for spawning was added to this program (not included in WUP expenditures) and the results of both programs are integrated into the same annual monitoring report.

The 2020 (Year 8) monitoring report, dated November 19, 2021, is attached.

The 2021 (Year 9) monitoring report will be submitted along with the 2024 Annual Report.

## **5.8 BRGMON-8 Seton Lake Resident Fish Habitat and Population Monitoring**

The objective of this monitoring program is to collect comprehensive information on the life history, biological characteristics, distribution, abundance, and composition of the fish community in Seton Lake to establish whether there are links to reservoir operations on fish populations.

This monitoring program was initiated in October 2012 with fieldwork starting in 2013 and was carried out annually over ten years. The first ten years of the project are complete; however, we anticipate the need to continue some of the monitoring scope until water management challenges stabilize in the Bridge River-Seton system after the Lajoie Dam upgrade project is complete. The outcome of the WUP Order Review may also impact the future need for this study. We plan on resubmitting a TOR revision in early spring 2023.

The 2019 (Year 7) monitoring report dated January 15, 2020, and the 2020 (Year 8) monitoring report, dated November 17, 2022, is attached.

The 2021 (Year 9) monitoring report will be submitted along with the 2024 Annual Report.

## **5.9 BRGMON-9 Seton River Habitat and Fish Monitoring**

The objective of this monitoring program is to monitor the response of fish habitat and fish populations to Seton Dam operations.

This monitoring program was initiated in November 2012 with fieldwork starting in 2013 and was carried out annually over ten years. The first ten years of the project are complete; however, we anticipate the need to continue some of the monitoring scope until water management challenges stabilize in the Bridge River-Seton system after the Lajoie Dam upgrade project is complete. The outcome of the WUP Order Review may also impact the future need for this study. We plan on resubmitting a TOR revision in early spring 2023.

In 2019, as part of Addendum 1, additional monitoring in the Lower Fraser was added to the project and is reported in a separate monitoring report. In 2021, minor additional non-WUP monitoring continued. This additional monitoring is complementary to BRGMON-9 WUP monitoring (not included in WUP expenditures) and the results of both programs are integrated into the same report.



The primary BRGMON-9 monitoring report for 2021 (Year 9) dated September 28, 2022, is attached. The 2022 (Year 10) monitoring report and the 10-year program report will be submitted with the 2024 Annual Report.

The 2020 (Year 2 of Addendum 1) report for the Lower Fraser River Stranding Assessment is in draft and under review and will be submitted with the 2024 Annual Report.

#### **5.10 BRGMON-10 Carpenter Reservoir Productivity Model Validation and Refinement**

The objective of this monitoring program was to collect the information required to validate and refine models of the effects of reservoir operation on the biological productivity of Carpenter Reservoir. Reservoir operations drive physical conditions such as light, temperature, nutrient concentrations, and turbidity, which translate to a biological response.

Using data collected under BRGMON-6, BRGMON-10 used two types of models to determine rates of biological production in Carpenter Reservoir. The first model was a habitat model and the second was a physical/chemical model. The models were linked together to predict the biological productivity response to reservoir operations.

This monitoring program was initiated in May 2015 and was implemented over three years to 2017.

This project is complete.

#### **5.11 BRGMON-11A Lower Bridge River Riparian Vegetation Monitoring**

The objective of the BRGMON-11A monitoring is to quantify the response of key physical and biological indicators in the Lower Bridge River to different instream flow regimes to determine which variables explain any changes in the riparian community. Note that the first year of BRGMON-11A project was reported in a combined report with BRGMON-11B under BRGMON-11.

This monitoring program was initiated in 2012 and has been implemented annually for ten years. Implementation was extended in 2022 for another ten years until 2032 to accommodate the monitoring of water management impacts until the Lajoie Dam is reconstructed.

From 2016 to 2018 BC Hydro implemented modified operations at Downton Reservoir for dam safety reasons and conducted major capital improvements at Bridge River 1 and Bridge River 2 powerhouses that required extensive planned outages. This resulted in having a variance approved by CWR to allow discharges down the Lower Bridge River during freshet that were higher than the WUP Ordered operations. To plan for and better assess the impact of these operations, additional monitoring complementary to BRGMON-3 WUP monitoring was added (not included in WUP expenditures) and the results of both programs are integrated into the same report.

BC Hydro operated Terzaghi Dam under a flow variance approved by the CWR between the spring of 2015 and the spring of 2021 with flows peaking above the WUP target (Note: the WUP target maximum peak flow is 15 m<sup>3</sup>/s) each year except for 2020. A flow Order dated April 29, 2022, supersedes previous flow variance from the CWR. The objective of the flow Order is to minimize the risk of

a more impactful unplanned fall spill event by allowing higher flows during spring freshet. The conditions of the Order include using a set of Guiding Principles to inform the shape of the hydrograph and actual flow releases from Terzaghi Dam into the Lower Bridge River. The Guiding Principles are used in conjunction with BC Hydro's inflow forecasts annually in the springtime by the St'at'imc/BC Hydro Joint Planning Forum (JPF) to make flow recommendations to BC Hydro. Flow conditional monitoring is also implemented as a condition of the flow Order, and the data from this additional monitoring is incorporated into the BRGMON-11A monitoring report.

The TOR schedule identifies a final year of field work in 2021 including an annual monitoring report and then a separate full program final report to be submitted later in 2022. For efficiency purposes, BC Hydro has combined these two reporting deliverables into one single final report to be submitted in 2023.

The final 10-year program report will be submitted in the 2024 Annual Report.

## **5.12 BRGMON-11B Lower Bridge River Riverine Wildlife Monitoring**

The objective of the BRGMON-11B monitoring program is to document how riverine and riparian wildlife in the Lower Bridge River respond to alternate flow regimes.

This monitoring program was initiated in 2012 and has been implemented annually for ten years. Implementation was extended in 2022 for another ten years until 2032 to accommodate the monitoring of water management impacts until the Lajoie Dam is reconstructed. Note that the first three years of BRGMON-11B project was reported in a combined report with BRGMON-11A under BRGMON-11.

From 2016 to 2018 BC Hydro implemented modified operations at Downton Reservoir for dam safety reasons and conducted major capital improvements at Bridge River 1 and Bridge River 2 powerhouses that required extensive planned outages. This resulted in having a variance approved by CWR to allow discharges down the Lower Bridge River during freshet that were higher than the WUP Ordered operations. To plan for and better assess the impact of these operations, additional monitoring complementary to BRGMON-3 WUP monitoring was added (not included in WUP expenditures) and the results of both programs are integrated into the same report.

BC Hydro operated Terzaghi Dam under a flow variance approved by the CWR between the spring of 2015 and the spring of 2021 with flows peaking above the WUP target (Note: the WUP target maximum peak flow is 15 m<sup>3</sup>/s) each year except for 2020. A flow Order dated April 29, 2022, supersedes previous flow variance from the CWR. The objective of the flow Order is to minimize the risk of a more impactful unplanned fall spill event by allowing higher flows during spring freshet. The conditions of the Order include using a set of Guiding Principles to inform the shape of the hydrograph and actual flow releases from Terzaghi Dam into the Lower Bridge River. The Guiding Principles are used in conjunction with BC Hydro's inflow forecasts annually in the springtime by the St'at'imc/BC Hydro Joint Planning Forum (JPF) to make flow recommendations to BC Hydro. Flow conditional monitoring is also implemented as a condition of the flow Order, and the data from this additional monitoring is incorporated into the BRGMON-11B monitoring report.

The final 10-year program report (2012-2021) dated January 27, 2023, is attached.

#### **5.13 BRGMON-12 Bridge-Seton Metals and Contaminant Monitoring Program**

The objective of this monitoring program was to document water quality and potential heavy metal contamination in the Bridge River system. It was also intended to determine if reservoir operations resulted in a change to the concentration and/or distribution of metals and other contaminants. If redistribution occurred, the program was to assess if it resulted in an increased bioaccumulation of metals and contaminants in fish in the system.

This monitoring program was initiated in May 2013 and final reporting was completed in 2016.

This project is complete.

#### **5.14 BRGMON-13 Seton Sockeye Salmon Smolts Monitoring Program**

The objective of this monitoring program is to assess the effectiveness of Seton powerhouse shutdowns to reduce the total entrainment mortality of Sockeye Salmon smolts leaving Seton Lake. This study also includes abundance, timing, and biological characteristics of Sockeye smolts leaving the lake, and the relationship between the dam water release and proportion of Sockeye smolts through the Seton Dam into Seton River.

This monitoring program was initiated in April 2012 and was carried out annually to 2015. In 2016, monitoring was suspended due to safety and equipment concerns from the Seton River peak flows. In 2016, trials were implemented to test the durability and suitability of alternate equipment configurations to ensure crews could operate the equipment safely and efficiently under the higher peak flows.

In February 2020 the CWR approved TOR Addendum 1 for this study. The TOR Addendum extended the sampling window and added radio telemetry tagging to the field program. With these additions, two more years of field work were expected for 2020 and 2021. However, there were challenges with the radio tagging program in 2020 including a relatively high proportion of mortalities among the tagged smolts that impacted the quality of data collected. With these results, along with expected shut down of Seton Generating Station during spring freshet for capital and maintenance work in 2021, 2022 and 2023 (and every spring for the foreseeable future), the original field program is no longer being implemented. BC Hydro is planning further methodological changes to focus on using 'sensor fish' through the powerhouse and various water passages at the dam. We will be resubmitting a TOR addendum in 2023 for approval of these changes. The timing of this new activity is not dependent on the seasonal outmigration of smolts and can be implemented easily under different operating conditions.

All reports to date have been submitted.

#### **5.15 BRGMON-14 Effectiveness of Cayoosh Flow Dilution, Dam Operation, and Fishway Passage on Delay and Survival of Upstream Migration of Salmon in the Seton-Anderson Watershed**

The objective of this monitoring program is to determine the effectiveness of current dam operations to ensure successful migration of adult salmon via Seton Dam to spawning grounds. The program aims to evaluate:

- The sensitivity of salmon populations to variations in the level of Cayoosh dilution in Seton River.
- Alternative operating strategies that will mitigate delays in upstream migration without conflicting with other water use goals for environmental protection, flood risk, and power production in the Bridge Seton generating system.

The original monitoring program was initiated in August 2012 and concluded in 2016.

On December 15, 2017, the CWR approved Addendum 1 for BRGMON-14 to test alternative siphon scenarios at Seton Dam by extending enumeration of the Gates Creek Sockeye for up to an additional four years (2017-2020) with a re-assessment after each field season. After Year 2 of 4 (2018), BC Hydro concluded that the accuracy of post-passage survival estimates was not sufficient to differentiate between routine and alternative Seton Dam Operations and therefore decided against continuing the study beyond 2018.

This project is complete.

#### **5.16 BRGMON-15 Seton Erosion Management Project: Phases 1 and 3**

The overall objective of both Seton Erosion Management Projects (BRGMON-15 and BRGWORKS-2) is to identify and manage the priority high and moderate risk shoreline and riverbank erosion sites that are impacted by the operation of the Bridge-Seton Generation facilities. The erosion sites may be adjacent to heritage, cultural and aesthetic resources, and other non-heritage sites on Seton Lake and Seton River.

Phase 1 includes identifying sites and determining the appropriate options to manage the erosion. Options may include mitigation (Phase 2) and/or may involve monitoring – depending on the risks and characteristics of the site. Subsequent implementation of mitigation plans would be carried out under BRGWORKS-2 Seton Erosion Management Projects: Site Specific Mitigation Physical Works.

Field work was completed in 2013 and 2014 on Seton Lake and on Seton River in 2015 and 2016. Following community meetings in 2018 and 2019, St'át'imc communities identified new sites on Seton Lake and field visits were conducted in August 2019.

On November 20, 2020, a TOR Revision was approved by the CWR that clarified the alignment to the WUP Order clauses, reflected changes to methods and approach and included scope and budget for Phase 3 monitoring.

The report dated October 21, 2020 (related to the 2013 and 2014 field work on Seton Lake) was submitted along with the TOR Revision. Additionally, one report related to work on Seton River, not funded by the WUP project, but relevant to

the updated scope of BRGMON-15 TOR Revision was also submitted to the CWR at that time.

A conceptual design report for the mitigation of three sites identified by local communities on Seton Lake was submitted February 2022.

In 2021, BC Hydro and St'at'imc developed a short-list of sites around Seton Lake for which geotechnical and geomorphological information was collected to determine the relative erosion risk at each site. The results of this work including recommendations for mitigation and monitoring is documented in a Phase 1 Recommendations Report submitted February 2022.

Our contract team for the Seton Lake sites completed conceptual designs for the identified priority erosion sites in 2022. This report is currently in draft form and will be submitted with next year's annual report. Upcoming design and construction work associated with priority sites under BRGMON-15 will be done under BRGWORKS-2. BC Hydro will be reviewing BRGMON-15 results and the outcome of BRGWORKS-2 to determine if future monitoring will be necessary. We expect activity under BRGMON-15 to pause until design work under BRGWORKS-2 is substantially complete.

#### **5.17 BRGMON-16 Lower Bridge River Spiritual and Cultural Value Monitoring**

The objective of this monitoring program was to assess the response of St'at'imc spiritual and cultural values to the flow regime on the Lower Bridge River.

This monitoring program was initiated in spring of 2014 and was carried out over five years ending in 2018.

This project is complete.

### **6 Status of Physical Works**

#### **6.1 BRGWORKS-1 Carpenter Re-vegetation**

The objective of this physical work program is to vegetate an approximately 400 ha area of the Carpenter Reservoir drawdown zone between Tyaughton Lake Road Junction and the Gun Creek Fan. Monitoring the effectiveness of this physical works program is undertaken as part of the BRGMON-2: Carpenter Reservoir Riparian Vegetation Monitoring.

This program was initiated in 2014 and was carried out in intervals until 2020.

In 2020, the final year of the planting program was completed which included seeding, live staking, and substrate mounding with 2021 including watering maintenance, comprehensive reporting, and installation of public information signage.

The 10-year program report dated May 27, 2022, is attached.

#### **6.2 BRGWORKS-2 Seton Erosion Management Projects – Site-specific Mitigation Physical Works**

The objective of this project is to implement the mitigation plans for erosion protection of the priority sites as developed under the related (Phase one) BRGMON-15 project.

On May 12, 2020, the CWR approved the TOR for BRGWORKS-2 to advance mitigation at the first site on the Seton River. The design basis was updated in 2022 and we are continuing to work with our engineering contractor on design. Construction could start as early as fall of 2023. Prior to moving to construction, we will resubmit a request for budget increase to the CWR for approval.

## **7 Monitoring Programs and Physical Works Costs**

The following table summarizes the Bridge River WUP monitoring programs and physical works costs approved by the Comptroller and the Actual Costs to January 31, 2023.

Table 7-1: Bridge River WUP Monitoring Programs and Physical Works 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
Bridge River WUP Annual Report	\$25,112	\$23,518	\$2,350	\$25,868	(\$756)		
BRGM01A Low Bridge R Aquatic	\$6,894,960	\$3,330,133	\$3,515,445	\$6,845,578	\$49,382		
BRGM01A Low Bridge R Aquatic - OR DM	\$318,876	\$144,686	\$176,815	\$321,502	(\$2,626)		
BRGM01A Low Bridge R Aquatic - OR Imp	\$6,576,084	\$3,185,447	\$3,338,630	\$6,524,076	\$52,008		
BRGM02A Carpenter Rse Riparia	\$837,752	\$755,727	\$47,196	\$802,923	\$34,829		
BRGM02A Carpenter Rse Riparia - OR DM	\$100,937	\$94,151	\$11,743	\$105,893	(\$4,956)		
BRGM02A Carpenter Rse Riparia - OR Imp	\$736,815	\$661,576	\$35,453	\$697,029	\$39,786		
BRGM03A Low BR Salmon & Steel	\$7,119,710	\$3,293,544	\$3,814,720	\$7,108,265	\$11,445		
BRGM03A Low BR Salmon & Steel - OR DM	\$282,107	\$103,203	\$187,612	\$290,815	(\$8,708)		
BRGM03A Low BR Salmon & Steel - OR Imp	\$6,837,603	\$3,190,342	\$3,627,108	\$6,817,450	\$20,153		
BRGM04A Carp Rse&Mld BR Fish	\$1,843,675	\$1,756,603	\$78,238	\$1,834,841	\$8,834	Extension required after Lajoie Dam upgrade is complete.	Resubmission expected in 2023.
BRGM04A Carp Rse&Mld BR Fish - OR DM	\$98,053	\$51,696	\$13,916	\$65,612	\$32,441		
BRGM04A Carp Rse&Mld BR Fish - OR Imp	\$1,745,622	\$1,704,907	\$64,321	\$1,769,228	(\$23,606)		
BRGM05A Downton Rse Riparian	\$355,756	\$193,883	\$161,449	\$355,332	\$424		
BRGM05A Downton Rse Riparian - OR DM	\$26,922	\$29,568	\$4,000	\$33,568	(\$6,646)		
BRGM05A Downton Rse Riparian - OR Imp	\$328,834	\$164,315	\$157,449	\$321,764	\$7,070		
BRGM06A Seton Lake Aquatic Pr	\$1,319,947	\$1,269,557		\$1,269,557	\$50,390	Project Complete	
BRGM06A Seton Lake Aquatic Pr - OR DM	\$32,524	\$24,224		\$24,224	\$8,300		
BRGM06A Seton Lake Aquatic Pr - OR Imp	\$1,287,423	\$1,245,333		\$1,245,333	\$42,090		
BRGM07A Downton Rse Fish Habi	\$1,063,401	\$1,054,866	\$8,507	\$1,063,373	\$28	Extension required after Lajoie Dam upgrade is complete.	Resubmission expected in 2023.
BRGM07A Downton Rse Fish Habi - OR DM	\$87,909	\$56,518	\$3,016	\$59,534	\$28,375		
BRGM07A Downton Rse Fish Habi - OR Imp	\$975,492	\$998,348	\$5,491	\$1,003,839	(\$28,347)		
BRGM08A Seton Fish Hab & Pop	\$947,702	\$806,919	\$52,603	\$859,522	\$88,180	Extension required after Lajoie Dam upgrade is complete.	Resubmission expected in 2023.
BRGM08A Seton Fish Hab & Pop - OR DM	\$85,780	\$37,270	\$6,603	\$43,873	\$41,907		
BRGM08A Seton Fish Hab & Pop - OR Imp	\$861,922	\$769,649	\$46,000	\$815,649	\$46,273		
BRGM09A Seton R Habitat & Fis	\$1,672,664	\$1,510,070	\$71,959	\$1,582,029	\$90,635	Extension required after Lajoie Dam upgrade is complete.	Resubmission expected in 2023.
BRGM09A Seton R Habitat & Fis - OR DM	\$72,067	\$76,305	\$6,415	\$82,721	(\$10,654)		
BRGM09A Seton R Habitat & Fis - OR Imp	\$1,600,597	\$1,433,764	\$65,543	\$1,499,308	\$101,289		
BRGM10A Carp Rse Prod Model	\$995,981	\$995,904		\$995,904	\$77	Project Complete	
BRGM10A Carp Rse Prod Model - OR DM	\$23,991	\$26,470		\$26,470	(\$2,479)		
BRGM10A Carp Rse Prod Model - OR Imp	\$971,990	\$969,434		\$969,434	\$2,556		
BRGM11A Low BR Riparian Vege	\$1,412,458	\$575,639	\$686,230	\$1,261,870	\$150,589	Efficiencies found during project implementation	
BRGM11A Low BR Riparian Vege - OR DM	\$148,689	\$85,915	\$30,850	\$116,765	\$31,924		
BRGM11A Low BR Riparian Vege - OR Imp	\$1,263,769	\$489,724	\$655,380	\$1,145,105	\$118,665		
BRGM11B Low BR Riverine Wild	\$588,448	\$182,747	\$381,455	\$564,202	\$24,246	Efficiencies found during project implementation	
BRGM11B Low BR Riverine Wild - OR DM	\$91,351	\$28,647	\$66,618	\$95,264	(\$3,913)		
BRGM11B Low BR Riverine Wild - OR IMP	\$497,097	\$154,101	\$314,837	\$468,938	\$28,159		
BRGM12A Bridge-Seton Metals	\$481,257	\$117,247		\$117,247	\$364,010	Project Complete	
BRGM12A Bridge-Seton Metals - OR DM	\$65,889	\$12,809		\$12,809	\$53,080		
BRGM12A Bridge-Seton Metals - OR Imp	\$415,368	\$104,438		\$104,438	\$310,930		
BRGM13A Seton Powerhouse	\$2,241,459	\$1,765,657	\$215,499	\$1,981,156	\$260,303	Project on hold pending reassessment.	Resubmission expected in 2023.
BRGM13A Seton Powerhouse - OR DM	\$113,881	\$105,691	\$15,499	\$121,190	(\$7,309)		
BRGM13A Seton Powerhouse - OR Imp	\$2,127,578	\$1,659,966	\$200,000	\$1,859,966	\$267,612		
BRGM14A Cayoosh Flow Dilutio	\$2,564,557	\$2,409,441		\$2,409,441	\$155,116	Project Complete	
BRGM14A Cayoosh Flow Dilutio - OR DM	\$66,600	\$54,591		\$54,591	\$12,009		
BRGM14A Cayoosh Flow Dilutio - OR Imp	\$2,497,957	\$2,354,850		\$2,354,850	\$143,107		
BRGM15A SON Erosion Mitigate	\$1,027,670	\$561,697	\$213,339	\$775,036	\$252,634	Efficiencies found during project implementation	
BRGM15A SON Erosion Mitigate - OR DM	\$224,463	\$177,596	\$45,026	\$222,622	\$1,841		
BRGM15A SON Erosion Mitigate - OR Imp	\$803,207	\$384,101	\$168,313	\$552,414	\$250,793		
BRGM16A Spiritual & Cultural	\$495,211	\$471,773		\$471,773	\$23,438	Project Complete	
BRGM16A Spiritual & Cultural - OR DM	\$44,246	\$31,244		\$31,244	\$13,002		
BRGM16A Spiritual & Cultural - OR Imp	\$450,965	\$440,530		\$440,530	\$10,435		
BRGW01A Carp Re-Vegetation	\$1,390,852	\$1,355,271	\$14,875	\$1,370,147	\$20,705	Project Complete	
BRGW01A Carp Re-Vegetation - OR DM	\$120,051	\$107,053	\$5,672	\$112,725	\$7,326		
BRGW01A Carp Re-Vegetation - OR Imp	\$1,270,801	\$1,248,218	\$9,203	\$1,257,421	\$13,380		
BRGW02A SON Erosion Control	\$1,196,621	\$293,333	\$415,680	\$709,013	\$487,608	Forecast doesn't include updated cost estimate as design is still in progress.	Resubmission with increased budget request expected in 2023.
BRGW02A SON Erosion Control - OR DM	\$180,710	\$156,275	\$39,370	\$195,646	(\$14,936)		
BRGW02A SON Erosion Control - OR Imp	\$1,015,911	\$137,058	\$376,310	\$513,368	\$502,543		
OR - Ordered Remissible ONR - Ordered Non-Remissible							

\* Red values in parentheses denote overage.