Bridge River Project Water Use Plan

Monitoring Program Terms of Reference

BRGMON-11B Lower Bridge River Riverine Wildlife Monitoring

Revision 2
March 28, 2022

BRGMON-11B – Lower Bridge River Riverine Wildlife Monitoring Monitoring Program Terms of Reference Revision 2

1.0 Monitoring Program Rationale

1.1 Introduction

This BRGMON-11B Terms of Reference (TOR) Revision 2 supports a submission package for an Interim Flow Decision and subsequent Order(s) anticipated from the Comptroller of Water Rights in addition to the original Bridge River Project Water Use Plan Order (Bridge WUP Order) dated March 30, 2011 (Schedule A, Clause 8b) as follows:

b. Monitor if changes in riparian community and instream flow conditions influence Lower Bridge River corridor wildlife populations.

The vegetation monitoring component continues to be addressed in the BRGMON-11A TOR.

1.2 Background

1.2.1 Water Use Planning

In 1998 an agreement between BC Hydro and regulatory agencies was adopted in response to public, First Nations, and agency concerns about the lack of continuous flow releases from the Terzaghi Dam into the Lower Bridge River. The agreement specified that an instream flow release and monitoring program be developed and implemented to resolve uncertainty about response of the Lower Bridge River aquatic ecosystem to reservoir releases. The agreement specified that an experimental flow release program was to be initiated and continued until a Water Use Plan (WUP) was developed for the Bridge-Seton watershed.

On July 28, 2000, the Comptroller of Water Rights issued an Order under the Water Act (now the Water Sustainability Act) to initiate an annual water budget of 3 m^3/s shaped into a seasonal hydrograph plus associated monitoring studies to estimate the effect of that flow treatment on the aquatic ecosystem. Previous flow assessment studies (1993-1995) and ecological monitoring (1996-2000) provided some baseline data on zero flow from Terzaghi Dam into the Lower Bridge River to compare with the 3 m^3/s flow trial.

Based on the recommendations of the WUP Consultative Committee, a WUP Order was issued by the Comptroller of Water Rights on March 30, 2011 requiring a second treatment with an increase in the annual water budget to 6 m^3/s shaped into a seasonal hydrograph. This WUP Order also included the implementation of monitoring studies to inform future flow decision.

BRGMON-11B evaluates the relationship between different flow releases at Terzaghi Dam and key physical and biological indicators of lotic productivity, including riverine wildlife. It was also recognized that the temporal dynamics of

the riparian plant community occur over much longer time scales than the aquatic community, with consequences for riparian wildlife.

Vegetation and wildlife monitoring were originally considered together under a single TOR for the BRGMON-11 program. The BRGMON-11 monitoring program was intended to document how the flow trials affect the riparian community in terms of spatial extent, relative recruitment rate of plant species, the overall productivity of the riparian community, indirect impacts on riparian wildlife populations, and direct impacts on riverine wildlife.

1.2.2 Long-Term Flow Decision

The results from WUP studies on the Lower Bridge River were intended to inform a long-term flow release strategy recommendation by 2015.

In 2015 and in subsequent years leading up to 2022 when a request for an Interim Flow Decision was submitted by BC Hydro, the Comptroller of Water Rights conditionally approved delaying decision on the long-term flow release strategy.

The water management challenges posed since 2016 (see Section 1.2.3) necessitated further deferral of the long-term flow release strategy until an interim flow strategy could be developed. The Interim Flow Decision requested by BC Hydro in 2022 considers the flexibility needed for flows from Terzaghi Dam until BC Hydro infrastructure upgrades are substantially complete and water management capacity in the Bridge River-Seton system is restored.

1.2.3 High Flow Challenges in the Lower Bridge River

In 2016, BC Hydro Dam Safety issued a directive to reduce storage capacity of Downton Reservoir by ~50% to manage seismic risk. In the same year, BC Hydro advanced critical infrastructure upgrades at the Bridge River 1 and 2 Generating Stations to address the added water management risks associated with reduced storage in Downton Reservoir. The infrastructure upgrades affected the volume of water that could be diverted through Bridge River 1 and 2 from Carpenter Reservoir to Seton Lake. As a result, releases higher than the annual average 6 m^3/s (specifically in the springtime freshet period) may be discharged from Terzaghi Dam down Lower Bridge River in some years based on inflows into the reservoirs and the capacity of Bridge 1 and 2 to pass those inflows. This increased risk of higher flows into the Lower Bridge River is expected to continue until water management capacity in the Bridge River-Seton system is restored through completion of major infrastructure upgrades.

BC Hydro received variance approvals (March 14, 2016, February 16, 2017, February 22, 2018, December 19, 2018 and May 4, 2021) from the Comptroller of Water Rights to vary the Terzaghi Dam discharges from those specified in the WUP, and to implement a more flexible flow regime at Terzaghi Dam following a set of Guiding Principles to inform within season flow release decisions. The discharge variance approvals permitted BC Hydro to exceed the annual average six m^3/s treatment hydrograph and specifically the 15 m^3/s maximum peak discharge during the annual freshet flow period (~March to August). Outside of the freshet flow period, BC Hydro has been able to operate Terzaghi Dam according to the seasonal WUP hydrograph limits. These actions to pre-

emptively release higher flows during the freshet period substantially reduce the risk of a late summer/fall high flow release which would pose a much greater impact to the aquatic life in the Lower Bridge River (i.e., spawning salmon).

1.2.4 Joint Water Management

From 2016 to 2018 the hydrograph peak and duration during the high flow period were shaped by inflow volumes, with Terzaghi Dam discharges reaching 97 m^3/s in 2016, 127 m^3/s in 2017, 100 m^3/s in 2018 and 25 m^3/s in 2021. Spring freshet flows in these years were managed using the *Guiding Principles* developed jointly in meetings with representatives from St'át'imc, BC Hydro and regulatory agencies where water management options and risks to aquatic life were discussed collaboratively.

The planning meetings were formalized in late 2019 into what is now known as the Joint Planning Forum (JPF) with membership from St'át'imc and BC Hydro, invited participants from regulatory agencies, and occasionally also invited guests from the St'át'imc communities and other supporting parties.

The JPF meets on a monthly basis (or more frequently as required) and has a mandate that includes reviewing water conveyance operations and flow management at the Bridge-Seton Generation Facilities, both on a near and long-term basis, and as part of a potential *interim long-term flow strategy*. The JPF has been successful in providing joint recommendations for water management decisions ultimately made by BC Hydro. The JPF has provided a venue for joint problem solving between St'át'imc and BC Hydro for water management and environmental mitigation projects associated with the impacts of BC Hydro operations.

Revision 2 of this Terms of Reference outlines environmental monitoring associated with the interim flow recommendations provided by the JPF to support BC Hydro's request to the Comptroller of Water Rights for an interim flow decision on the Lower Bridge River.

1.3 Revision Rationale and Summary of Key Changes

In Revision 1 of this TOR, the uniquely separate goals and tasks related to the riparian vegetation versus wildlife monitoring were considered, and a decision was made to split BRGMON-11 into two separate components BRGMON-11A for vegetation monitoring and BRGMON-11B for wildlife monitoring. The rationale for that decision was as follows:

- Clarity with respect to the Management Questions for each BRGMON-11 component.
  - Revision 1 adopted the original single general Management Question related to wildlife an overall objective and then added six new Management Questions. These changes include:
    - Management Questions one to three were added to clarify scope and expectations for meeting the objective of the Order
    - Management Questions four and five more explicitly relate to a riparian keystone species (beaver) which is likely to be sensitive to flows, depends on riparian habitat, and influences riparian habitat through herbivory

    - Management Question six seeks to address a general riparian wildlife community knowledge gap
- With the new Management Questions, Revision 1 also added two related hypotheses for discussion purposes.
- Revision 1 retained the original monitoring program that encompassed potential direct and/or indirect impacts of flow on riverine birds.
- Revision 1 addressed relevant interactions between flows, and the riparian community (riparian wildlife – see below) as per concerns expressed by the Consultative Committee, and in accordance with the Order.
- Revision 1 introduced tasks for monitoring beaver populations which were not included in the original TOR.

Revision 2 of the TOR outlines changes to be implemented after the initial WUP-Ordered monitoring period has been completed (Final Report anticipated in 2022). The Revision 2 TOR shifts the monitoring objective from assessing performance of the WUP "regime" (i.e., six m^3/s vs three m^3/s), to informing the Guiding Principles for flow management during the spring freshet. Revision 1 Management Questions (MQ's) remain unchanged; however, it is recognized that a subset of the MQ's are unrelated to flow management during the freshet, and that several will be adequately addressed in the WUP-Ordered Final Report. Monitoring performed under the Revision 2 TOR will focus on MQ's related to the Revision 2 objective, and some monitoring approaches may need to be modified.

Specific considerations for Revision 2 include:

- Provide opportunity to adjust monitoring focus away from management concerns that have been adequately addressed under the WUP study
- Shifting focus of monitoring goals towards evaluating how the magnitude and duration of peak flows affects riverine and riparian wildlife
- Informing assessment of the trade offs between wildlife impacts and impacts to other values considered in the Guiding Principles
- Clarity on reporting expectations that align with annual reviews by the JPF and collaboration with study teams to foster adaptive management of this study

A detailed summary of the revision changes to this WUP TOR revision is provided in Appendix A.

1.4 Management Questions

Riverine Birds

The first three management questions are addressed using the multi-year dataset generated by Harlequin Duck monitoring done under the original BRGMON-11 TOR and by earlier independent monitoring programs.

1. How has the population of Harlequin Ducks in Reaches 3 and 4 of the Lower Bridge River[1] (as enumerated prior to the nesting period with 'pair surveys') varied over time, and is this population index related to flow conditions?
2. Are Harlequin Duck brood counts, monitored in Reaches 3 and 4 of the Lower Bridge River, influenced by flow conditions?

[1] Reach 3 and 4 extend between the Terzaghi Dam and the confluence of the Lower Bridge River with the Yalakom River.

3. Are other riverine bird species likely to be influenced by flow conditions; if so, how?

The interpretation of results should recognize and consider that nesting or brood-rearing areas may shift into or out of the study area. The underlined portion of management question 1 is of greatest relevance to this TOR and will consider within-season variability over among-year variability; however, extending the multi-year time series (i.e., maintaining status quo pair surveys) remains a priority. To address the Revision 2 objective under management question 1 and 2, it is anticipated that changes may be required to the analysis, and potentially the introduction of additional pair and brood surveys during the spring freshet.

Riparian Wildlife

Riparian wildlife communities rely on riparian vegetation, which is in turn dependent on river flows, and is potentially influenced by flow conditions in the Lower Bridge River.

Addressing management question four involves analysis of a multi-year datasets where each year provides a single data point. Given the late initiation of beaver population monitoring, additional years of monitoring are required to address management question four.

4. How many active beaver lodges are there in reaches 2, 3, and 4 of the Lower Bridge River in fall, how are they distributed, and how do these data vary among years?

Management questions five and six were addressed by work completed in Revision 1 and no further effort is necessary.

5. Is the distribution of beavers in the Lower Bridge River influenced by river morphology or possibly by flows?
6. Which riparian bird populations are most vulnerable to being impacted by changes to riparian habitat along the Lower Bridge River, and what ramifications do vegetation monitoring results have for riparian birds at the regional scale?

1.5 Management Hypotheses

In most cases, BRGMON-11B monitors effects and addresses data gaps for which there are no working hypotheses or predictions. Two working hypotheses/predictions emerged during early monitoring and are useful to describe; H_1 has relevance to Management Question three, and H_2 has relevance to Management Question five.

H_1: The timing and availability of American Dipper food is influenced by the regulation of the Lower Bridge River. This can include: (A) altered phenology to developing salmon eggs; and (B) low retention and/or recruitment of aquatic invertebrates below the Terzaghi Dam.

H_2: The density and distribution of beaver is influenced by river morphology and flow, and beavers exert a strong impact on riparian habitat in the Lower Bridge River. In particular: (A) beaver require a minimum flow for the Lower Bridge River to be suitable; (B) beaver distribution is influenced by the strength of river currents; and (C) the balance between cottonwood mortality caused by herbivory versus cottonwood recruitment is influenced by flow.

H_2 and Management Question five were addressed by work completed in Revision 1 and no further effort is necessary.

1.6 Key Water Use Decision Affected

The key water use planning decision affected by BRGMON-11B will be continuing to support the original WUP monitoring objectives and decision processes anticipated during the WUP Order review while also supporting year by year decision making using the Guiding Principles during a period of variable instream flows for the Lower Bridge River.

2.0 Monitoring Program Proposal

2.1 Objective

The objective of this monitoring program is to document how riverine and riparian wildlife in the Lower Bridge River respond to flow; under this TOR, this objective specifically considers flows during the spring freshet release period. Results will be used to inform the upcoming WUP Order Review process and the anticipated year by year water management decisions using the Guiding Principles.

2.2 Approach

The proposed monitoring program will continue to collect three components standardized to be comparable with the existing long-term dataset collected under BRGMON-11:

7. Harlequin Duck 'pair' surveys,
8. Harlequin Duck 'brood count' surveys, and
9. Beaver Lodge surveys to monitor the autumn abundance and distribution of beavers on the Lower Bridge River.

The Harlequin Duck surveys (one and two above) are distinguished only based on their early versus late time of implementation during the Harlequin Duck breeding season. Additional Harlequin Duck surveys can be introduced before, between or after these standard surveys to enhance temporal resolution of data during the freshet period when water management decisions are being made. During all surveys standardized inventory on other riverine wildlife is encouraged.

The biennial monitoring schedule will sustain long term monitoring and strengthen ability to address the Management Questions; however, monitoring will be a priority in years when water management decisions are anticipated (i.e., high flow years).

Workshops will be held to inform and refine sampling approaches outlined above.

2.3 Methods

2.3.1 Task 1 Project Coordination

Project coordination involves the general administrative and technical oversight of the program. This will include but not be limited to 1) budget management;

2) staff selection; 3) logistic coordination; 4) technical oversight in field and analysis components; and 5) liaison with regulatory and First Nations groups.

2.3.2 Task 2 Data Collection

Riverine Bird Surveys

Riverine bird surveys (Harlequin Duck pair and brood surveys) will be conducted to assess how riverine birds are responding to flow conditions; methods will be consistent with those previously used (e.g., Heinrich and Walton 2014). After each survey, the number of individuals of each species and their locations will be totaled and recorded. All bird locations will be marked onto field maps and later plotted using a GIS program.

Fall Beaver Lodge Surveys

Active beaver lodges will be surveyed to describe how beaver are distributed along reaches 2,3 and 4 of the Lower Bridge River. After each survey, the number of lodges and their locations will be totaled and recorded. All lodge locations will be marked onto field maps and later plotted using a GIS program.

Data Entry

All data will be entered into multi-year relational databases; one for riverine bird data, and another for beaver lodge data. At minimum, each database will include a table for observations, and a table for surveys; the beaver database will also have a table capturing data about each lodge, which could be observed across multiple surveys/years.

2.3.3 Task 3 Workshop

St'át'imc and BC Hydro wildlife biologists will participate in the workshops. The goal of the workshops will be to optimize survey effort for monitoring Harlequin Duck. Specifically, there will be two objectives:

1. To determine if all five Harlequin Duck surveys (two pair and three brood) are required for multi-year monitoring, and
2. To determine the most appropriate monitoring plan for informing Guiding Principles for JPF water management decisions on the Lower Bridge River.

The workshop participants will work with existing Riverine Bird data to accomplish these objectives. Examples of workshop activities include (a) assessing sensitivity of long term analysis outcomes to data exclusions (to optimize sustainment of long term data set), (b) assessing the spread of available data throughout the freshet period and across flow regimes (to understand data gaps), and (c) assessing sequential within-year variability in survey results (to better understand survey results and patterns of detection).

2.3.4 Task 4 Reporting

- Annual technical reports will be submitted in each year of study to describe annual conditions, summarize survey effort, and to report results.
- The final report will analyze all available data, including relevant data collected outside of this WUP program. Any external sources of information, if

referenced appropriately with permissions if required, should be used in conjunction with the study's data to address the Management Questions.

- The Final Report will access and/or reference data and/or results from:
  - Other WUP studies (e.g., BRGMON-11A);
  - Other relevant non-WUP studies; and
  - Other relevant sources of local information (e.g., historic Harlequin Duck data).

Reports will follow the standard format for WUP monitoring projects (templates to be provided by BC Hydro). All reports will be provided to BC Hydro as Microsoft Word and Adobe Acrobat (*.pdf) format.

2.4 Interpretation of Monitoring Program Results

The data and information collected will ultimately be used to assess the degree to which management objectives and technical expectations were met by the implementation of various operational conditions and application of the Guiding Principles as well as to inform refinements to the Guiding Principles with respect to wildlife if recommended by the JPF. The results of the monitoring program can also be used to better support more inferences of the expected influence of instream flow on wildlife habitat conditions and permit more defensible conjecture about impacts of flow on abundance and diversity of wildlife populations.

2.5 Schedule

The schedule for the annual activities will be phased to accommodate the requirements of the program. The schedule for the proposed program is provided below in Table 1.

- Riverine Bird surveys and fall beaver surveys will occur at minimum on a bi-annual basis until the end of the study period.
- Riverine Bird surveys and fall beaver surveys will occur in intervening years if the WUP conditions cannot be met (e.g., when freshet flow is anticipated to exceed 15 m^3/s) with additional field days applied upon recommendation from the JPF.
- Annual reporting will coincide field survey years.
- A final report will follow the last year of survey.

Table 1: Schedule

Tasks	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Wildlife Surveys[2]	X		X		X		X		X	
Annual Report	X		X		X		X		X	
Technical Workshop[2]	X	X	X							
Final Report										X

2.6 Budget

Total program cost: $497,097.

References

Walton, R and R Heinrich. 2014. BRGMON-11. Riverine bird response to habitat restoration on the Lower Bridge River; 2014 report. Unpublished report prepared for BC Hydro Water Licence Requirements, Burnaby, BC.

[2] Effort may be required in intervening high flow years. The assumption we have made for budget purposes is 3 additional field years. Workshops can also occur during intervening years and timing can be adjusted as necessary.

2.6.1 Appendix A: Key changes to the BRGMON-11B WUP TOR and rationale for their inclusion

Section	Change	Rationale
Throughout	• Shifted focus a focus on flow regime to flow conditions • Introduced the Guiding Principles and a shift in monitoring focus to year-by-year variable flow conditions during freshet • Introduced the role of the Joint Planning Forum and their needs to inform annual decision based on the Guiding Principles • Consolidating scope that was formerly included in high flow and mitigation monitoring within the scope of the WUP Terms of Reference	• Although the flow regime concept will be revisited at the WUP Order review and this monitoring will continue to support that, the monitoring is shifting focus to better support variable freshet flow conditions on a year by year basis that we expect to continue until BC Hydro has substantially completed facility upgrades. • Acknowledge the linkages between data collected under this monitoring program and its value to applying the Guiding Principles to year-by-year recommendations for water management • Identifying that this monitoring program will now be under more direct oversight and recommendations of the Joint Planning Forum in order to support year-by-year recommendations for water management
Background	• Introduced Interim Flow Decision and discussed scheduling change of the Long Term Flow Decision • Detailed the history of high flow management in the Lower Bridge River from 2016 to 2022.	• Provides additional context for current water management approach in the Lower Bridge River.
Methods	• Adjusted monitoring focus away from management concerns that have been adequately addressed under the WUP Study (management questions 5 and 6) • Shifted focus of monitoring goals towards evaluating how the magnitude and duration of peak flows affects riverine and riparian wildlife.	• Clarify core program monitoring as well as conditional monitoring managed adaptively by the JPF
Reporting	• Updated reporting deliverables to include annual reports, interim final reports and final reports	• Align reporting deliverables with requirements of the JPF to foster adaptive management of the study as well as program summary reports to inform WUP order review and long term flow decisions.
Budget	• Detailed budget table includes estimates for conditional high flow monitoring	• Document full program cost and clarify budget allocation between ONR and BC Hydro funded years.