



Bridge River Project Water Use Plan

Monitoring Program Terms of Reference

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

**Revision 1
November 30, 2018**

BRGMON-11B – Lower Bridge River Riverine Wildlife Monitoring Monitoring Program Terms of Reference Revision 1

1.0 Monitoring Program Rationale

1.1 Introduction

This BRGMON-11B Terms of Reference (TOR) Revision 1 is submitted in compliance with the 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.*

This TOR Revision 1 replaces the wildlife component of BRGMON11 TOR approved by the Comptroller of Water Rights (CWR) on June 27, 2012. The vegetation monitoring of the original BRGMON-11 TOR is now addressed in the BRGMON-11A TOR, which has been submitted in compliance with the Bridge WUP Order Schedule A, Clause 8a as follows:

- a) Monitor influence of the flow regime on the riparian community of lower Bridge River.*

1.2 Background

The lack of continuous flow releases from the Terzaghi Dam into the Lower Bridge River has been a long standing concern of the public, First Nations, and regulatory agencies. In 1998, an agreement between BC Hydro and regulatory agencies specified that an instream flow test release and monitoring program be developed and implemented in an attempt 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.

As a result, on July 28, 2000, the Comptroller of Water Rights (CWR), under Section 39 of the *Water Act* ordered BC Hydro to initiate instream flow releases as of August 1, 2000, with an annual water budget of 3 m³/s (3 m³/s/y treatment) plus associated monitoring studies.

Beginning in 2003, BC Hydro embarked on developing Water Use Plans (WUPs) across the province. The WUP Consultative Committee for Bridge River (Bridge CC) recommended that BC Hydro evaluate the relationship between different flow releases at Terzaghi Dam and key physical and biological indicators of productivity. The Bridge River WUP Order, issued on March 30, 2011 under Sections 87 and 88 of the *Water Act* required a flow treatment with an annual water budget to 6 m³/s (6 m³/s/y treatment) and a maximum discharge of 15 m³/s. The Order also required monitoring, plus a long-term flow release

recommendation for Terzaghi Dam to be agreed upon by the Comptroller of Water Rights, regulatory agencies, St'at'imc First Nations and stakeholders by May 1, 2015 (Bridge WUP Order, Clause 9).

In terms of vegetation and wildlife, the Bridge CC identified that the test program associated with these flows should explicitly evaluate the impacts of the flow regime on riparian habitat conditions. It was recognized that the temporal dynamics of the riparian plant community occur over a much longer time scales than the aquatic community. The Bridge CC also recommended that monitoring program that documented how the flow regime trials affected the riparian community in terms of spatial extent, relative recruitment rate of plant species, the overall productivity of the riparian community and the consequent impact on wildlife populations.

Consequently, riparian and riverine wildlife monitoring is included under WUP Order dated March 30, 2011 and the CWR approved the BRGMON-11 TOR on June 27, 2012. The BRGMON-11 TOR included both riparian and wildlife monitoring and had a schedule requiring a complete suite of monitoring every four years with bird surveys every two years.

May 1, 2015 was the target decision and implementation date for the long-term flow release strategy under Clause 9 of the Bridge WUP Order. However, this target date has been delayed for various reasons. Since 2015, BC Hydro has received CWR approval to delay the target date on numerous occasions to allow more time for further consultation (May 28, 2015; December 18, 2015; December 23, 2016; and February 21, 2018). The target date continues to be deferred while consultation is ongoing.

In 2016, Dam Safety issued a directive to reduce storage capacity of Downton Reservoir by ~50% in order to manage seismic risk. In the same year, BC Hydro advanced critical infrastructure replacements at the Bridge Generating Station which affected the volume of water that could be diverted through the generating station from Carpenter Reservoir to Seton Lake. As a result, releases higher than the annual average $6 \text{ m}^3/\text{s}$ would need to be discharged from Terzaghi Dam down Lower Bridge River in some years, until the critical replacements are complete.

Since this time, BC Hydro received variances from the CWR to vary the Terzaghi Dam discharges from those specified in the WUP Order, and to implement a modified flow regime at Terzaghi Dam. These variances permitted BC Hydro to exceed the annual average $6 \text{ m}^3/\text{s}$ hydrograph and the $15 \text{ m}^3/\text{s}$ maximum discharge during the annual high flow period (~March to August). Outside of the high flow period, Terzaghi Dam has been operated according to the seasonal hydrograph limits. On February 21, 2018, the CWR confirmed that BC Hydro can continue to operate under the February 2017 variance order while consultation is underway and until a new decision is made by the CWR. The 2017 variance permitted modified discharges in accordance with a set of guiding principles jointly developed with DFO, MFLNRORD and the St'at'imc First Nations.

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 m³/s in 2016, 127 m³/s in 2017 and 100 m³/s in 2018.

The changes in this TOR Revision 1 are intended to improve the ability of the TOR to meet the requirements of the WUP Order, including informing a long-term flow recommendation and are considered necessary to improve the study, regardless of the modified operations.

Moreover, during the modified operations even without any changes to the monitoring methods and locations, the enhanced effect size potential is advantageous to addressing the original Management Questions in the BRGMON-11 program. However, the frequency of study has been increased to capture the variability of the modified operations flows, and have been excluded from the TOR budget.

1.3 Revision Rationale and Summary of Key Changes

The TOR has been revised in order to achieve the following objectives:

Separate the goals and tasks related to the independent riparian vegetation and wildlife monitoring components.

The TOR has been separated into BRGMON-11A for vegetation monitoring and BRGMON-11B for wildlife monitoring.

- By having two separate revised TOR's (BRGMON-11A and BRGMON-11B) there is clarity with respect to which Management Questions must be addressed for each BRGMON-11 component.
- The separated TORs are more consistent with the way the studies are implemented – with two separate contactors. The two revised TOR's provide clarity with respect to which project tasks must be addressed by the each contractor.

Improve clarity, particularly through revision of Management Questions and hypothesis.

In this TOR revision, all Management Questions are new. The original TOR had a single general Management Question related to wildlife which has been adopted as an overall objective in this Revision. This TOR revision now has six Management Questions. Specifically the changes that have been made include:

- Replacing the single wildlife Management Question from the original TOR with three more detailed questions (1 – 3). These management questions provide clear scope and expectations for meeting the objective of the Order;
- Management questions 4 through 6 have been added explicitly to address riparian wildlife impacts. Questions 4 and 5 relate to a riparian keystone species (beaver) which is likely to be sensitive to flows, depends on riparian

habitat, and also influences riparian habitat through herbivory. Question 6 seeks to address a general riparian wildlife community knowledge gap; and

- With the new Management Questions, we have also added two new related hypotheses.

Update monitoring tasks based on monitoring results and the new management questions.

The initial TOR was drafted with less pre-existing information for Lower Bridge River, and therefore had limited scope to direct monitoring based on linkages between flow regime, riparian vegetation, and riparian wildlife. The original TOR did not explicitly address this impact pathway, focusing instead on monitoring riverine wildlife which generally does not depend as much on riparian vegetation. This revision takes into account new information gathered during the early years of BRGMON-11 monitoring.

- The revised TOR retains the existing monitoring program that encompasses potential direct and/or indirect impacts of flow regime on riverine birds.
- The revised TOR addresses 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.
- New tasks have been added related to monitoring beaver populations which was not included in the original TOR.

Focus on a long-term flow recommendation and ensure comparability across all flow regimes implemented in the Lower Bridge River.

Only minor wording changes have been made to the original TOR to ensure it is applicable to all available instream flow regimes. This will insure the TOR provides information to support the long-term flow recommendation as required by Section 9 of the Bridge WUP Order.

1.4 Modified Operations Monitoring not included in this Revision

While operating under the CWR approved variances, BC Hydro has an added additional monitoring year to the original WUP schedule (2019) for BRGMON-11B. This additional monitoring year is not included in this TOR Revision 1 budget.

As the temporal dynamics of the riparian plant community and wildlife populations occur over a much longer scale than the aquatic community, annual evaluation was not included in the original TOR. However, an additional of monitoring has been added to supplement the WUP requirement to capture any impacts from larger variability in modified operations.

1.5 Management Questions

Riverine Birds

The first three management questions will be 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 River¹ (as enumerated prior to the nesting period with 'pair surveys') varied over time, and is this population index related to flow regime?
- 2) Are Harlequin Duck brood counts, monitored in Reaches 3 and 4 of the Lower Bridge River, influenced by flow regime?
- 3) Are other riverine bird species likely to be influenced by flow regime; 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.

Riparian Wildlife

Riparian wildlife communities rely on riparian vegetation, which is in turn dependent on river flows, and is potentially influenced by flow regime in the Lower Bridge River. Beaver is both a riparian and riverine species and is therefore likely to be indirectly and directly influenced by flow regime. Furthermore, early monitoring under BRGMON-11 determined that beaver herbivory is having a considerable directional impact on the survival of old cottonwood trees in the Lower Bridge River. Beaver therefore both rely-upon, and have an impact on riparian habitats, and their population size and distribution is potentially influenced by flow regime. Management Question-4 addresses an information gap on the temporal variability of beaver population size and distribution. Management Question-5 requires interpretation of Management Question-4 with respect to river morphology and flow regime.

To assess the impact of altered riparian vegetation on riparian wildlife, BRGMON-11 must address an information gap with respect to the nature of the riparian wildlife community that is potentially vulnerable to habitat alteration (Management Question-6). Management Question-6 will be informed by expert opinion and will include a review and or analysis of available data, or summary of available reports related to riparian birds in the Lower Bridge River. The response to this Management Question should focus on (1) riparian species that are most abundant the Lower Bridge River; (2) riparian species most likely to respond to the vegetation changes documented by BRGMON-11A; and (3) riparian species of conservation concern (e.g., Western Screech-owl). In each case, the importance should be couched within a regional context.

- 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?

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

- 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?

1.6 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 have emerged from recent monitoring and observations, and are useful to describe; H_1 has relevance to Management Question 3, and H_2 has relevance to Management Question 5.

- 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 regime, 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 regime.

1.7 Key Water Use Decision Affected

The key water use planning decision affected by BRGMON-11B will be establishment of a long term instream flow regime for the Lower Bridge River that considers the overall aquatic and riparian objectives for the area. The objective of the recommended program was to evaluate impacts of the flow trials on the riparian community and to use these data to help make predictions about the long term response of the plant community and how these factors may impact wildlife populations. Ultimately this information will contribute to the decision about the long term flow regime 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 alternate flow regimes regulated by the Terzaghi Dam.

2.2 Approach

The proposed monitoring program will have three components that are repeated annually:

- 1) Harlequin Duck 'pair' surveys to assess how the number and distribution of Harlequin Duck pairs is influenced by flow regime.
- 2) Harlequin Duck 'brood count' surveys to assess how Harlequin Duck productivity and/or the distribution of brood-rearing Harlequin Ducks are influenced by flow regime.
- 3) Beaver Lodge surveys to monitor the abundance and distribution of beavers on the Lower Bridge River.

During the Harlequin Duck surveys (1 and 2 above), data will be collected to enumerate the breeding populations of four other riverine bird species: Spotted Sandpiper, Common Merganser, Belted Kingfisher, and American Dipper.

2.3 Methods

The proposed monitoring program has the following primary tasks:

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 regime; 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 Reporting

- Annual technical reports will be submitted in each year of study to describe annual conditions, summarize survey effort, and to report results. Analyses can be included in the Annual report, but are not a requirement.
- A detailed Final report will be prepared prior to the review of the WUP.
- The Interim and Final Reports 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. In particular, it is expected that the Final Report will access and/or reference data and/or results from:
 - Other WUP studies (e.g, BRGMON-11A);
 - Other non-WUP studies including results from added years during modified flow regime; and
 - Other 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 in the proposed monitoring programs would ultimately be used to assess the degree to which management objectives and technical expectations were met by the implementation of various operational regimes. The results of the monitoring program can also be used to better support more inferences of the expected influence of instream flow regime on wildlife habitat conditions and permit more defensible conjecture about impacts of flow regime on abundance and diversity of wildlife populations.

2.5 Schedule

- The schedule for the annual activities is necessarily phased to accommodate the requirements of the program. Riverine Bird surveys will occur annually for the first three years and then on a bi-annual basis until the end of the 10-year study period. The schedule for the proposed program is provided below in Table 1.
- Work in 2019 is scheduled to measure short term impacts of modified operations instream flow regime changes (grey column in Table 1) and is not included in the budget in Section 2.6 below.

Table 1: Schedule

Tasks	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
1 Project Coordination	X	X	X		X		X	X	X	
2 Wildlife Surveys	X	X	X		X		X	X	X	
3 Reporting								X		
a Annual Report	X	X	X		X		X	X	X	
b Interim/Final Report			X					X		X

2.6 Budget

Total program cost: \$216,886.

3.0 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.

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

Section	Change	Rationale
All Sections	<ul style="list-style-type: none"> Removed all references to vegetation monitoring 	<ul style="list-style-type: none"> The vegetation monitoring will be conducted under BRGMON-11A
	<ul style="list-style-type: none"> Improved clarity over riparian versus riverine wildlife 	<ul style="list-style-type: none"> The original TOR was unclear regarding riparian versus riverine wildlife, which made the TOR confusing.
1.1 Introduction	<ul style="list-style-type: none"> Included references to the WUP Order. 	<ul style="list-style-type: none"> Included for reference
1.2 Background	<ul style="list-style-type: none"> Updated the background section summarizing the pre-WUP and WUP flow treatments. Added background on the modified flow regime. 	<ul style="list-style-type: none"> Added new relevant history and background since the original TOR from 2012.
1.3 Revision Rationale and Summary of Key Changes	<ul style="list-style-type: none"> Summarizes the changes in the Revision and the rationale Clarifies scope not included in this TOR related to only modified operations 	<ul style="list-style-type: none"> Provides continuity from previous TOR.
1.4 Management Questions	<ul style="list-style-type: none"> Removed original Management Question 1 	<ul style="list-style-type: none"> Management Question 1 was not relevant to wildlife
	<ul style="list-style-type: none"> Removed original Management Question 2, and converted into an in-text objective 	<ul style="list-style-type: none"> This Management Question was very general; useful as an objective, but not useful as an Management Question to direct contractor research/deliverables
	<ul style="list-style-type: none"> Created three new Management Questions (Management Questions 1 to 3) to be consistent with the former monitoring program's focus on riverine wildlife 	<ul style="list-style-type: none"> The original TOR was not detailed, and the implementation, while good, was not always clear regarding methods/objectives. The new Management Questions make it clear that riverine surveys are designed for specific Harlequin Duck nesting phases, and that other riverine species should be surveyed at the same time, to maximize value of surveys.
	<ul style="list-style-type: none"> Management Questions 4 and 5 added 	<ul style="list-style-type: none"> These pertain to beaver, which have been identified during early field work as a likely the most important ecological factor for riparian vegetation (herbivory). Because beaver distribution is likely influenced by flow regime, this species is a probable biotic pathway/mechanism by which flows influence riparian vegetation.
	<ul style="list-style-type: none"> Management Question 6 added 	<ul style="list-style-type: none"> This Management Question asks for a review of relevant information regarding the community of riparian wildlife that depend on riparian vegetation in the Lower Bridge River. This is recognized as a major data gap.

Section	Change	Rationale
1.5 Management Hypotheses	<ul style="list-style-type: none"> Removed previous formal Management Hypotheses 	<ul style="list-style-type: none"> Most were not relevant to wildlife H₁ is similar to the new Management Question 1 and Management Question 2, so is no longer useful.
	<ul style="list-style-type: none"> Added two new hypotheses 	<ul style="list-style-type: none"> These are presented more as working hypotheses/predictions, and in this regard, add guidance towards appropriate information, regarding discussion topics in the final report.
1.6 Key Water Use Decision Affected	<ul style="list-style-type: none"> Minor wording 	<ul style="list-style-type: none"> No changes of note
2.1 Objective and Scope	<ul style="list-style-type: none"> Minor wording 	<ul style="list-style-type: none"> Minor changes reflecting the wildlife focus of this TOR The focus of the program continues to be to define a long term flow release regime for the Lower Bridge River
2.2 Approach	<ul style="list-style-type: none"> Changed to be more specific, and to reflect new monitoring task. In particular, it is explained here that the surveys are HADU-specific, but that other riverine bird pops should be monitored 	<ul style="list-style-type: none"> Updating content Improving clarity
2.3 Methods	<ul style="list-style-type: none"> Task 2 Data collection edited for clarity 	<ul style="list-style-type: none"> To be more specific
	<ul style="list-style-type: none"> Task 2 Data collection added Beaver survey 	<ul style="list-style-type: none"> To address new Management Questions
	<ul style="list-style-type: none"> Task 2 Data entry added 	<ul style="list-style-type: none"> To assure data archived appropriately
	<ul style="list-style-type: none"> Task 3 Reporting - updated 	<ul style="list-style-type: none"> To provide more detail and clarity. To encourage usage of external data sources
2.4 Interpretation of Monitoring Program Results	<ul style="list-style-type: none"> Shortened this section – removed analysis details 	<ul style="list-style-type: none"> This section is related to relevance of monitoring program to WUP process, had material more relevant to final analysis, which was out of place, and confusing.
2.5 Schedule	<ul style="list-style-type: none"> Minor correction to Interim and final reporting 	<ul style="list-style-type: none"> To match historic and best future reporting schedule. To be more clear.
2.6 Budget	<ul style="list-style-type: none"> Updated 	<ul style="list-style-type: none"> Wildlife only. The only major budget change is the minor additional line item required for beaver surveys.