Bridge River Water Use Plan

Monitoring Program and Physical Works

Annual Report: 2016

Implementation Period: February 2015 to January 2016

- **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-11 Lower Bridge River Riparian Vegetation 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 29, 2016

BC Hydro Bridge River Project Water Use Plan Monitoring Programs and Physical Works Annual Report: 2016

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, 2016, as per the Bridge River Order under the *Water Act*, dated March 30, 2011. There are 16 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 CWR.

Table: 2-1: Dates of Bridge River WUP TOR Submissions and Approvals by the Comptroller of Water Rights

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.1	Jan 30, 2012	Apr 12, 2012		
BRGMON-2 Carpenter Reservoir Riparian Vegetation Monitoring	Schedule A.6	Jan 30, 2012	Jun 26, 2012		
BRGMON-3 Lower Bridge River Adult Salmon and Steelhead Enumeration	Schedule A.10	Jan 30, 2012	Feb 07, 2012	Feb 10, 2016	Pending
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		
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-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		
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	Feb 03, 2016	Pending
BRGMON-15 Seton Lake Erosion Mitigation Program	Schedule A.13	Mar 30, 2012	Jul 13, 2012		
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 Revegetation	Schedule A.4	Mar 14, 2014	May 02, 2014		
BRGWORKS-2 Seton Lake Erosion	Schedule A.12	Not yet submitted			

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, 2016

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
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-11 Lower Bridge River Riparian Vegetation 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		✓	✓	✓	■	■					
Physical Works											
BRGWORKS-1 Carpenter Revegetation			✓	✓	■	■	■	■			
BRGWORKS-2 Seton Lake Erosion				x	x[1]						

Legend:
■ = Program to be undertaken/initiated in identified year
✓ = Program completed for the year
x = Program start delayed
1 = Program start delayed due to complexities in identifying erosion sites and setting priorities.

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.bchydro.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

This monitoring program was initiated in August 2012 and will be carried out annually for ten years. As this work will be impacted by flow release for Terzaghi Dam, the scope, budget and timelines may be subject to change when a flow release strategy is determined. Discussions related to operations in the Bridge River system and the flow release strategy are still underway.

The 2014 monitoring report is attached. The 2015 monitoring report will be included in the next annual report.

5.2 BRGMON-2 Carpenter Reservoir Riparian Vegetation Monitoring

This monitoring program was initiated in April 2013 and will be carried out over seven years of the ten-year review period.

This monitoring program is intended to monitor vegetation response around the entire drawdown zone of Carpenter Reservoir, which is a vast project area with significant variability in terrain. Now that the program has been implemented for two years, it is apparent that to successfully deliver the program and answer the management questions, an increase to the TOR budget is required.

We will submit a budget increase request for this monitoring program by March 1, 2016. Reporting for the 2013 field season is in draft and under review. No reporting was required in 2014 as no field work occurred. Reporting for the 2015 field season is underway. These reports will be included in the next annual report.

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

This monitoring program was initiated in August 2012 and will be carried out annually over ten years. Thus far, adult salmon and steelhead spawner return abundance and distribution data were collected using a fish counter and two telemetry methods (radio tags and PIT tags). The radio tags are very accurate, and provided detailed information on the spawning distribution and resident times for key target species (Chinook, Coho and Steelhead) in the Lower Bridge River. The radio telemetry study has been supported by the PIT telemetry method. Now that a robust dataset exists for spawner distribution from the radio telemetry studies, and significant improvements have been made to the PIT telemetry's effectiveness, the study team concluded that the radio telemetry method is no longer required.

A TOR revision was submitted on February 10, 2016, which outlines a PIT telemetry approach as the primary method of assessing spawner distribution with a larger data set.

The 2014 monitoring report is attached. The 2015 monitoring report will be included in the next annual report.

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

This monitoring program was initiated in October 2012 with field work starting in 2013 and will be carried out annually over ten years.

In May 2015, approval was received for a TOR addendum that addressed observed deficiencies in the original hypotheses and data collection methods to ensure the

study will answer management questions. A budget increase was associated with the resubmission.

The final 2013/14 monitoring report is attached. The 2014/15 monitoring report will be included in the next annual report.

5.5 BRGMON-5 Downton Reservoir Riparian Vegetation Monitoring

This monitoring program was implemented in 2013 and will be implemented again in 2022. The 2013 report will be included in the next annual report.

5.6 BRGMON-6 Seton Lake Aquatic Productivity Monitoring

This three-year monitoring program was implemented in 2014/15 and 2015/16. Monitoring in 2016/17 will be the final year of field work for the program.

The 2014/15 monitoring report is attached. The 2015/16 monitoring report will be included in the next annual report.

5.7 BRGMON-7 Downton Reservoir Fish Habitat and Population Monitoring

This monitoring program was initiated in October 2012 with field work starting in 2013 and will be carried out annually over ten years.

In June 2015, approval was received for a TOR addendum that addressed observed deficiencies in the original hypotheses and methodology to ensure the study will answer management questions. A budget increase was associated with the resubmission.

Due to changes in the study team, reporting for 2013 and 2014 has been combined into one report, which is attached. The 2015 monitoring report will be included in the next annual report.

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

This monitoring program was initiated in October 2012 with field work starting in 2013 and will be carried out annually over ten years.

In May 2015, approval was received for a TOR addendum that addressed observed deficiencies in the original hypotheses and data collection methods to ensure the study will answer management questions. A budget increase was associated with the resubmission.

Due to changes in the study team, reporting for 2013 and 2014 has been combined into one report, which is attached. The 2015 monitoring report will be included in the next annual report.

5.9 BRGMON-9 Seton River Habitat and Fish Monitoring

This ten-year monitoring program was initiated in November 2012 with field work starting in 2013.

The data collected in 2013 was found to be insufficient for the needs of the study and were subsequently modified to correct the deficiency. With the updated method, costs over the ten-year study may exceed the current TOR approved implementation budget, however the current forecast indicates that the total spend for this program will be within the overall CWR approved budget.

Due to changes in the study team, reporting for 2013 and 2014 has been combined into one report, which is attached. The 2015 monitoring report will be included in the next annual report.

5.10 BRGMON-10 Carpenter Reservoir Productivity Model Validation and Refinement

This three-year monitoring program was initiated in May 2014. The field work was first implemented in 2015/16. The 2015/16 report is in development and will be submitted in the next annual report.

5.11 BRGMON-11 Lower Bridge River Riparian Vegetation Monitoring

This monitoring program was initiated in November 2012 and will be carried out over 10 years. There was no field work done in 2015.This monitoring program is intended to document the impacts of alternate flow regimes from Terzaghi Dam on the productivity of riparian vegetation and the population and usage response of riverine birds in the Lower Bridge River. Now that the program has been implemented for three years, it is apparent that to successfully deliver the program and answer the management questions, an increase to the TOR budget is required.

We will submit a budget increase request for this monitoring program by March 1, 2016.

Reporting for the 2014 field season will be included in the next annual report.

5.12 BRGMON-12 Bridge-Seton Metals and Contaminant Monitoring Program

This monitoring program was initiated in May 2013.

The monitoring reports for 2013 and 2014/15 are attached.

5.13 BRGMON-13 Seton Sockeye Salmon Smolts Monitoring Program

This monitoring program was initiated in April 2012 and will be carried out annually over ten years.

The 2015 monitoring report will be submitted in the next annual report.

5.14 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

This monitoring program was initiated in August 2012 and is a five year program.

In 2014, an alternative flow release experiment was implemented which involved reconfiguring which siphons delivered the flows, in order to reduce some of the turbulence at the entrance to the fishway. Preliminary results from this experiment showed that fish passage success improved under the alternative flow scenario. This conclusion is based on the one-time experiment in 2014; therefore, in a TOR addendum submitted on February 3, 2016 we proposed to conduct the alternative flow release experiment again in 2016 to assess repeatability of the results. To accommodate an additional field season, the study program period will need to be extended to 2018 from the original completion date of 2017.

The final monitoring report for the 2014 field season is attached. The 2015 monitoring report will be included in the next annual report.

5.14.1 BRGMON-15 Seton Lake Erosion Mitigation Program Status

This monitoring program was initiated in July 2013 and will be carried out in stages over the ten-year review period. The first phase of this project focuses on identification of known erosion sites and on conducting initial assessments so as to develop a work plan for BRGWORKS-2 Seton Lake Erosion Control.

The field work for the first phase of BRGMON-15 was completed in 2014. In 2015, work was done to review the inventory information collected, and we began to develop technical criteria to determine priority erosion sites. In 2016, this criteria development will continue. Refer to Section 6.2 BRGWORKS-2 for further details.

The draft report is complete and under review, and will be included in the next annual report.

5.15 BRGMON-16 Lower Bridge River Spiritual and Cultural Value Monitoring

This monitoring program was initiated in spring of 2013 and will be carried out over five years of the 10-year review period.

The 2015 monitoring report will be included in the next annual report.

6 Status of Physical Works

6.1 BRGWORKS-1 Carpenter Re-vegetation

This six-year physical works program was initiated in 2014. The 2014 report will be submitted with the next annual report.

6.2 BRGWORKS-2 Seton Lake Erosion

This physical works has not yet been initiated.

The BRGMON-15 Seton Lake Erosion Mitigation Program will inform the TOR for BRGWORKS-2. In addition, the scope and priorities for this physical works will be determined with input from the affected St'at'imc communities.

As part of community discussions in 2015 around Bridge River System operations, an erosion assessment of key sites on the Seton River was completed. Along with the 2015 BRGMON-15 work on Seton Lake, we will be further discussing priorities for BRGWORKS-2 with affected St'at'imc communities before developing a TOR.

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, 2016.

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	$17,703	$4,141	$13,562	$17,703	($0)		
BRGM01A Low Bridge R Aquatic	$2,126,171	$1,073,682	$1,133,792	$2,207,474	($81,303)	Ongoing work for the flow release strategy.	Resubmit TOR once a flow strategy is determined.
BRGM01A Low Bridge R Aquatic - ONR IO	$0	$4,606	$0	$4,606	($4,606)		
BRGM01A Low Bridge R Aquatic - OR DM	$92,854	$49,305	$72,962	$122,266	($29,412)		
BRGM01A Low Bridge R Aquatic - OR Imp	$2,033,317	$1,019,772	$1,060,830	$2,080,602	($47,285)		
BRGM02A Carpenter Rse Riparia	$412,706	$185,636	$382,898	$568,534	($155,828)	Higher than expected photogrammetry costs in Year 1 and the vast size of project area. Future photogrammetry costs are expected to be lower.	Resubmit TOR by March 1, 2016
BRGM02A Carpenter Rse Riparia - OR DM	$65,857	$19,032	$46,825	$65,857	($0)		
BRGM02A Carpenter Rse Riparia - OR Imp	$346,849	$166,604	$336,073	$502,677	($155,828)		
BRGM03A Low BR Salmon & Steel	$1,975,352	$1,085,746	$869,119	$1,954,865	$20,487		
BRGM03A Low BR Salmon & Steel - OR DM	$92,722	$30,401	$52,165	$82,565	$10,157		
BRGM03A Low BR Salmon & Steel - OR Imp	$1,882,630	$1,055,345	$816,955	$1,872,300	$10,330		
BRGM04A Carp Rse&Mld BR Fish	$1,843,675	$472,506	$1,324,093	$1,796,599	$47,076		
BRGM04A Carp Rse&Mld BR Fish - OR DM	$98,053	$18,667	$35,802	$54,469	$43,584		
BRGM04A Carp Rse&Mld BR Fish - OR Imp	$1,745,622	$453,840	$1,288,291	$1,742,130	$3,492		
BRGM05A Downton Rse Riparian	$355,756	$167,795	$192,212	$360,007	($4,251)	Higher than expected photogrammetry costs in Year 1. Future photogrammetry costs are expected to be lower.	Resubmit TOR prior to Year 10 when final photogrammetry and other costs can be assessed.
BRGM05A Downton Rse Riparian - OR DM	$26,922	$7,309	$10,380	$17,689	$9,233		
BRGM05A Downton Rse Riparian - OR Imp	$328,834	$160,486	$181,832	$342,318	($13,484)		
BRGM06A Seton Lake Aquatic Pr	$1,319,947	$963,050	$284,600	$1,247,650	$72,297		
BRGM06A Seton Lake Aquatic Pr - OR DM	$32,524	$17,354	$14,997	$32,351	$173		
BRGM06A Seton Lake Aquatic Pr - OR Imp	$1,287,423	$945,696	$269,603	$1,215,299	$72,124		
BRGM07A Downton Rse Fish Habi	$1,063,401	$266,335	$791,388	$1,057,723	$5,678		
BRGM07A Downton Rse Fish Habi - OR DM	$87,909	$19,387	$44,381	$63,767	$24,142		
BRGM07A Downton Rse Fish Habi - OR Imp	$975,492	$246,948	$747,008	$993,956	($18,464)		
BRGM08A Seton Fish Hab & Pop	$947,702	$249,066	$635,096	$884,162	$63,540		
BRGM08A Seton Fish Hab & Pop - OR DM	$85,780	$13,469	$39,348	$52,818	$32,962		
BRGM08A Seton Fish Hab & Pop - OR Imp	$861,922	$235,597	$595,748	$831,345	$30,577		
BRGM09A Seton R Habitat & Fis	$1,185,918	$390,316	$793,066	$1,183,382	$2,536		
BRGM09A Seton R Habitat & Fis - OR DM	$85,924	$9,271	$43,384	$52,656	$33,268		
BRGM09A Seton R Habitat & Fis - OR Imp	$1,099,994	$381,044	$749,682	$1,130,727	($30,733)		
BRGM10A Carp Rse Prod Model	$995,981	$371,908	$623,959	$995,867	$114		
BRGM10A Carp Rse Prod Model - OR DM	$23,991	$13,094	$10,897	$23,991	($0)		
BRGM10A Carp Rse Prod Model - OR Imp	$971,990	$358,814	$613,062	$971,876	$114		
BRGM11A Low BR Riparian Vege	$567,076	$244,735	$446,121	$690,856	($123,780)	Higher than expected photogrammetry costs in Year 1 and ongoing work supporting the flow release strategy. Future photogrammetry costs are expected to be lower.	Resubmit TOR by March 1, 2016
BRGM11A Low BR Riparian Vege - OR DM	$33,052	$15,860	$32,871	$48,731	($15,679)		
BRGM11A Low BR Riparian Vege - OR Imp	$534,024	$228,875	$413,250	$642,125	($108,101)		
BRGM12A Bridge-Seton Metals	$481,257	$116,999	$23,516	$140,515	$340,742		
BRGM12A Bridge-Seton Metals - OR DM	$65,889	$12,561	$13,516	$26,077	$39,812		
BRGM12A Bridge-Seton Metals - OR Imp	$415,368	$104,438	$10,000	$114,438	$300,930		
BRGM13A Seton Powerhouse	$1,958,221	$735,285	$1,220,749	$1,956,034	$2,187		
BRGM13A Seton Powerhouse - OR DM	$89,289	$29,529	$45,972	$75,501	$13,788		
BRGM13A Seton Powerhouse - OR Imp	$1,868,932	$705,756	$1,174,778	$1,880,534	($11,602)		
BRGM14A Cayoosh Flow Dilutio	$2,234,341	$1,741,938	$69,717	$1,811,655	$422,686		
BRGM14A Cayoosh Flow Dilutio - OR DM	$46,517	$29,788	$21,977	$51,765	($5,248)		
BRGM14A Cayoosh Flow Dilutio - OR Imp	$2,187,824	$1,712,149	$47,741	$1,759,890	$427,934		
BRGM15A SON Erosion Mitigate	$184,648	$101,466	$347,280	$448,747	($264,099)	Etimated costs are for the entire study period, but the approved budget is currently for the first phase only.	Submit TOR for remaining phases of work upon completion of first phase.
BRGM15A SON Erosion Mitigate - OR DM	$17,403	$18,362	$41,814	$60,176	($42,773)		
BRGM15A SON Erosion Mitigate - OR Imp	$167,245	$83,104	$305,466	$388,570	($221,325)		
BRGM16A Spiritual & Cultural	$495,211	$214,269	$270,415	$484,683	$10,528		
BRGM16A Spiritual & Cultural - OR DM	$44,246	$13,682	$22,600	$36,282	$7,964		
BRGM16A Spiritual & Cultural - OR Imp	$450,965	$200,587	$247,815	$448,402	$2,563		
BRGW01A Carp Re-Vegetation	$1,329,224	$429,250	$778,220	$1,207,469	$121,755		
BRGW01A Carp Re-Vegetation - OR DM	$55,986	$22,881	$33,105	$55,986			
BRGW01A Carp Re-Vegetation - OR Imp	$1,273,238	$406,368	$743,642	$1,150,010	$123,228		

OR - Ordered Remissible
ONR - Ordered Non-Remissible

* Red values in parentheses denote overage.