

## **Columbia River Water Use Plan**

### **Arrow Lakes Reservoir Operations Management Plan Monitoring Program**

**Annual Report: 2021**

**Implementation Period: June 2020 – May 2021**

- **CLBMON-31 Arrow Lakes Reservoir: Burbot Life History Study**
- **CLBMON-32 Arrow Lakes Reservoir: Tributary Fish Migration Study**
- **CLBMON-36 Kinbasket and Arrow Lakes Reservoir: Nest Mortality of Migratory Birds due to Reservoir Operations**
- **CLBMON-37 Kinbasket and Arrow Lakes Reservoir: Amphibian and Reptile Life History and Habitat Use Assessment**
- **CLBMON-39 Arrow Lakes Reservoir: Neotropical Migrant Use of the Drawdown Zone**
- **CLBMON-40 Arrow Lakes Reservoir: Arrow Lakes Reservoir Shorebird and Waterbird Monitoring Program**
- **CLBMON-41 Arrow Lakes Reservoir: Recreational Demand Study**
- **CLBMON-58 Monitoring of Impacts on Amphibians and Reptiles from Mica Units 5 and 6 in Kinbasket Reservoir**

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

**June 30, 2021**

## **BC Hydro Columbia River Project Water Use Plan Arrow Lakes Reservoir Operations Management Plan Monitoring Programs Annual Report: 2021**

### **1 Introduction**

This document represents a summary of the status and the results of the Arrow Lakes Reservoir Operations Management Plan Water Use Plan (WUP) monitoring programs to May 31, 2021, as per the Columbia River Order under the *Water Act*, dated January 26, 2007. There are eight monitoring programs.

### **2 Status**

The following table outlines the dates that Terms of Reference (TOR) for the Arrow Lakes Reservoir Operations Management Plan WUP monitoring programs were submitted to and approved by the Comptroller of Water Rights (CWR).

**Table: 2-1: Dates of Arrow Lakes Reservoir Operations Management Plan WUP TOR Submissions and Approvals by the Comptroller of Water Rights**

Monitoring Program	Order Clause	Original ToR Submission		Most Recent ToR Resubmission	
		Date Submitted	Date Approved	Date Submitted	Date Approved
CLBMON-31 Arrow Lakes Reservoir: Burbot Life History Study	Schedule D: 5.a	Oct 24, 2007	Dec 03, 2007		
CLBMON-32 Arrow Lakes Reservoir: Tributary Fish Migration Study	Schedule D: 5.b	Oct 24, 2007	Dec 03, 2007		
CLBMON-36 Kinbasket and Arrow Lakes Reservoir: Nest Mortality of Migratory Birds due to Reservoir Operations	Schedule A: 6.a Schedule C: 5.c	Jan 25, 2008	Mar 03, 2008	Dec 18, 2014	Feb 04, 2015
CLBMON-37 Kinbasket and Arrow Lakes Reservoir: Amphibian and Reptile Life History and Habitat Use Assessment	Schedule A:6.b Schedule C: 5.d	Jan 25, 2008	Mar 03, 2008	Jan 04, 2011	Apr 12, 2011
CLBMON-39 Arrow Lakes Reservoir: Neotropical Migrant Use of the Drawdown Zone	Schedule C: 5.f	Jan 25, 2008	Mar 17, 2008	Jun 22, 2015	Jul 16, 2015
CLBMON-40 Arrow Lakes Reservoir: Arrow Lakes Reservoir Shorebird and Waterbird Monitoring Program	Schedule C: 5.e, 5.g	Jan 25, 2008	Mar 03, 2008	Dec 23, 2015	Jan 26, 2016
CLBMON-41 Arrow Lakes Reservoir: Recreational Demand Study	Clause 6.c Ordered Jan 26, 2007 and Clause 6.c Ordered by CWR Apr 24, 2007	Jul 31, 2008	Sep 11, 2008		
CLBMON-58 Monitoring of Impacts on Amphibians and Reptiles from Mica Units 5 and 6 in Kinbasket Reservoir	Augment to Schedule A:6.b Schedule C: 5.d	Jan 04, 2011	Apr 12, 2011		

### 3 Schedule

The following table outlines the current schedule for the monitoring programs being delivered for the Arrow Lakes Reservoir Operations Management Plan WUP.

**Table 3-1: Monitoring Programs Schedule as of May 31, 2021**

Monitoring Programs	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
	WLR YR1	WLR YR2	WLR YR3	WLR YR4	WLR YR5	WLR YR6	WLR YR7 Interim Review	WLR YR8	WLR YR9	WLR YR10	WLR YR11	WLR YR12
CLBMON-31 Arrow Lakes Reservoir: Burbot Life History Study		✓	✓	✓	✓	✓F						
CLBMON-32 Arrow Lakes Reservoir: Tributary Fish Migration Study		✓	✓	✓	✓	✓	✓F					
CLBMON-36 Kinbasket and Arrow Lakes Reservoir: Nest Mortality of Migratory Birds due to Reservoir Operations		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓F	
CLBMON-37 Kinbasket and Arrow Lakes Reservoir: Amphibian and Reptile Life History and Habitat Use Assessment		✓	✓	✓		✓		✓		✓		✓F
CLBMON-39 Arrow Lakes Reservoir: Neotropical Migrant Use of the Drawdown Zone		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓F	
CLBMON-40 Arrow Lakes Reservoir: Arrow Lakes Reservoir Shorebird and Waterbird Monitoring Program		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓F	
CLBMON-41 Arrow Lakes Reservoir: Recreational Demand Study			✓	✓	✓	✓	✓F					
CLBMON-58 Mica Addendum to CLBMON 37 Amphibians and Reptiles					✓		✓		✓		✓F	
Legend:	✓ = Program completed for the year ✓F = All field work for this project is complete. No further field work is planned.											

### 4 Monitoring Programs Terms of Reference

The monitoring programs being implemented under the Arrow Lakes Reservoir Operations Management Plan WUP are described in Terms of Reference. These Terms of Reference and the reports for work completed to date can be found here:

[http://www.bchydro.com/about/sustainability/conservation/water\\_use\\_planning/southern\\_interior/columbia\\_river/arrow-operations.html](http://www.bchydro.com/about/sustainability/conservation/water_use_planning/southern_interior/columbia_river/arrow-operations.html)

### 5 Status of Monitoring Programs

#### 5.1 CLBMON-31 Arrow Lakes Reservoir: Burbot Life History Study

The objective of this study was to assess the potential effects of winter drawdown of Arrow Lakes Reservoir to spawning Burbot. This monitoring program was initiated in 2008 and was completed in 2013. All reports have been submitted.

#### 5.2 CLBMON-32 Arrow Lakes Reservoir: Tributary Fish Migration Study

The objective of this study was to assess passage conditions for fish at tributaries to Arrow Lakes Reservoir under a range of operating levels and streamflow conditions. This monitoring program was initiated in 2008 and was completed in 2014. All reports have been submitted.

**5.3 CLBMON-36 Kinbasket and Arrow Lakes Reservoir: Nest Mortality of Migratory Birds due to Reservoir Operations**

This monitoring program researches the impacts that reservoir operations have on the productivity of birds breeding in the reservoir drawdown zones of Kinbasket and Arrow Lakes Reservoir. The study was initiated in 2008 and was carried out annually over ten years. The study was completed in 2017.

**5.4 CLBMON-37 Kinbasket and Arrow Lakes Reservoir: Amphibian and Reptile Life History and Habitat Use Assessment**

This monitoring program is intended to address the relative influence and importance of the current reservoir operating regime on the life history and habitat use of amphibians and reptiles occurring in the drawdown zones of each reservoir. The study was initiated in 2008 and was carried out every other year for eleven years (2018 was the final year).

Attached is the final comprehensive report dated June 8, 2020.

**5.5 CLBMON-39 Arrow Lakes Reservoir: Neotropical Migrant Use of the Drawdown Zone**

This monitoring program was designed to determine the effects of reservoir operations on neotropical migrant songbirds in Revelstoke Reach during fall migration. The study was initiated in 2008 and was carried out annually over ten years. The study was completed in 2017.

In 2017, two sites in the drawdown zone (Airport Islands and Machete Island) and one site outside of the drawdown zone (Jordan River) were monitored by constant effort mist netting. The water levels of Arrow Lakes Reservoir at the beginning of the fall migration season (August 1) were higher than the long-term average for that time of year, but water levels gradually dipped below the long-term average in September.

**5.6 CLBMON-40 Arrow Lakes Reservoir: Arrow Lakes Reservoir Shorebird and Waterbird Monitoring Program**

This monitoring program studies the use of the Revelstoke Reach wetlands during spring and fall migration, the importance of these wetlands for breeding waterbirds, and how ecological functions are impacted by reservoir operations. The study was initiated in 2008 and was carried out annually over ten years. The study was completed in 2017.

**5.7 CLBMON-41 Arrow Lakes Reservoir: Recreational Demand Study**

The objective of this study is to establish a functional link between recreational use and water levels on Arrow Lakes Reservoir. This monitoring program was initiated in 2009 and field work was completed in 2013, with additional data analysis completed in 2016. No further work is required.

**5.8 CLBMON-58 Monitoring of Impacts on Amphibians and Reptiles from Mica Units 5 and 6 in Kinbasket Reservoir**

This monitoring program addresses the potential predicted impacts of the installation of Units 5 and 6 (and the consequential predicted increase of 0.6 m in

maximum reservoir elevation) at Mica Dam on amphibian and reptile populations in Kinbasket Reservoir. The study was initiated in 2011 and implemented every other year over seven years (2017 was the final year).

## **6 Monitoring Programs Costs**

The following table summarizes the Arrow Lakes Reservoir Operations Management Plan WUP monitoring programs approved by the Comptroller and the Actual Costs to May 31, 2021.

**Table 6-1: Arrow Lakes Reservoir Operations Management Plan WUP Monitoring Programs Costs**

Monitoring Programs	Costs approved by CWR	Life to Date Actuals (LTD)	Estimated to Complete (Forecast)	Total Forecast (LTD and Forecast)	Variance Total to Approved	Explanation	Corrective Action
<b>CLB MP6 Arrow Res Ops Annual Report</b>	\$14,601	\$11,228	\$0	\$11,228	\$3,373	Guide to explanations below	
<b>C06M31A ARROW: Burbot Life - ONR</b>	\$114,277	\$116,683		\$116,683	(\$2,406)	Project complete. Final completion report outstanding.	
C06M31A ARROW: Burbot Life - ONR DM	\$0	\$73		\$73	(\$73)		
C06M31A ARROW: Burbot Life - ONR Imp	\$114,277	\$116,610		\$116,610	(\$2,333)		
<b>C06M31A ARROW: Burbot Life - OR</b>	\$970,525	\$860,047	\$1,624	\$861,671	\$108,854	Project complete. Final completion report outstanding.	
C06M31A ARROW: Burbot Life - OR DM	\$67,022	\$58,337	\$1,624	\$59,961	\$7,061		
C06M31A ARROW: Burbot Life - OR Imp	\$903,503	\$801,710		\$801,710	\$101,793		
<b>C06M32A ARROW:Tributary Fish</b>	\$439,574	\$369,167	\$1,624	\$370,790	\$68,784	Project complete. Final completion report outstanding.	
C06M32A ARROW:Tributary Fish - OR DM	\$81,842	\$45,955	\$1,624	\$47,578	\$34,264		
C06M32A ARROW:Tributary Fish - OR Imp	\$357,732	\$323,212		\$323,212	\$34,520		
<b>C06M36A ARROW &amp; KIN: Nest</b>	\$4,256,071	\$3,926,993	\$1,650	\$3,928,643	\$327,428	Project complete. Final completion report outstanding.	
C06M36A ARROW & KIN: Nest - OR DM	\$204,722	\$140,937	\$1,650	\$142,587	\$62,135		
C06M36A ARROW & KIN: Nest - OR Imp	\$4,051,349	\$3,786,056		\$3,786,056	\$265,293		
<b>C06M37A ARROW &amp; KIN: Amphib</b>	\$1,166,608	\$1,164,704	\$1,904	\$1,166,608	(\$0)	Project complete. Final completion report outstanding.	
C06M37A ARROW & KIN: Amphib - OR DM	\$127,889	\$133,317		\$133,317	(\$5,428)		
C06M37A ARROW & KIN: Amphib - OR Imp	\$1,038,719	\$1,031,387	\$1,904	\$1,033,291	\$5,428		
<b>C06M39A ARROW: Neotropical</b>	\$2,150,992	\$2,043,658	\$1,624	\$2,045,281	\$105,711	Project complete. Final completion report outstanding.	
C06M39A ARROW: Neotropical - OR DM	\$189,932	\$148,962	\$1,624	\$150,586	\$39,346		
C06M39A ARROW: Neotropical - OR Imp	\$1,961,060	\$1,894,696		\$1,894,696	\$66,364		
<b>C06M40A ARROW: Shore&amp;Wat</b>	\$2,890,326	\$2,649,522	\$1,624	\$2,651,146	\$239,180	Project complete. Final completion report outstanding.	
C06M40A ARROW: Shore&Wat - OR DM	\$189,388	\$178,873	\$1,624	\$180,497	\$8,891		
C06M40A ARROW: Shore&Wat - OR Imp	\$2,700,938	\$2,470,649		\$2,470,649	\$230,289		
<b>C06M41A ARROW: Recreation</b>	\$755,561	\$708,807		\$708,807	\$46,754	Project complete. Final completion report outstanding.	
C06M41A ARROW: Recreation - OR DM	\$71,661	\$47,023		\$47,023	\$24,638		
C06M41A ARROW: Recreation - OR Imp	\$683,900	\$661,784		\$661,784	\$22,116		
<b>C06M58A ARROW Amphibs &amp; Rep</b>	\$497,676	\$419,539	\$6,275	\$425,814	\$71,862	Project complete. Final completion report outstanding.	
C06M58A ARROW Amphibs & Rep - ONR DM	\$68,894	\$21,142	\$6,275	\$27,418	\$41,476		
C06M58A ARROW Amphibs & Rep - ONR Imp	\$428,782	\$398,397		\$398,397	\$30,385		

OR - Ordered Remissible  
ONR - Ordered Non-Remissible

\* Red values in parentheses denote overage.