# Duncan Dam Water Use Plan

# Monitoring Program Terms of Reference

- **DDMMON-14 Duncan River Watershed Wildlife Monitoring**

**Revision 1**
**June 9, 2017**

# DDMMON-14 – Duncan Dam Watershed Wildlife Monitoring Monitoring Program Terms of Reference Revision 1

## 1.0 Overview

BC Hydro's Duncan Dam operates under the Columbia River Treaty, the 50-year-old US-Canada flood-mitigation storage agreement. In 2001, the Duncan Dam Water Use Plan (DDM WUP) was initiated to refine the operations of Duncan Dam in consideration of regulatory, stakeholder and First Nations interests. During the WUP process, the Consultative Committee (CC) recommended several operating guidelines to benefit fisheries and wildlife interests that are influenced by Duncan Dam operations. The final adopted alternative flow management regime (Alternative S73) attempts to mimic the preferred hydrograph of black cottonwood (*Populus trichocarpa*) (within other constraints) as a means of restoring pre-dam riparian communities, and in turn increasing biodiversity and wildlife use.

The objective of DDMMON-14 is to evaluate how wildlife resources are responding to changes in riparian vegetation under the new Alternative S73 (AltS73) operating regime in both the lower Duncan River and the Duncan Reservoir. This study is closely linked with DDMMON-8: Duncan Watershed Riparian and Cottonwood Monitoring.

The 2007 Terms of Reference (TOR) for DDMMON-14 outlined a four-year study implemented over a 10-year time frame (i.e., implementing in 2009, 2011, 2014 and 2018). However, the final two years of implementation (i.e., 2014 and 2018) were postponed because the management questions in the 2007 TOR were deemed too broad and the sample sizes from years 2009 and 2011 were too small to answer those questions. This TOR proposes new management questions and simplifies the original study design.

## 1.1 Background

The Duncan Dam Project is located within the Regional District of Central Kootenay, and is within the Duncan River drainage basin (2400 $km^2$). The Duncan Dam is located immediately upstream of the confluence of the Duncan and Lardeau Rivers, approximately 11 km upstream of Kootenay Lake and 42 km north of the Village of Kaslo. The Duncan Reservoir, impounded by the dam, is 45 km long and covers an area of 7150 ha when the reservoir is at full pool (576.4 m – 576.7 m elevation). The reservoir receives inflow from the Duncan River in May and June due to snowmelt, and reaches full pool by the beginning of August. Besides providing storage for downstream hydroelectric generation and flood control, the reservoir also provides for fish flow regulation for the Duncan River between the dam and the mouth of the river at Kootenay Lake. There are no power generation facilities at the dam.

The Duncan Dam Water Use Plan project was initiated in 2002 to refine Duncan Dam operations in consideration of interests represented by the CC. The CC reached a conditional consensus on WUP AltS73 (Duncan Dam Water Use Plan

Consultative Committee, 2005). AltS73 involves the reservoir reaching full pool between August 1 to 10, after which reservoir elevation decreases to 575.5 m and maintains within 0.3 m of this level until Labour Day (Duncan Dam Water Use Plan Consultative Committee, 2005). Changes to reservoir operation because of AltS73 may affect the vegetation communities in the reservoir drawdown zone, which may in turn affect wildlife use of the reservoir.

Downstream of Duncan Dam, under AltS73, flows in the Lower Duncan River will more closely fit a hydrograph favourable for cottonwood recruitment than previous operations. This includes "natural" reductions in flows during ramp down operations, maximum flows of 250 $m^3$/s over the fall and early winter period, peak flows in early to mid-summer, and disruptive or channel-changing flows in the spring/early summer. These changes in flows may affect the riparian vegetation and cottonwood recruitment in Lower Duncan River riparian areas, which may in turn affect wildlife abundance, diversity, and use.

## 1.2 Previous Wildlife Work in the Lower Duncan River Area

Previous wildlife survey work in the Lower Duncan River area has been relatively limited. Peterson and Withler (1965) produced the first review of the area's wildlife, concentrating on big game, furbearers, waterfowl and upland game in the reservoir area. Herbison (1983) examined ungulate winter range in the Duncan-Lardeau Flats, and reported on painted turtle breeding in the area (Herbison 1999). Painted turtles were reported to be breeding in one location in the Duncan-Lardeau area, upslope of a marsh on the Argenta slough (Herbison 1999).

Herbison (1996) reviewed wildlife habitat enhancement opportunities in the Duncan and Lardeau drainages, and reported use of the area by Red- and Blue-listed species. The only Red-listed species reported to use the Duncan-Lardeau area was the Western Grebe, which were seen in small numbers (Herbison 1996). Blue-listed species reported using the area included Great Blue Heron (not nesting), Bobolink (nests), mountain caribou, and grizzly bear (Herbison 1996). Yellow-listed species included the Bald Eagle (nests in Lower Lardeau – Duncan flats) and the Western Bluebird (occasional nester). Herbison (1996) noted that large herd sizes of ungulates are not supported in the Duncan-Lardeau area due to the relative scarcity of low elevation winter range. The Duncan-Lardeau was also identified as an important area for wildlife species that require mid-elevation old-growth and/or remote wilderness, such as wolverine, caribou, and grizzly bears (ibid).

Herbison *et al.* (2002) summarized existing wildlife information and data gaps for the reservoir and Lower Duncan River area. The Lower Duncan River to Kootenay Lake was identified as an area with high value as winter range and fawning/calving areas for white-tailed deer and elk (Herbison *et al.* 2002). The area was identified as critically important for obligate aquatic mammals (e.g., otter, beaver, mink, muskrat), for birds associated with aquatic habitats (e.g., ducks, geese, blackbirds, kingfisher, heron), and for painted turtles, pacific treefrogs and western toads (ibid). Seasonal use of this area was reported for grizzly bear (seen each fall at the Meadow Creek spawning channel; Krebs, pers.

comm.) and moose, and regular use was reported for black bear, cougar and coyote (ibid).

Work on elk movement patterns in the Duncan-Lardeau area was completed in 1998, 2000, and 2001 (Poole and Park 1998, 2001; Poole *et al.* 2000). Radio-collared elk used the Lardeau River drainage from the confluence with Lower Duncan River past Trout Lake and the Hamill Creek drainage, a tributary to the Lower Duncan River (Poole *et al.* 2000). Elk preferred slopes <25% during all seasons, and were primarily found at <1500 m elevation (<813 m elevation in late winter; Poole and Park 2001). Late-winter habitat use included riparian and cedar-hemlock – leading stands along the lower Lardeau River, and older age-class cedar-dominated selectively logged stands with heavy shrub cover in the Lower Duncan River (Poole and Park 2001).

### 1.3 Previous Wildlife Work in the Duncan Reservoir Area

As with previous wildlife work conducted in the Lower Duncan River area, there has been limited wildlife survey work in the Duncan Reservoir area. Peterson and Withler (1965) produced the first review of the area's wildlife and found elk use of the Howser Creek area in winter, a concentration of mountain goats between Duncan Lake and Howser Creek, and caribou and black bear in the upper reservoir area. They also noted that grizzly bears were common in the Upper Duncan drainage (ibid). Beaver and muskrat were reported to be using the wetlands in the reservoir area, and mink were common in riparian areas (ibid). Geese and ducks were noted to be nesting in large numbers in marshes in the Upper Duncan area (ibid). Ruffed grouse were reportedly common in the reservoir area (ibid).

Herbison *et al.* (2002) summarized existing wildlife information and data gaps for the reservoir and Lower Duncan River area. The slopes bordering the reservoir were identified as having variable-quality winter range for white-tailed deer, mule deer and elk, and perch and nest sites for raptors (Herbison *et al.* 2002). The north end of the reservoir was identified as having a small area of rich riparian habitat that supports grizzly bear, moose, nesting waterfowl and aquatic mammals (ibid).

Radio-collared elk have been reported using the Duncan Reservoir area, especially the north end (Poole *et al.* 2000).

## 2.0 Management Questions

### 2.1 Rationale for Changes to the 2008 Management Questions

DDMMON-14 was designed as a four-year study implemented over a 10-year period. The objective of DDMMON-14 is to assess the performance of the Duncan Dam Water Use Plan (WUP) on wildlife communities in the Lower Duncan River and Duncan Reservoir riparian areas as outlined in Clause 6 (d) and Clause 6 (h) of the Order (File No. 76975-35/Duncan) for the Duncan Dam Water Use Plan (dated December 21, 2007) which states:

- Monitor wildlife habitat use in the Lower Duncan River floodplain; and

- Monitor riparian vegetation and wildlife habitat, including nesting birds, in the drawdown zone of the Duncan Reservoir.

To address the Order clauses above, the management questions and the associated null hypotheses in the original Terms of Reference (BC Hydro 2008) were:

1) Will the implementation of the DDM WUP result in neutral, positive or negative changes in wildlife resources for the Lower Duncan River?

   $H_{01}$. Cottonwood forests are an indicator of riparian habitat diversity.

   $H_{02}$. Bird diversity is an effective indicator of overall wildlife diversity.

   $H_{03}$. Wildlife diversity and abundance (or their habitat proxies) are positively affected by operational changes proposed in the WUP.

2) Will the implementation of the DDM WUP result in neutral, positive or negative changes in wildlife resources for the Duncan Reservoir?

   $H_{01}$. Riparian ecosystems are an indicator of wildlife diversity and productivity.

   $H_{02}$. Bird diversity is an effective indicator of overall wildlife diversity.

   $H_{03}$. Wildlife diversity and abundance are negatively affected by operational changes proposed in the WUP.

The first two years of the study were completed (2009 and 2011) and the remaining two years (i.e., 2014 and 2018) were postponed when it became apparent that this study would be unable to answer the management questions as they were written in 2008. An external review of this project in 2014, and further review by BC Hydro, suggested the management questions in the 2008 TOR above were unanswerable due to several factors, listed below:

- The current study design has a small likelihood of linking a wildlife response to a change in operations (i.e., alternative flow management regime) in the face of high natural variation in wildlife use, diversity and abundance;
- The areas around the reservoir and lower Duncan River that are affected by BC Hydro operations are too narrow to enable the sampling that could detect a meaningful impact on wildlife and wildlife habitat;
- The 10-year WUP monitoring period (i.e., 2008-2018 inclusive) is too short of a time frame to assess how BC Hydro operations are affecting wildlife habitat. Changes in the abundance and distribution of the key wildlife habitat feature being studied, mature cottonwood trees, may not be apparent for over 50 years; and
- The management questions and underlying hypotheses are too broad and vague to effectively address the Order.

## 2.2 Revised Management Questions

The purpose of this revised Terms of Reference (TOR) is to provide new management questions that can be answered in the remaining two years of the project and that are congruent with the Order clauses.

In the Duncan Reservoir area, the focus in this revised TOR has shifted away from the drawdown zone along the east side of the reservoir to a wetland area at the north end[1] of the reservoir where no previous survey work has been completed. In earlier years of this project, the drawdown zone along the east side of the reservoir was reported to be essentially barren habitat with few birds and little wildlife sign (Hallstrom 2012). Although little is known about the wetland at the north end of the reservoir, it has potential to provide wildlife habitat that is affected by reservoir operations.

Downstream of Duncan Dam, the Lower Duncan River will continue to be a focus, but the control watercourse (Lardeau River) will no longer be monitored. Including a control watercourse in the design is no longer deemed necessary since hypothesis testing will no longer be a part of this project.

The revised management questions are as follows:

1) What are the wildlife habitat values (e.g., wildlife habitat suitability) of the wetland at the north end of Duncan Reservoir?

2) What are the wildlife habitat values (e.g., wildlife habitat suitability) of the riparian habitat along the Lower Duncan River?

3) How could reservoir operations under Alternative S (73) affect wildlife habitat in the wetland at the north end of Duncan Reservoir?

4) How could reservoir operations under Alternative S (73) affect wildlife habitat along the Lower Duncan River?

## 2.3 Key Water Use Decision Affected

The results of this monitoring program will reflect the impacts of the recommended operating regime for the Lower Duncan River and the Duncan Reservoir on the riparian wildlife community. In future WUP reviews, the results of this study will guide flow management in terms of the target flows and their annual timing by providing an increased understanding of the relationship between flow management and wildlife resources.

[1] The north end of Duncan Reservoir refers to an area approximately 40 km upstream from Duncan Dam along the thalweg.

# 3.0 Monitoring Program Proposal

## 3.1 Study Area

The study area for DDMMON-14 will include portions of the study area for DDMMON-8: Duncan Watershed Riparian and Cottonwood Monitoring, except for the Lardeau River (see note above). The study area for DDMMON-14 will include the approximately 10 km of floodplain along the lower Duncan River between Duncan Dam and Kootenay Reservoir, as well as the wetland at the north end of Duncan Reservoir.

## 3.2 Tasks

In the above management questions, the term 'wildlife values' is defined as the ability of a habitat to provide something that a species or group requires to meet at least one of its life requisites (e.g., breeding, security cover, foraging, thermal regulation). This can be assessed using mapping, species-specific knowledge, ground-truthing, and field surveys. The tasks laid out below provide a general framework for the project.

### 3.2.1 Task 1 – Selection of Focal Species/Groups

Focal species groups will include migratory birds that nest in or near the zone of inundation, and amphibians that reproduce there. Focal species from these groups will be chosen based on the following criteria:

- Species for which life-stage-specific habitat requirements are known (e.g. from previous survey work, scientific literature, provincial databases, etc.). Species/groups for which little is known about their habitat requirements should not be selected; and
- Species which use habitat that has the potential to be affected by AltS73 operations.

### 3.2.2 Task 2 – Mapping of Habitats

*Duncan Reservoir*

Using the orthophotos collected through DDMMON-8 (Duncan Watershed Riparian and Cottonwood Monitoring), or other available information, delineate habitat polygons in the wetland at the north end of Duncan Reservoir. The habitat types delineated should be informed by the wildlife species/groups of interest and need not follow Terrestrial Ecosystem Mapping (TEM) standards. These habitat maps should include all habitats that can be affected by reservoir filling and riparian habitats, but need not include upland habitats beyond the riparian area. At the end of the project, these maps will be compared to each other to determine if there has been any change in habitats (area or composition) over the course of the entire project.

*Lower Duncan River*

Using the orthophotos collected through DDMMON-8 (Duncan Watershed Riparian and Cottonwood Monitoring), or other available information, delineate habitat polygons along the floodplain and riparian areas of the Lower Duncan River. As above, the habitat types delineated should be informed by the wildlife species/groups of interest and need not follow TEM standards. Vegetation classes identified in DDMMON-8 may be combined where appropriate to ensure the habitat divisions are meaningful to the selected wildlife species/groups. As above, these maps will be compared to each other at the end of the project to determine if there has been any change in habitats (area or composition) over the course of the entire project.

For certain species/groups (e.g., amphibians), it is likely that landscape features other than vegetation classes are important for determining habitat value. For both the Duncan Reservoir wetland and the Lower Duncan River, the consultant may need to create a separate habitat base map using more meaningful habitat divisions should these species/groups be selected.

Please note that DDMMON-8 has collected orthophotos of the Duncan Reservoir and Lower Duncan River in years 2009, 2011, 2015 and is scheduled to collect more imagery in 2018. The multiple years of orthophotos may be used for comparative analysis. Task 2 will occur prior to 2018 and; therefore, will utilize all available orthophotos and can be updated once the 2018 imagery is available.

### 3.2.3 Task 3 – Habitat Assessments

Using the habitat maps created for the wetland and the Lower Duncan River, assess the value of each habitat type for the selected wildlife species/groups. The consultant will need to come up with an appropriate value ranking scheme for the selected wildlife species/groups (e.g., high, moderate, low, nil) and will need to determine which life requisites are being assessed for each species/group. The consultant should provide their modelling assumptions for the habitat assessment for each species/group in the interim report.

At the end of the project, the maps from each area (i.e., Reservoir wetland and Lower Duncan River) will be compared to each other to determine if there has been any change in the area of habitats of different value for the species/groups of interest over the course of the entire project, or if any such changes are expected.

### 3.2.4 Task 4 – Elevation Modelling of Duncan Reservoir Wetland

The consultant will propose a method of modelling and mapping the elevation of the wetland at the north end of Duncan Reservoir (e.g., bathymetry or LiDAR, etc.). This information will be coupled with the habitat value mapping to allow modelling of the effects of reservoir operations on the selected wildlife species/groups. Water elevation loggers might be used in conjunction with the above elevation model to determine timing of inundation of certain areas of the wetland (e.g., if topography suggests that reservoir filling might not inundate all areas at the same time).

### 3.2.5 Task 5 – Field Work

The consultant will propose a field program that will field truth the habitat mapping and habitat value assessments. Any field truthing of habitat boundaries will need to be completed after an updated habitat map is created using all available information. Surveys for nesting birds and breeding amphibians, and basic wetland parameter measurements (e.g., aquatic macrophyte cover, etc.) should be utilized to verify habitat use assumptions, and to create a preliminary species list for these groups.

### 3.2.6 Task 6 – Reporting

The consultant will provide an interim report at the end of the first year of the project (2017). This report should include the list of selected wildlife species and the habitat modelling assumptions for each. It should also include the habitat mapping and habitat assessments and the results of any surveys and map truthing completed.

At the end of the final year of the project (2018), the consultant will provide a final report to BC Hydro. This report will build on available results and analyses from DDMMON-8 to do the following:

- Complete wildlife habitat mapping and wildlife habitat assessments based on available information including orthophotos;
- Describe results of field surveys and field truthing;
- Analyze change in wildlife habitat (type, area, value class (high, medium, low, nil)) over the course of the entire project in the wetland at the north end of Duncan Reservoir and along Lower Duncan River, including a discussion of where (spatially) any changes have occurred; and
- Analyze and discuss how reservoir operation under AltS73 may affect wildlife habitats of focal wildlife species in the wetland at the north end of Duncan Reservoir and along the Lower Duncan River.

The consultant must provide a database of all survey information (including georeferenced survey locations) to BC Hydro, and must provide spatial files of the habitat maps created at interim and final reporting times.

## 4.0 Budget

Total Revised Program Cost: $459,211.

## 5.0 References

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