

Alouette Project Water Use Plan

Monitoring Program Terms of Reference

- **ALUMON#1 Smolt Enumeration**
- **ALUMON#2 Kokanee Out-migration**
- **ALUMON#3 Substrate Quality**
- **ALUMON#4 Sockeye Adult Enumeration**
- **ALUMON#5 Water Temperature**
- **ALUMON#6 Kokanee Age Class Structure**
- **ALUMON#7 Archaeological Monitoring**

October 15, 2009

Alouette Project Monitoring Program Terms of Reference

1.0 OVERVIEW

This document presents Terms of Reference for both the fisheries and archaeological monitoring programs recommended by the Alouette Water Use Plan Consultative Committee and required per the 20 October 2009 Water Act Order issued by the Comptroller of Water Rights (Table 1). These monitoring programs involve effectiveness monitoring to assess the response of the aquatic environment to licenced BC Hydro operations as well as monitoring to assess the effects of BCH operations on archaeological sites situated within the drawdown zone of the Alouette Lake Reservoir and a section of the South Alouette River.

Table 1. Alouette Fisheries and Archaeological Monitoring Plan Terms of Reference Submission Information

Name of Monitoring Program	Order Clause Fulfilled	Submitted with this Package	Previously Submitted To CWR	Submission Date	Leave to Commence
ALUMON#1 Smolt Enumeration	Section 16.a	Yes	No	20 Oct 2009	-
ALUMON#2 Kokanee Out-migration	Section 16.b	Yes	No	20 Oct 2009	-
ALUMON#3 Substrate Quality	Section 16.c	Yes	No	20 Oct 2009	-
ALUMON#4 Sockeye Adult Enumeration	Section 16.d	Yes	No	20 Oct 2009	-
ALUMON#5 Water Temperature	Section 16.e	Yes	No	20 Oct 2009	-
ALUMON#6 Kokanee Age Class Structure	Section 16.f	Yes	No	20 Oct 2009	-
ALUMON#7 Archaeological Monitoring	Section 16.g	Yes	No	20 Oct 2009	-

Fisheries Monitoring Program Terms of Reference

1.0 INTRODUCTION

As the Alouette Lake Water Use Plan (WUP) reached completion, a number of uncertainties were identified regarding the effect of BC Hydro operations on aquatic resources. The primary consequence of these uncertainties was a limited ability to predict the response of fish and wildlife populations to operational changes as a result of WUP implementation. This in turn highlighted the general uncertainty surrounding the likelihood that the expected fish and wildlife benefits of the WUP operation will be realised.

The framework for WUP process requires that it be reviewed on a periodic and ongoing basis. Therefore, in the years subsequent to the implementation the WUP, there will be a need for compliance monitoring and effectiveness monitoring to gain the information necessary to address these uncertainties. Compliance monitoring consists of monitoring activities to ensure that BC Hydro complies with the conditions of its water license. Effectiveness monitoring is more complex. It involves the observation, measurement, and evaluation of streamflows, fish and wildlife habitat, and population changes to test the efficacy of the WUP.

Effectiveness monitoring for the Alouette Lake system will require the collection of data in order to quantify relationships between specific fish population parameters and different aspects of BC Hydro operations. Monitoring will assess whether a predicted biological response to changes in operations actually occurred as predicted, and thereby assess whether the objectives of greater abundance and/or diversity were met.

2.0 OVERVIEW

At the conclusion of the Alouette Lake WUP Review process, the Consultative Committee (CC) recommended several key changes to the way Alouette Dam is operated. They are believed to have at least some impact to the ecology of resident fish species. The proposed changes are in addition to the operational changes made in 1996 as part of the original water license review process:

1. Spring surface release starting April 15 and ending June 14.
2. A higher reservoir elevation (122.5) during the peak recreation season starting June 15 and ending Labour Day (September 5).
3. Short recreation shoulder season ending Sep 15 when water levels are above 121.25m.
4. Removing the need for a prescribed flushing flow to clear fine sediments

When recommending these operational changes, the CC acknowledged that there was a need for additional fish related information that would add greater certainty to their decision making, but could not be collected at the time of the WUP review process or had to be monitored *in situ* to confirm their assumed consequences. In particular, the CC identified the following critical uncertainties:

1. Long term impact on Alouette River smolt output
2. Success of surface release in allowing kokanee to leave to reservoir and begin their seaward migration.
3. Long term impact on the transport of fine sediments in Alouette River.
4. Success of the kokanee re-anadromisation initiative, and hence an evaluation of the need for the surface release.
5. Water temperature impacts on the Alouette River.
6. Long term impact on the kokanee reproductive success.

In addition to the uncertainties above, the CC also recommended that an Alouette Monitoring Review Committee be created to oversee the general progress of the monitor, review all reports before general release, and recommend changes regarding the monitoring program's implementation as deemed necessary. Committee membership is to include representatives from BC Hydro, BC Ministry of Environment, Fisheries and Oceans Canada, Katzie First Nation, District of Maple Ridge, and Alouette River Management Society.

3.0 COST

The total cost of the 7 year monitoring program, including year 1 (2008) and a component of year 2 expenditures through July 2009, is estimated to be roughly \$1,316,879 (in 2006 dollars). When incorporating a future annual inflation rate of 2%, the anticipated cost of the program is expected to be closer to \$1,437,623. Average annual cost for the remaining 5 full implementation years is expected to be \$185,258 (in 2006 dollars), but will vary between \$172,107 and \$203,909 depending on the tasks to be completed or the equipment to be purchased.

ALUMON-4

Adult Sockeye Enumeration

1.0 PROGRAM RATIONALE

1.1 Background

A spring surface release operation, where $3 \text{ m}^3\text{s}^{-1}$ is released through the spillway gate rather than the LLO for the months of April and May, has been integrated into the Alouette WUP to provide a means by which kokanee smolts can migrate out of the reservoir and to the ocean via the Alouette River. This operation forms part of a longer term strategy in the watershed to re-establish a sockeye salmon run that was extirpated soon after the construction of the Alouette dam. A key assumption that was made when adopting the operation is that the kokanee smolts are fully capable of successfully 're-anadromising' to ocean rearing conditions, i.e.,

- successfully adapt to salt water conditions,
- adopt behavioural strategies to successfully compete and avoid predation in an ocean environment, and finally
- retain their ability recognise and return to their native lake/stream system to spawn.

The FTC however, expressed some uncertainty in this assumption and in turn has recommended that a monitor be carried out to confirm the return of released Alouette kokanee as adult sockeye.

1.2 Management Questions

The FTC recommended that the following management question be addressed through the Adult Sockeye enumeration monitor:

1. Are the Alouette Lake kokanee smolts successfully adapting to an anadromous existence by returning from the ocean environment to spawn in Alouette Lake?

This question cannot be answered without first addressing the following three critical data gaps:

2. What is the run timing of adult sockeye returns so that an appropriate enumeration study can be carried out?

Run timing can vary considerably from stock to stock depending on prevailing freshwater and ocean conditions. Too little is known at this time to predict the run timing of Alouette kokanee/sockeye. It will have to be determined empirically.

3. Are adult sockeye caught during the monitor members of the 'Alouette stock' or are they strays from other nearby coastal systems?
4. Are ocean survival rates of returning re-anadromised kokanee comparable to that of sockeye stocks found elsewhere?

It should be noted that the issue of what to do with the sockeye adults that return to the base at the dam falls outside the scope of WUP, and is more appropriately addressed through a BC Hydro lead multi agency partnership including Ministry of Environment, Fisheries and Oceans Canada, Katzie First Nation, Alouette River Management Society and Alco Hatchery. In the short term, the FTC have recommended that a trap and truck approach be implemented to get returning sockeye adults past the Alouette Dam so that they can complete their lifecycle. The CC fully endorses such an approach to alternative project funding and coordination, and recommends that a letter be issued on behalf of the CC in support of the partnership agreement.

1.3 Summary of Hypotheses

The management questions concerning sockeye run timing and genetic composition is largely descriptive in nature and does not readily lend itself to hypothesis testing. However, management question 4 can be addressed through the following null hypothesis:

H₀1: Estimated annual ocean survival rate of re-anadromised kokanee (calculated using total kokanee returns and the smolt abundance data from Monitors 1 and 2) is within 95% of values observed in other stocks (Bradford 1995).

Management question 1 will be addressed largely through inference based on the pattern of annual test results of hypothesis H₀1 through time.

1.4 Key Water Use Decision

Results of the sockeye adult enumeration monitor are linked to the need for a benefit assessment of spring surface release operation and the decision whether to continue the operation should the Alouette kokanee stock (or a proportion of it?) fail to successfully switch life cycle strategies to an anadromous existence. It is recognised that it may take several years for a measurable response to manifest, but it is expected that some indication of success will be evident by the 2014 WUP review period.

2.0 PROGRAM PROPOSAL

2.1 Approach

The general approach to the sockeye/kokanee adult enumeration program will be to extend the period that the Alco hatchery brood stock collection fence is operated to a year-round operation for the first three years of the monitor (commencing the year the first release of Alouette kokanee is expected to return). The fence is located in the upper watershed and is in position to intercept all migrating adult sockeye on their way to the reservoir. This will provide the data needed to determine the run timing of adult, re-anadromised kokanee and stray sockeye so that in subsequent years, the fence operation can be coordinated between both functions; brood stock collection and sockeye adult enumeration.

Included in the monitor will be the collection of tissue samples (up to 20 individual per year) for stock identification through genetic analysis, which will be carried out at the Pacific Biological Station laboratories in Nanaimo BC. To accomplish this, the monitor will include funds to set up and maintain a temporary holding facility for captured sockeye. Choice of what to do with the captured sockeye falls outside the scope of WUP, though they will likely be trucked to the reservoir to continue with their migration and spawning activity.

2.2 Objective and Scope

The objective of this monitor is to collect the data necessary to test the hypotheses outlined in Section 1.3 and hence, address the management questions presented in Section 1.2. The following aspects define the scope of the study:

1. The study area will consist primarily of the riverine habitat located downstream of the Alouette Lake Reservoir, and particularly the brood collection fence operated by the Alco Hatchery.
2. The monitor will be an addition to the current brood collection operation conducted annually by the Alco Hatchery which will consist of the following:
 - a. Year round fence operations, starting the year that the first returns from the 2005 kokanee release are expected, for a period of three years.
 - b. Extended fence operations to cover the sockeye adult return period once the run timing has been established.
3. The scope of the monitor shall include provision for genetic analysis of a maximum 20 randomly selected adult returns per year for three years, and include the development/construction of a sockeye adult holding facility outside the perimeter of the hatchery.

4. The monitor will also cover the increased cost of maintenance and operation associated with the extend use of the Alco Hatchery fence.
5. The monitor will be carried out annually until the next WUP review period (2014)
6. A data report, including a detailed executive summary and short presentation, will be prepared annually summarising the data collected to date, as well as discuss inferences and present conclusions as they pertain to the impacts of the WUP over time.
7. A final report will be prepared at the end of the monitor that summarises the results of the entire monitoring program, discusses inferences that can be drawn from the data pertaining to the impacts of the WUP over time, and presents conclusions concerning the hypotheses and the management questions in Section 1.2.

2.3 Methods

2.3.1 Field Methods

Fence operations and associated field activities will continue unchanged from those normally used for Alco Hatchery brood stock collection and adult enumeration. The only difference is that all captured sockeye salmon will be held in a separate holding facility for processing.

All captured fish will be assigned a unique identification number, have the date and time of capture noted, and will be measured for fork length (mm FL) and wet weight (g). Tissue samples will also be taken, which will be stored in sealable containers, clearly labelled and frozen till the end of the run. Of the tissue samples collected, only 20 will be sent to the Pacific Biological Station laboratories in Nanaimo, BC for genetic analysis. Sample selection will occur at the end of the run and will be done randomly should the total number of samples exceed the cap for analysis.

2.3.2 Safety Concerns

A safety plan will have to be developed for all aspects of the study in accordance to BCH procedures and guidelines. It is important to note that the adult sockeye enumeration monitor must always be carried out by at least two crew members and that appropriate daily check-in and checkout procedures must be followed.

2.3.3 Data Analysis

All data will be entered into a common database in a standard format for analysis. This will ensure that all data collected over the years on monitoring are compatible and can be analysed with transformation.

Data analysis will consist primarily of descriptive statistics and the use of inference to draw conclusions regarding management questions and hypotheses. Hypothesis H_01 will be tested using a simple z-test where the probability distribution function of published ocean survival estimates will be derived from the work of Bradford (1995).

Although morphometric data will be collected from all the captured sockeye/re-anadromised kokanee, its analysis beyond simple descriptive summaries is considered to be outside the scope of this monitor.

2.3.4 Reporting

Project reporting will consist of annual data reports and a comprehensive final report at the conclusion of the monitor. The annual data reports will summarise the year's findings and include a short discussion of how the year's data compare to that collected in previous years. It will include a brief description of methods, present the data collected that year, and report on the results of all analyses.

At the conclusion of the monitor, a final comprehensive report will be prepared from all of the annual reports written to date that:

1. Re-iterates the objective and scope of the monitor,
2. Presents the methods of data collection,
3. Describes the compiled data set and presents the results of all analyses, and
4. Discusses the consequences of these results as they pertain to the current WUP operation, and how it may or could factor into future decision making.

All reports will be submitted to regulatory agencies for review and comment prior to being finalised for general release.

2.4 Interpretation of results

Annual ocean survival rates that are consistently outside the 95% range of published values for other sockeye stocks for the duration of the monitor, and show no sign of increasing through time, will be considered an indication that the re-anadromization strategy may not be successful. It is possible that the duration of the monitor is insufficient to detect a response, and that a much longer time frame is needed. The likelihood of that being the case will be evaluated at the time of the next WUP review based on the data collected to date, observed sockeye ocean survival estimates since the start of the monitor for other stocks in BC, and the extent of departure from these values. Data from other studies done in the watershed may also be useful in this assessment (e.g., Baxter and Bocking 2006).

It should be noted that the introduction of river caught sockeye adult strays to the Alouette Lake Reservoir may confound the results of this monitor and should be taken into account when drawing inferences regarding the management questions in Section 1.2.

2.5 Schedule

The sockeye adult enumeration monitor will be carried out year-round for the first three years of the monitor, and then be more closely matched to the sockeye run timing for the remainder of monitor till the next WUP review period in 2014. A data report and executive summary of the year's data will be due the 1st week of February the following year. The final report will be due just prior to the start of the next WUP review process in 2014, though the precise due date will be set at BC Hydro's discretion.

2.6 Budget

The total cost of the 7-year adult sockeye enumeration monitor enumeration monitor, including February 2008 (year 1) through July 2009 (portion of year 2) expenditures of \$31,043, is estimated to be \$128,514 in 2006 dollars. Taking into account an average inflation rate of 2%, the total cost is expected to be closer to \$107,790 over the remaining 6-year implementation period. The average annual cost of the monitor, not taking into account inflation, is expected to be \$21,555 per year.

The purchase and maintenance of a holding facility is only budgeted for a 2 year period. It is expected that a permanent facility will be in operation as part of the sockeye trap-and-truck program to be planned for the remainder of the monitoring period.

2.5 References

Baxter, B.E. and R.C. Bocking. 2006. Field Trials to Assess Coho smolt migration success through the Alouette Reservoir, 2005. *Prepared for:* BC Hydro Bridge Coastal Fish and Wildlife Restoration Program. BCRP Report No. 05.A1.02. February 2006. 24 pp. + App.

Bradford, M. J. 1995. Comparative Review of Pacific Salmon Survival Rates. *Can. J. Fish. Aquat. Sci.* 52: 1327-1338