

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.

Archaeological Monitoring Terms of Reference

1.0 MONITORING PROGRAM RATIONALE

During the Alouette Project Water Use Planning (WUP) process, the WUP Committee recognized the importance of archaeological sites to the First Nations with an interest in the area. The effects of reservoir operations on archaeological sites were a key concern raised during the WUP process. A total of three archaeological sites were identified in the draw down zone of the Alouette Reservoir during an archaeological impact assessment conducted in 1991 (Arcas 1991) and it is expected that other undocumented archaeological sites may exist within areas affected by reservoir operations. The WUP Committee was not able to fully evaluate the potential effects of operations on archaeological sites due to incomplete information on their locations and condition.

An archaeological monitoring plan was recommended by the WUP Committee to provide a more accurate assessment of the impacts of BC Hydro operations on archaeological sites and to inform the evaluation of operating alternatives in future WUP reviews. The WUP Committee recommended a program consisting of an archaeological inventory and impact assessment, including an erosion monitoring component, of the Alouette reservoir draw down zone and the South Alouette River.

Subsequently, the Comptroller of Water Rights (CWR) clarified that only non-intrusive heritage work could be included in an Order issued under the Water Act, thereby excluding any study that would require a permit under the Provincial Heritage Conservation Act such as: 1) inventories involving subsurface testing; 2) placement of physical structures onto an archaeological site for monitoring purposes; or 3) investigative excavations. As a result, terms of reference (TOR) for the Archaeological Monitoring Plan have been designed to be non-intrusive to reflect this new understanding.

ALUMON-7 - Archaeological Monitoring Study is a one-year study intended to, in part, address a knowledge gap regarding the number, location, elevation, condition, susceptibility to erosion and relative importance of archaeological sites within the Alouette reservoir and South Alouette River study area. Baseline information on the archaeological resources and potential within the study area and a qualitative assessment of the nature and extent of the impacts to archaeological sites occurring as a result of reservoir operations will be documented as a result of this study.

The detailed approach, methods and budget for this study is presented in the attached terms of reference.

Table 9. Proposed schedule and estimated annual expenditure for the implementation of the Alouette Project Archaeological Monitoring Plan

Year of Implementation		2009	Total Cost
Ref. #	Monitoring Program		
ALUMON-7	Alouette Project- Archaeological Monitoring Study	\$116,402	\$116,402
Total Annual		\$116,402	\$116,402

ALUMON-7

Archaeological Monitoring Study

1.0 PROGRAM RATIONALE

During the Alouette Project Water Use Planning (WUP) process, the WUP Committee recognized the importance of archaeological sites, particularly to the First Nations with an interest in the area. To address this, the WUP Committee developed a cultural resources objective *to maximize the protection of cultural resources within the Alouette System*. This objective included a number of sub-objectives:

- Maximizing the number of days at high reservoir elevation to prevent unauthorized collection of artifacts from archaeological sites situated in the draw down zone;
- Maximizing the number of days at high reservoir elevation to provide access to upland sites;
- Maximizing the number of days in early winter where reservoir levels would be low to enable archaeological fieldwork in the draw down zone;
- Minimize reservoir fluctuations to prevent erosion of archaeological sites; and
- Minimize number of flood events to prevent bank erosion.

A number of these sub-objectives were seen to overlap with an existing Flood Control objective so the Consultative Committee developed a distinct performance measure that could be applied to the fundamental cultural resources objective for use in evaluating operating alternatives. This performance measure is described as the average number of days per year that the reservoir elevation is operated below 122.6 m asl thereby making the draw down zone accessible for archaeological fieldwork. However, the WUP Committee was not able to fully evaluate the potential effects of operations on archaeological sites due to incomplete information on their locations and condition.

Several management questions were raised in consideration of the cultural resources objective, including:

- Where are the archaeological sites in the reservoir;
- What are the relative heritage values of identified sites;
- What is the nature and extent of the impacts to archaeological sites that are caused by reservoir operations;
- Are there archaeological resources that are impacted by river flows; and

- Would an operational change potentially minimize those impacts

The WUP Committee report recommended an Archaeological Monitoring Plan that would address these management questions and provide information necessary for future Alouette Project WUP reviews

In keeping with the recommended Archaeological Monitoring Plan, ALUMON-7 is intended to, in part, address a knowledge gap regarding the number, location, elevation, condition, susceptibility to erosion and relative importance of archaeological sites within the Alouette reservoir and South Alouette River study area. Baseline information on the archaeological resources and potential within the study area and a qualitative assessment of the nature and extent of the impacts to archaeological sites occurring as a result of reservoir operations will be documented as a result of this study.

Subsequent to the completion of the WUP Committee recommendations, the Comptroller of Water Rights clarified that only non-intrusive heritage work could be included in an Order issued under the Water Act, thereby excluding any study that would require a permit under the Provincial Heritage Conservation Act (e.g. subsurface testing, the collection of artifacts, or the placement of physical structures onto an archaeological site for monitoring purposes). In meeting this requirement ALUMON-7 has been designed to exclude any activities that require a Provincial Heritage Permit.

In a parallel process, established through a Memorandum of Understanding, by which the Archaeology Branch of the Ministry of Tourism, Sport and the Arts and BC Hydro are engaged in for the purpose of managing archaeological sites, a Reservoir Archaeology Program is in development. This Program is expected to address the aspects of long-term archaeological management recommended by the Alouette consultative committee that are not included in these Terms of Reference. It should be noted that Heritage Conservation Act permits have requirements over and above Water Use Plan requirements and that the Archaeology Branch will likely require an AIA be completed before alterations to archaeological sites resulting from operation of the Alouette Reservoir will be authorized.

A note on terminology: the language of professional archaeology uses the term “monitoring” for a specific purpose which can lead to confusion regarding the way this term is used in the WUP process. For the purpose of this document, a monitoring program is a general reference for scientific study intended to provide information to future WUP processes by the collection of data as distinguished from a program of physical works which typically involves a construction project such as a boat ramp.

1.1 Background

The Alouette Dam was originally constructed in 1926, and subsequently replaced in 1984 with a modern earth fill structure, as part of the Alouette-Stave-Ruskin

hydroelectric development. Other facility redevelopment has included spillway reconstruction in 1993. Alouette Lake occupies a narrow valley extending in a northeast direction for 17 km from the dam located at its south end and covers a surface area of 16 km² at full pool (Fig 2-1). The majority of inflow to Alouette Lake comes from spring snowmelt and seasonal storms. A tunnel intake to the Alouette powerhouse is situated on the east shore near the north end of the reservoir where the Alouette basin is separated from Stave Reservoir by a narrow granite ridge.

In accordance with Provincial heritage law at the time of the spillway reconstruction project, an archaeological impact assessment was carried out which included a site inventory along the shoreline of Alouette Lake to take advantage of low reservoir levels available at that time (Arcas 1991). In addition, three archaeological impact assessments were completed for various campground developments within Golden Ears Provincial Park (Golder 1998a, 1998b and 1999).

A total of three archaeological sites have been documented along the shoreline of the Alouette Reservoir through these various assessments (Arcas 2006). Not all land within the Alouette Reservoir draw down zone or along the South Alouette River has been intensively surveyed and it is expected that additional undocumented archaeological sites may exist in unexamined areas.

In 2006 BC Hydro's Generation Engineering Services conducted a map review to determine the area potentially subjected to reservoir induced erosion, flooding, landslides and groundwater impacts along the shoreline of the Alouette reservoir above the maximum normal reservoir level (MNRL). This review provides information on the geology, geomorphology and configuration of the shoreline that can be used to better understand conditions within the draw down zones.

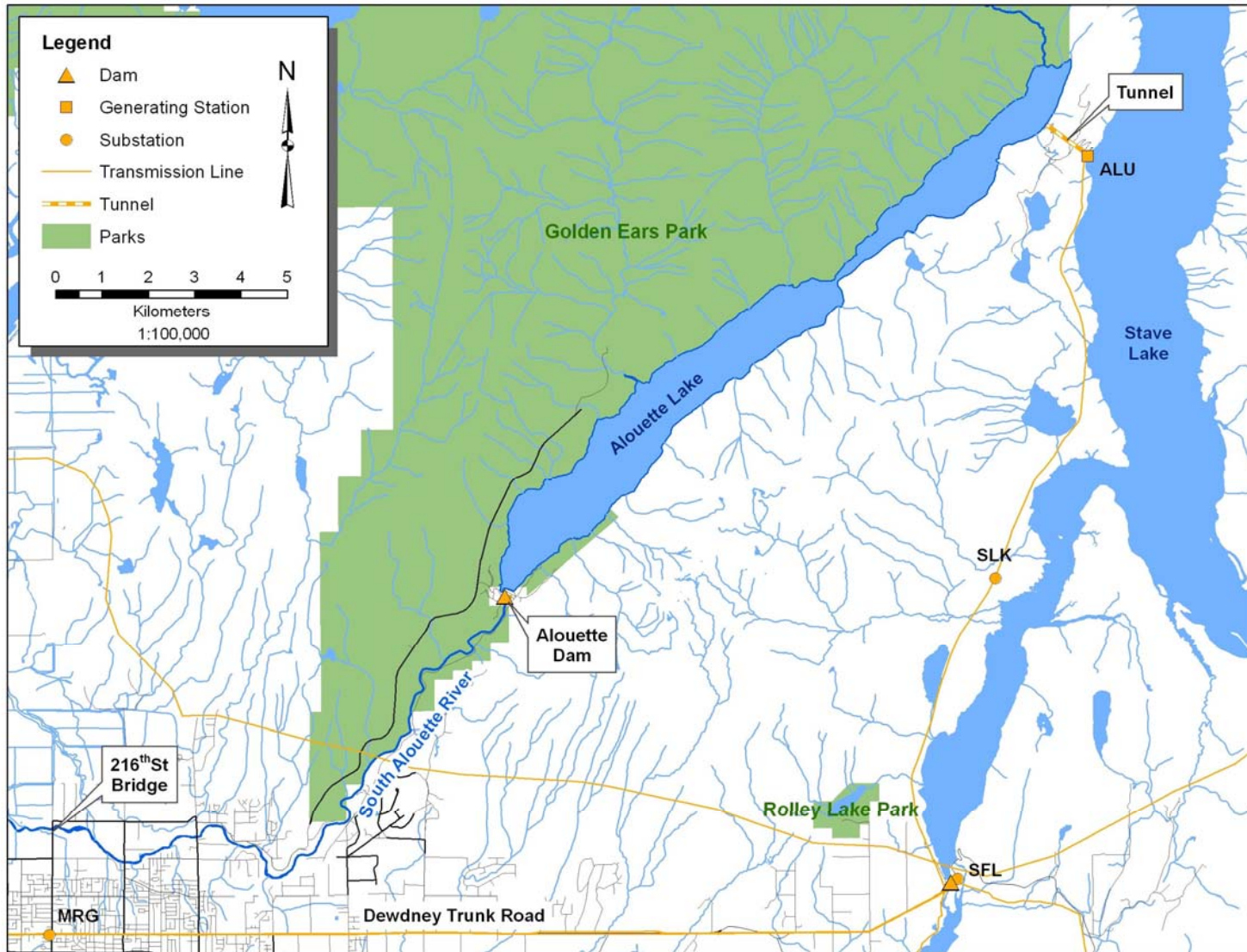
The condition of a documented archaeological site is typically assessed only once, at the time of recording, and few sites are formally re-assessed. Since erosion in a reservoir takes place in a complex environment involving landform, aspect, de-vegetation, surface debris, surficial geology, weather, and human or animal intervention in addition to reservoir operations, the cumulative effect can be difficult to interpret. In order to develop an understanding of taphonomic process (post-depositional effects on archaeological materials) related to reservoir operations, repeated visits to a site over time may be required.

1.2 Purpose

The primary purpose of this archaeological monitoring study is to provide information that can be used in evaluating operating alternatives during the next Alouette Project WUP review. During the WUP discussions, it became clear that an information gap exists regarding the number, location and condition of archaeological sites in the Alouette Reservoir and the South Alouette River. The contents and significance of

documented sites within the study area have not been comprehensively reviewed, and it is possible that additional undocumented archaeological sites exist in areas which have not been surveyed. A comprehensive level of baseline data for the Alouette Reservoir and South Alouette River study area must be assembled in order to address the management questions posed by the Consultative Committee.

Figure 2. Location of Alouette Reservoir - Archaeological Overview Assessment Study Area



1.0 PROGRAM PROPOSAL

2.1 Approach

The archaeological monitoring study will follow the guidelines established for Overview and Preliminary Field Reconnaissance in the Archaeological Impact Assessment Guidelines (Archaeology Branch 1998, Sect 3.4.3). The study will provide an opportunity to review existing heritage data in detail and consolidate documented and previously undocumented information. This information will be used to inform a landscape-based analysis that develops hypotheses on the relationship of landform types to archaeological potential. Hypotheses may pose such questions as:

- Do the sampled areas exhibit, in the field, the characteristics predicted on the basis of map and document review?
- Do archaeological sites appear to exist in the predicted landscape contexts?
- Are there landscape contexts which limit or preclude archaeological site potential due to geomorphologic constraints?

A preliminary field reconnaissance will be used to ground-truth the archaeological landscape hypotheses and it is expected that quantitative methods will be used in framing the questions and assessing the results of the survey. A component of the field reconnaissance may also be applied to areas of key interest to local First Nation communities where these areas do not overlap with the ground-truthing component described above.

All documented archaeological sites within the study area will be revisited as part of the preliminary field reconnaissance and effects directly related to reservoir operations will be assessed qualitatively and recorded as part of the field survey. The development of a preliminary evaluative framework for assessing site significance is a key deliverable. The project will be directed by a professional archaeologist who will be assisted by technical field staff and GIS support.

Through review of these terms of reference local First Nations will have been given the opportunity to comment on the study plan before it is carried out. All reports will be shared with local First Nations.

In addition to methods described in Archaeological Impact Assessment Guidelines, the archaeologist will conduct accurate surveys in accordance with BC Hydro's *General and Technical Standards for Reservoir Archaeological Work*, meeting all relevant requirements.

2.2 Objective and Scope

The objective of this archaeological overview is to collect information that will contribute to the development of a model of archaeological potential or sensitivity within the drawdown zone of the Alouette reservoir and the South Alouette River. This information can then be used to develop a GIS landscape-based archaeological potential model for the study area.

This project will involve documentary research and analysis as well as an in-field survey component that will ground-truth a sample of areas according to stated hypotheses related to archaeological potential. Documentary research for this overview will pertain to the entire study area described above. The field survey component will be undertaken at selected locations within the overall study area. Although this study is not designed to function as an archaeological impact assessment, qualitative assessments of effects directly related to reservoir operations will be recorded as part of the field survey to address a need for baseline erosion monitoring data.

The typical draw down elevation of the Alouette Reservoir is between 118 and 124 m. Portions of this draw down zone and the banks of the South Alouette River from the dam to the 216th bridge, a distance of about 15 km, constitutes the geographical scope of the study area.

2.3 Methods

The overview will involve four basic tasks outlined below:

2.3.1 Task 1: Project Management

Project management will involve the general administrative and technical oversight of the project. This task will include, but not be limited to: 1) budget management, 2) study team management, 3) logistic coordination, 4) technical oversight of field and analysis components, and 5) facilitation of data transfer among other investigators, as required.

A safety plan must be developed and submitted to the BC Hydro contact for all aspects of the study involving field work, in accordance with BC Hydro procedures and guidelines.

2.3.2 Task 2: Documentary Research

This task includes, but is not limited to:

- 1) a review of published and unpublished reports;
- 2) a review of all documented archaeological sites within the study area described in Section 3.1;

- 3) direct contact with persons or organizations knowledgeable about the archaeological resources in the study area where this information has the potential to expand on available documentary information;
- 4) a review of relevant earth science maps and other documents available for the study area, including but not limited to surficial geology maps;
- 5) the development of landscape-based hypotheses on archaeological potential; and
- 6) the development of a preliminary quantitative evaluative framework based on the criteria set out in Appendix D of the *Archaeological Impact Assessment Guidelines* for assessing site significance.

It is expected that the research team will work with First Nations to determine key locations of interest to incorporate into the research design where possible.

2.3.3 Task 3: Preliminary Field Reconnaissance

Using survey sampling techniques the study team will assess the archaeological resource potential of sampled portions of the study area with reference to the documentary research, archaeological landscape hypotheses and community interest. A minimum 50 ha of survey area is expected to be achieved over the life of the study. The orientation of survey transects is expected to be linear (5 m wide by 2000 m long = 1 ha as one example.) along shorelines or riverbanks. Pedestrian survey methods supported with vehicle and/or boat access will be employed.

The Alouette Reservoir drawdown zone will be accessible for the preliminary field reconnaissance between mid-September and November and between February to April while water levels are low and snow coverage on the shoreline is minimal. The optimal period for fieldwork is typically in the mid to late fall. Actual reservoir levels are dependent on weather variability during spring runoff and on reservoir operations. Survey along the South Alouette River will be more readily available with the exception of private lands which will be exempt from the survey. Areas subject to inspection will be selected based on a review of maps, air photos and the landforms they exhibit in the context of the stated hypotheses regarding archaeological potential. It may be necessary to exempt certain areas from intensive inspection owing to topographic constraints (excessive slope, landslides, etc.) or status (land ownership or land use) as noted above.

At each identified or re-visited archaeological site, the position, type and morphological characteristics of all surface artifacts, cultural features, exposed sediments and landscape context will be recorded by the professional archaeologist and technical support staff. A qualitative assessment of the nature and extent of the impacts to archaeological sites directly attributable to reservoir operations will be made. Digital photographs with a minimum 300 dpi will be taken of the site context and of all

archaeological features and artifacts observed within. Information required for submitting or updating B.C. Archaeological Site Inventory Forms will be recorded in detail.

2.3.4 Task 4: Analysis and Reporting

A draft report that summarizes the methods employed and study findings will be prepared shortly after the conclusion of the preliminary field reconnaissance. The draft report will include all the components expected in a final report to enable a thorough review at the draft stage. A final report for the study will include:

- an executive summary;
- a description of the methods employed;
- results of research on documented and/or known sites in the reservoir;
- a detailed landscape-based hypotheses on archaeological potential;
- site significance evaluation matrix;
- a detailed summary of the preliminary field reconnaissance findings including a qualitative assessment of effects to archaeological sites directly related to reservoir operations;
- hard copy and digital maps, in an acceptable format, showing survey coverage and the location of all documented archaeological sites; and
- specific recommendations regarding the suitability for long-term erosion monitoring of specific heritage sites and the scope of further studies

All reports will be provided in hard-copy and as Microsoft Word and Adobe Acrobat (*.pdf) format, and all maps and figures will be provided both as embedded objects in the Word file and as separate shapefile layers in accordance with BC Hydro's Reservoir Archaeology Standards.

The preparation and submission of B.C. Archaeological Site Inventory Forms through the Archaeology Site Inventory Section's ADIF system for all newly identified sites or updates to previously documented site data records is also required.

2.4 Schedule

The study will take place over the course of a one to two year period with an emphasis on documentary research tasks and a preliminary field reconnaissance survey of portions of the reservoir draw down zone taking place in the spring and a preliminary field reconnaissance survey of the South Alouette River section taking place in the fall. The exact timing will depend on site conditions, but it is expected that the greatest amount of the drawdown zone will be exposed in the fall and spring months. Low water levels and minimal snow cover on the ground are needed for an effective survey.

1.5 Budget

The total budget for the Alouette Project Archaeological Monitoring study is estimated at \$116,402 with year to date expenditures of \$22,260..

2.6 References

- Arcas Consulting Archaeologists Ltd. 1991. Alouette Dam Spillway Rehabilitation Archaeological Impact Assessment. Prepared for BC Hydro.
- Arcas Consulting Archaeologists Ltd. 2006. Archaeological Data Summary to 2005 in BC Hydro Reservoirs Archaeological Data Collection Project. Prepared for BC Hydro (Alouette Reservoir section).
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- Golder Associates Ltd. 1998a. Archaeological Impact Assessment of Proposed Campground Expansion, Golden Ears Provincial Park. Heritage Inspection Permit 1998-247 and Sto:lo Nation Permit 1998-028. Report on file, Archaeology Branch, Victoria, B.C.
- Golder Associates Ltd. 1998b. Archaeological Reconnaissance of Proposed Golden Ears Campground at Alouette Lake. Report on file, Archaeology Branch, Victoria, B.C.
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