Alouette Water Use Plan

Monitoring Programs
Annual Report: 2010

- Smolt Enumeration
- Kokanee Out-migration
- Substrate Quality
- Sockeye Adult Enumeration
- Water Temperature
- Kokanee Age Structure Analysis
- Archaeological Monitoring

For Water Licences 124724, 124725, 124726
1.0 INTRODUCTION

This document represents a summary of the status and the results of the Alouette Project Water Use Plan (WUP) monitoring programs to 30 April 2010, as per the Alouette Project Order under the Water Act, dated 20 April 2009. There are seven monitoring programs:

a) Smolt Enumeration
b) Kokanee Out-migration
c) Substrate Quality
d) Sockeye Adult Enumeration
e) Water Temperature
f) Kokanee Age Structure Analysis
g) Archaeological Monitoring

2.0 BACKGROUND

The water use planning process for BC Hydro’s Alouette storage/hydroelectric project was initiated in May 2005 and completed in May 2006. The conditions proposed in the WUP for the operation of the project reflect the August 2006 recommendations of the WUP Consultative Committee (CC).

In April 2006, as a component of the Alouette Water Use Plan, the draft TOR for the fisheries component of the Alouette WUP monitoring program was confirmed by the WUP fish technical committee (FTC) including Fisheries and Oceans Canada (DFO), Ministry of Environment (MOE), Katzie First Nation, City of Maple Ridge, BC Corrections (Alco Hatchery) and Alouette River Management Society.

On 20 November 2007 the Alouette WUP Monitor Committee including DFO, Ministry of Environment, Alouette River Management Committee, Katzie First Nation, City of Maple Ridge, and BC Corrections (Alco Hatchery) and local stewards met to confirm the draft TOR for the fisheries component of the Alouette WUP monitoring program with full endorsement provided based on minor revisions to the Sockeye Adult Enumeration and Smolt Enumeration TOR.

In January 2008 BC Hydro committed to the Alouette Monitoring Committee (AMC) that all recommended WUP monitoring programs including the Archaeology monitoring would be implemented in 2008 to ensure continued progress of the Alouette Sockeye Restoration Program which is contingent on three of the recommended WUP monitoring programs as well as to stay within the originally committed seven year review period through 2014.

In an attempt to facilitate the Comptroller of Water Rights (CWR) TOR review process, on 22 January 2008 BC Hydro forwarded the draft TOR for the fisheries components of the Alouette WUP monitoring program to the CWR for consideration given impending Order issue and communicated CWR work load issues. BC Hydro acknowledged that no TOR leave to commence would be provided from the CWR until after the Alouette Order was issued.
The TOR for the WUP recommended Archaeology Monitoring was accepted by Katzie FN in January 2009 and the BC Archaeology Branch in November 2008.

In April 2009, BC Hydro submitted a revised Alouette WUP to the CWR.

On 21 April 2009, BC Hydro was ordered to implement the conditions proposed in the Alouette WUP and submit monitoring programs TOR as well as provide a summary of WUP monitoring work done to date.

Based on initial AMC TOR endorsement in November 2007, a further seven minor revisions to the fisheries component TOR including both budget increases and methodology changes were accepted by the AMC between September 2008 and September 2009.

On 19 October 2009 the Alouette WUP monitoring programs TOR were submitted to the CWR for review and approval.

On 16 November 2009, the CWR accepted the TOR for the Smolt Enumeration, Kokanee Out-migration, Substrate Quality, Sockeye Adult Enumeration, Water Temperature, Kokanee Age Structure Analysis, and Archaeological Monitoring.

The Order will be implemented until 2014, when BC Hydro will assess the results of the monitoring programs and merge the Stave and Alouette into a single Water Use Plan that better reflects the integrated nature of the Alouette, Stave Falls, and Ruskin hydroelectric power developments.

3.0 STATUS

The following table outlines the status and schedule for the Alouette WUP monitoring programs.
Table 3-1: Status of Alouette WUP Monitoring Programs Implementation.

<table>
<thead>
<tr>
<th>Monitoring Program</th>
<th>2008 WLR Yr1</th>
<th>2009 WLR Yr2</th>
<th>2010 WLR Yr3</th>
<th>2011 WLR Yr4</th>
<th>2012 WLR Yr5</th>
<th>2013 WLR Yr6</th>
<th>2014 WLR Yr7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smolt Enumeration</td>
<td>✔</td>
<td>✔</td>
<td>U/W</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
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<tr>
<td>Kokanee Outmigration</td>
<td>✔</td>
<td>✔</td>
<td>U/W</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
</tr>
<tr>
<td>Substrate Quality</td>
<td>✔</td>
<td>✔</td>
<td>U/W</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
</tr>
<tr>
<td>Sockeye Adult Enumeration</td>
<td>✔</td>
<td>✔</td>
<td>U/W</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
</tr>
<tr>
<td>Water Temperature</td>
<td>✔</td>
<td>✔</td>
<td>U/W</td>
<td>■</td>
<td>■</td>
<td>■</td>
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<tr>
<td>Kokanee Age Class Structure Analysis</td>
<td>✔</td>
<td>✔</td>
<td>U/W</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
</tr>
<tr>
<td>Archaeological Monitoring</td>
<td>DEL³</td>
<td>✔</td>
<td>U/W</td>
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</tbody>
</table>

Legend: ■ = Project to be undertaken/initiated in identified year
         U/W = Project is underway
         DEL = Project is delayed for this year
         ✔ = Project is complete for the year

Footnotes:
1. Programs initiated prior to receipt of monitoring program leave to commence from CWR.
2. BC Ministry of Environment program commitment to provide yearly reporting of fall field data by December of following year (e.g. 2008 reporting due in December 2009).
3. Archaeological Monitoring delay until 2009 based on delayed TOR approval by Katzie First Nation and BC Archaeological Branch

4.0 SUMMARY OF ALOUETTE WUP MONITORING PROGRAMS

This section provides a summary of the Alouette WUP monitoring programs as per the Order under the Water Act dated 20 April 2009. The following table summarizes the monitoring programs results according to the key monitoring indicators for each program.
### Table 4-1: Summary of Alouette WUP Fisheries Monitoring Program Results

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</thead>
<tbody>
<tr>
<td>Smolt Enumeration</td>
<td>(a) Coho Smolt Density (Production)</td>
<td>1,400 smolts/km²</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>1,473 (16,200)</td>
<td>321 (10,236)</td>
<td>1,818 (20,063)</td>
<td>1,522 (13,789)</td>
<td>1,790 (19,358)</td>
<td>1,524 (18,855)</td>
<td>1,788 (16,838)</td>
<td>1,248 (13,020)</td>
<td>1,216</td>
<td>1,788</td>
<td>236</td>
<td>3,522 (2,509)</td>
<td>3,801</td>
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<tr>
<td></td>
<td>(b) Steelhead Smolt Density (Production)</td>
<td>418 smolts/km²</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Low Capture</td>
<td>164 (1,813)</td>
<td>308 (3,363)</td>
<td>308 (2,286)</td>
<td>343 (2,768)</td>
<td>215 (2,364)</td>
<td>297 (2,826)</td>
<td>Low Capture</td>
<td>Low Capture</td>
<td>Low Capture</td>
<td>604 (4,204)</td>
<td>583</td>
<td>5,101</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>(c) Chum Fry Production</td>
<td>15M^3</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>13.4M</td>
<td>13.4M</td>
<td>14.7M</td>
<td>14.7M</td>
<td>15.3M</td>
<td>15.3M</td>
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<tr>
<td></td>
<td>(d) Pink Fry Production</td>
<td>1M^6</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>55K</td>
<td>N/A</td>
<td>190K</td>
<td>N/A</td>
<td>143.3K</td>
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<td>Kokanee Outmigration</td>
<td>Number of Outmigrating Kokanee Smolts</td>
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<td>Not Studied</td>
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<td>Substrate Quality</td>
<td>Substrate Quality (areal fraction of fine sand &lt; 2mm)</td>
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<td>31</td>
<td>16</td>
<td>13</td>
<td>12</td>
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<td>Sockeye Adult Enumeration</td>
<td>Number of Returning Adult Sockeye</td>
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<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
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<td>Not Studied</td>
<td>Not Studied</td>
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<td>54</td>
<td>46</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Water Temperature</td>
<td>(a) Number of days with temperatures &gt; 25 (Degrees Celsius)</td>
<td>N/A</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
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<td>0</td>
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</tr>
<tr>
<td></td>
<td>(b) Number of days with daily average temperatures &gt; 16 (Degrees Celsius)</td>
<td>N/A</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>28</td>
<td>61</td>
<td>Not Studied</td>
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<td>71</td>
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<td>89</td>
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<tr>
<td>Kokanee Age Class Structure Analysis</td>
<td>Kokanee spawner Abundance</td>
<td>7,000</td>
<td>10,000</td>
<td>10,000</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>12,000</td>
<td>26,000</td>
<td>14,000</td>
<td>13,500</td>
<td>7,000</td>
<td>9,000</td>
<td>25,000</td>
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</tr>
</tbody>
</table>

1. Monitoring as per 1996 Alouette Water Use Plan recommendations.
2. Monitoring as per 2006 Alouette Water Use Plan recommendations.
5. Fisheries and Oceans Canada (2007) estimated maximum chum fry production.
8. Upper lethal temperature threshold for stream dwelling juvenile salmonids.
10. BC Ministry of Environment adult kokanee biomass density biostandard of 5 kg/ha
11. Fisheries and Ocean Canada (1996) Phosynthetic Rate Model

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**Note:**
- WLR: Water Level Regulation
- YR: Year
- N/A: Not Applicable
- Not Studied: Data not collected or available

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**References:**
- Fisheries and Oceans Canada (2007).
4.1 Smolt Enumeration

4.1.1 Overview

The objective of this monitoring program is to confirm if the average base-flow release of 2.6 m$^3$s$^{-1}$ from the Alouette Dam (obtained by fully opening the low level outlet) is adequate to sustain or improve current levels of salmonid smolt production downstream in Alouette River. The species of interest include chum, pink, chinook, and coho salmon as well as steelhead and cutthroat trout. Supporting objectives include: 1) confirmation that following their migration out of Alouette Reservoir that kokanee smolts immediately continue migration out of the Alouette River and 2) using adult chum salmon counts as an indicator of run strength, is there evidence of a persistent, declining trend in egg to smolt survival that would suggest a degrading condition in spawning substrate quality.

Monitoring Indicator (a): smolt production (coho, steelhead, pink, chum, chinook)
Monitoring Indicator (b): Kokanee smolt migration timing (Mud Creek trap downstream to 224th trap locations)
Monitoring Indicator (c): Chum egg to smolt survival

This monitoring program is comprised of several study components involving:

- Instream trapping of fry and smolt outmigrating from the Alouette River; and
- Observations of salmon adults returning to spawn

4.1.2 Status

This program commenced in 1998 as a component of the initial 1996 Alouette WUP commitments. As a result, it is in its thirteenth year of full implementation. The 2007/2008 study program report$^1$, which is a summary of studies between 1998 - 2009, was submitted in January 2010. The 2008/2009 study program report is due for submission in January 2011.

4.1.3 Interpretation of Data

The 2009 chum fry out-migrant estimate was 54.3 million fish which represents an unprecedented production estimate for the Alouette River; well above the previous maximum annual outmigration estimate (30.3 million) and the previous 11-year average (13.9 million).

The 2009 coho smolt out-migration estimate of 40,156 was also far greater than expected and was more than double the 10 year annual average of 15,000 smolts. The high 2009 coho smolt estimates, in contrast to 2008, suggest hatchery fry releases the year previous are making a significant and substantial contribution to coho smolt production.

The steelhead smolt out-migration estimate of 6,191 suggests steelhead smolt production in the South Alouette River is exceeding expectations and may have increased in recent years. The 1999 to 2005 average annual estimate was 2,780 steelhead smolts.

Moving the rotary screw trapping location upstream to 224th St. and incorporating efficiency or flow deflection panels, both undertaken in 2008, has proven successful in restoring smolt catch success. These results demonstrate the declines in coho and steelhead smolt out-migration in 2006-07, and perhaps, the more subtle declines since 2003, were an artifact of trapping bias due to the increasing effect of backwatering from the tidal influence of the Pitt River at the 216th St. location.

4.2 Kokanee Outmigration

4.2.1 Overview

The objective of this monitoring program is to confirm whether a surface release of at least 3 m³s⁻¹ from the Alouette Dam between April 15 and June 15 (obtained through the spillway gate) is adequate to promote the downstream migration of kokanee smolts out of the Alouette Reservoir. A supporting objective relates to whether a post-surface release flush of 6-9 m³s⁻¹, lasting 7 days following the tail end of the outmigration period, encourage more smolts to leave the system.

Monitoring Indicator (a): Number of outmigrating kokanee smolts.

This monitoring program involves instream trapping of smolts outmigrating from the system.

4.2.2 Status

Supporting program data was collected from 2005 through 2007 by the BC Hydro Bridge Coastal Restoration Program as a component of an Alouette sockeye restoration initiative to assess salmonid smolt passage response with spill releases in the order of 3 m³s⁻¹ over the Alouette Dam. In 2006 the kokanee outmigration monitoring program was confirmed as a component of the Alouette WUP recommended monitoring program. As a result, it is in its sixth year of implementation. The 2009 study program (WUP monitor year 2) report², which is a summary of studies between 2005-2009, was submitted in February 2010. The 2009 study program report is due for submission in January 2011.

4.2.3 Interpretation of Data

In 2009, 1,247 kokanee were captured at Mud Creek as they migrated over the spillway from the Alouette Reservoir with a recapture estimate of 4,287 calculated for the period 21 April to 28 May. The 2009 estimate of 4,287 was the smallest migration estimated since monitoring began in 2005. Spillway gate flows were

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² Mathews, M., Bocking, B. 2010. Evaluation of the Migration Success of O. nerka (Kokanee/Sockeye) from the Alouette Reservoir, 2009. Prepared for BC Hydro, Burnaby, BC.
maintained between 3.2 and 4.3 m$^3$s$^{-1}$ from 15 April to 15 June, comparable to the flows maintained during the 2007 and 2008 smolt migrations.

During the last three years of full season monitoring the kokanee migration has begun in mid April and continued until late May or early June. The 2007 and 2009 migrations both tapered off a week later than the 2008 migration. In 2009 the peak occurred in the latter half of May, substantially later than the late April peaks of the previous two years. Given the variation in peak timing and end date, continued monitoring is important to help improve our understanding of typical run timing.

Spring 2009 was the first year of a 6-9 m$^3$s$^{-1}$ post-surface release flush, scheduled for seven days at the tail end of the migration; however, once flows reached a maximum of 6 m$^3$s$^{-1}$ the integrity of the rotary screw trap and safety of crew and captured fish became a concern and the flush had to be terminated after only three days. No increases in catch were associated with the flushing flows. A more robust trapping plan is proposed for evaluation of the 6 m$^3$s$^{-1}$ flush in 2010.

4.3 Substrate Quality

4.3.1 Overview

The objective of this program is to assess Alouette River substrate quality considering underlying management questions to evaluate the general composition of bed material and to confirm the threshold of fine sediments less than 2 mm diameter to maintain productive salmonid habitat. Program findings will be evaluated to confirm the need for an Alouette Dam flushing flow.

Monitoring Indicator (a): Substrate Quality (areal fraction of fine sand < 2 mm)

This program will involve direct instream observations of substrate quality at index sites in the Alouette River.

4.3.2 Status

This program commenced in 1998 as a component of the initial 1996 Alouette WUP commitments. In 2006 the monitoring program was confirmed as a component of the Alouette WUP Consultative Committee recommended monitoring program. As a result, it is in its eighth year of full implementation. The 2009 study program report$^3$, which is a summary of studies between 1998 -2009, was submitted in March 2010. The 2009 study program report is due for submission in January 2011.

4.3.3 Interpretation of Data

The 2009 Alouette River substrate sampling showed an overall increase in fine particles less than 2mm diameter of 4.0% since 2008 with an average of 16% for all monitoring sites. This overall average of 16% in fine particles is still within the 20% threshold for protection of fish habitat in Pacific Northwest Streams. Analyses

indicated that the levels of fines in the river declined sharply during the 1995 high water event, and then have remained relatively stable since that time.

As with prior year sampling results, 2009 sampling confirmed an overall increase in the percentage of suitable spawning gravels 16 – 128 mm for all sites following the 2000 Bridge Coastal Restoration Program gravel placement project at Mud Creek and Alouette Dam.

All observations made during the duration of the Alouette studies have supported the study management question which asks if the < 20% fines threshold is adequate to distinguish a state in substrate quality that would require a prescribed flushing event.

2008 program findings indicate that a directed flush flow could benefit upriver lower velocity sites by removing accumulated fines from certain sections of the lower velocity side habitats. However, these did not appear to be having a negative effect on area salmonids and / or their food sources. In addition, negative sedimentation impacts such as compaction at a level that would hinder or prevent spawning were not encountered at any site. Other assessments that were made during the study, such as examining the abundance and variety of macro invertebrates, strongly suggest that sedimentation is not a limiting factor on salmonid habitat. Accordingly, an Alouette Dam flushing flow was not seen as a critical requirements to enhance fish habitat quality in Alouette River.

4.4 Sockeye Adult Enumeration

4.4.1 Overview

The objective of this program is to confirm that Alouette Lake kokanee smolts passed over the Alouette dam during the spring surface release flow are successfully adapting to an anadromous existence by returning from the ocean environment to spawn in Alouette Lake as adult sockeye. Supporting objectives include: 1) confirmation that the adult sockeye returns are members of the ‘Alouette stock’ and not strays from other nearby coastal systems, 2) confirmation of the adult sockeye return run timing to allow streamlining of enumeration efforts, and 3) confirmation that ocean survival rates of returning re-anadromised kokanee comparable to that of sockeye stocks found elsewhere.

Monitoring Indicator (a): Number of returning adult sockeye

This program will involve enumeration of adult sockeye captures at the Alco Hatchery fish collection facility.

4.4.2 Status

This program was supported in 2007 by the BC Hydro Bridge Coastal Restoration Program as a sockeye restoration initiative. The monitoring program was further confirmed as a component of the Alouette WUP Consultative Committee recommended monitoring program in 2006. As a result, it is in its fourth year of implementation with the 2009 second year WUP recommended study program.
report\textsuperscript{4} submitted in January 2010. The 2010 study program report is due for submission in January 2011.

4.4.3 Interpretation of Data

The 2009 Alouette River adult sockeye run was much lower than predicted, with only 45 adults returning between the June 27 of June and October 17, 2009. The low 2009 Alouette adult returns were similar to the Fraser River where sockeye smolt to adult survival was estimated to be 0.3%, which is considerably lower than the long term average of 8.5%. A federal inquiry is currently underway to identify possible causes for the 2009 low adult returns for the entire Fraser River system.

The 2009 Alouette sockeye return were caught at the Allco Fish Hatchery with 43 released in the Alouette Reservoir (Figure 1 and 2). Genetic sampling of 15 adults confirmed that all out-migrating smolts and returning adults were of Alouette origin and not strays from other Lower Fraser River systems.

Based on the first year of monitoring, the adult sockeye return appears to be a summer run, arriving to the Alouette Watershed in July and August, however, the 2010 monitor year will be used to further confirm run timing given continuous trapping from April through December. Based on findings to date 2011 through 2014 trapping is expected to be focussed on the July through August adult migration periods only.

Figure 1. Allco Fish Hatchery fence and trap.

Figure 2. Alouette adult sockeye transport tanks funded through Bridge Coastal Restoration program.
4.5 Water Temperature

4.5.1 Overview
The objective of this monitoring program is assess if high summer water temperatures in Alouette River downstream of Alouette Dam approach incipient lethal limits of rearing salmonids that would impact survival and growth during the summer critical rearing period. A supporting objective includes whether a general increase in stream temperatures shifts fish community structure from a cold-water, primarily salmonid system to a warm-water primarily cyprinid system.

Monitoring Indicators (a): Number of days with temperatures > 25 Degrees Celsius
Monitoring Indicators (b): Number of days with daily average temperatures > 16 Degrees Celsius

The monitoring program is comprised of continuous temperatures loggers situated in the Alouette Dam forebay as well as four Alouette River downstream locations.

4.5.2 Status
This program commenced in 2001 as a component of the initial 1996 Alouette WUP commitments. The year 1 WUP recommended program report\(^5\) submitted in June 2009 summarizes the temperature data collected since the beginning of the WUP monitoring program (October 2008) and also summarizes the available data collected earlier through 2001. The 2009 study program report was submitted in May 2010 with the year 3, 2010, report to be submitted in May 2011.

4.5.3 Interpretation of Results

Water temperatures in the plunge pool just downstream of the Alouette Dam generally ranged from a low of about 4°C in December and January and generally increased from February with peak temperatures observed in late August and early September. There were no significant differences between water temperatures at the plunge pool site and sites located further downstream.

The upper lethal temperatures for juvenile salmonids in the range of 25 Degrees Celcius were not approached at any of the Alouette Dam forebay or down river monitoring sites. However, the upper sustained temperatures threshold of 16 Degrees Celcius was surpassed throughout the summer in 2009 and all previous monitoring years through 2001.

Fish productivity (smolt production) has been relatively stable and increasing over the monitoring period with little correlation observed between high summer water temperatures decreased smolt production. Summer temperature data will continue to be assessed to confirm any correlation between smolt production and summer water temperatures.

4.6  Kokanee Age Class Structure Analysis

4.6.1  Overview

The objective of this monitoring program is to determine if there is any correlation between the extent of Alouette Reservoir fluctuation during the spawning and incubation period and reduced juvenile kokanee recruitment caused by habitat dewatering.

Monitoring Indicator (a): Total kokanee fry production.

This monitoring program is comprised of several study components involving both hydro acoustic assessments and gill netting in Alouette Reservoir:

4.6.2  Status

This program was initiated in fall 2008 as part of the 2006 Alouette WUP recommendations. Year 1 field components were completed in fall 2008 with a final report\(^6\) submitted in April 2010. The 2009 field component was completed in fall 2009 with a study program report due in December 2010.

The extended reporting period for this study is related to BC Ministry of Environment (MOE) study delivery and reliance on hydroacoustic data collected via BC Hydro’s ,non-WUP, Alouette Reservoir Fertilization program. MOE has committed to provision of all future reports by December 31 of the year following data collection.

4.6.3  Interpretation of Data

A model based approach was used to assess whether the Alouette Reservoir kokanee population was recruitment\(^7\) limited and whether reservoir fluctuations during the spawning and incubation period affected subsequent fry and adult abundance. The study utilized a size-at-age model of the kokanee collected from gillnet data from 1998-2009 to determine if the population’s size-at-age is stable or decreasing. In addition, a kokanee stock-recruitment model was developed from hydroacoustic data collected from 2000-2008 to assess if reservoir fluctuations affected fry abundance and whether any drops in fry abundance persisted to affect the numbers of older age classes.

Preliminary analyses suggest that the Alouette Reservoir kokanee population may be regulated by density dependent mechanisms, similar to other kokanee populations. While this would suggest a rejection of a key management question relating to the reservoir being recruitment limited, considerable uncertainty in the estimates makes this difficult to discern. In addition, the stock-recruitment analyses failed to confirm the impact of reservoir fluctuation on recruitment. Incorporation of more data over the next few years will assist in supporting the models for analyses and assessing mechanisms regulating the kokanee population in Alouette Reservoir.


\(^7\) Recruitment is generally defined as the number of new juvenile fish reaching a size where they can be sampled.
In consideration of MOE kokanee monitoring and associated biostandards from other BC large lake systems, the abundance of Alouette Reservoir age 3 adult kokanee appears to be fluctuating within the expected range of 7,000 – 19,000.

4.7 Archeological Assessment

4.7.1 Overview

The objective of this monitoring program is to address a knowledge gap regarding the number, location, elevation, condition, susceptibility to erosion and relative importance of archaeological sites within the Alouette reservoir and Alouette River study area.

Monitoring Indicator (a): N/A

This monitoring program is comprised of several study components involving field survey of the Alouette Reservoir drawdown zone and Alouette River as well as an archival literature review.

4.7.2 Status

This one year program was initiated in April 2009 as part of the 2006 Alouette WUP recommendations. The 2009 field components are complete with the Alouette Reservoir drawdown and Alouette River surveys complete. The draft program study report was submitted in May 2010 with a final version to be submitted with the 2011 Alouette Annual report.

4.7.3 Interpretation of Data

Preliminary archaeological assessment findings include the identification of three new archaeological sites along the southwest shoreline of Alouette Reservoir and an area of high archaeological potential in the Alouette River between 232nd Street and 216th Street.

Recommendations for further study include completion of additional inventory and subsurface investigation in the Alouette Reservoir drawdown zone under a permit issued under the Heritage Conservation Act. It is further recommended that periodic surface inspections be completed of the high archaeological potential sites in Alouette River with an Archaeological Impact Assessment completed as necessary.

Based on finalization of the Archaeological Assessment report and discussion with Katzie is it expected that assessment outcomes will be addressed through a combination of BC Hydro’s Reservoir Archaeological and WUP programs.
4.8 **Wahleach Project WUP Monitoring Programs and Physical Work Costs**

The following table summarizes the Alouette Project WUP monitoring programs and physical work costs approved by the Comptroller and the actual costs to 30 April 2010.
### Table 6-1: Alouette Project WUP Monitoring Programs and Physical Work Cost

<table>
<thead>
<tr>
<th>Monitoring Programs</th>
<th>Activity</th>
<th>Costs approved by CWR</th>
<th>Total Forecast (Life to Date Actuals and Forecast)</th>
<th>Variance Total to Approved</th>
<th>Explanation</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ALUWLR ANNUAL REPORT</td>
<td>$8,830</td>
<td>8,880</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ALUMON#1 SMOLT ENUMERATION</td>
<td>$795,137</td>
<td>784,879</td>
<td>$10,258</td>
<td>Minor variance acknowledged and will endeavour to manage to zero over project duration.</td>
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</tr>
<tr>
<td></td>
<td>Direct Management</td>
<td>$26,068</td>
<td>24,573</td>
<td>$1,495</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Implementation</td>
<td>$769,069</td>
<td>760,307</td>
<td>$8,762</td>
<td>Minor variance acknowledged and will endeavour to manage to zero over project duration.</td>
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<tr>
<td></td>
<td>ALUMON#2 KOKANEE OUT MIGRATION</td>
<td>$377,677</td>
<td>378,780</td>
<td>($1,103)</td>
<td>Minor variance acknowledged and will endeavour to manage to zero over project duration.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Direct Management</td>
<td>$35,860</td>
<td>33,892</td>
<td>$1,968</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Implementation</td>
<td>$341,817</td>
<td>344,888</td>
<td>($3,071)</td>
<td>Per 19 May 2010 CWR email correspondence, variance related to additional program cost requirements related to monitoring of a pulse flow release in spring 2010</td>
<td>Resubmit TOR based on confirmation of spring 2010 monitoring success and associated future program costs.</td>
</tr>
<tr>
<td></td>
<td>ALUMON#3 SUBSTRATE QUALITY</td>
<td>$82,012</td>
<td>81,665</td>
<td>$347</td>
<td>Minor variance acknowledged and will endeavour to manage to zero over project duration.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Direct Management</td>
<td>$17,774</td>
<td>17,070</td>
<td>$704</td>
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<tr>
<td></td>
<td>Implementation</td>
<td>$64,238</td>
<td>64,595</td>
<td>($357)</td>
<td>Minor variance acknowledged and will endeavour to manage to zero over project duration.</td>
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<tr>
<td></td>
<td>ALUMON#4 SOCKEYE ADULT ENUMERATION</td>
<td>$164,184</td>
<td>160,948</td>
<td>$3,236</td>
<td>Minor variance acknowledged and will endeavour to manage to zero over project duration.</td>
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<tr>
<td></td>
<td>Direct Management</td>
<td>$25,351</td>
<td>25,707</td>
<td>($356)</td>
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<tr>
<td></td>
<td>Implementation</td>
<td>$138,833</td>
<td>135,241</td>
<td>$3,592</td>
<td>Minor variance acknowledged and will endeavour to manage to zero over project duration.</td>
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<tr>
<td></td>
<td>ALUMON#5 WATER TEMPERATURE</td>
<td>$57,974</td>
<td>55,579</td>
<td>$2,395</td>
<td>Minor variance acknowledged and will endeavour to manage to zero over project duration.</td>
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<tr>
<td></td>
<td>Direct Management</td>
<td>$17,925</td>
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<td>Implementation</td>
<td>$40,049</td>
<td>39,699</td>
<td>$350</td>
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<td>ALUMON#6 KOKANEE AGE STRUCTURE</td>
<td>$95,162</td>
<td>93,391</td>
<td>$1,771</td>
<td>Minor variance acknowledged and will endeavour to manage to zero over project duration.</td>
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<tr>
<td></td>
<td>Direct Management</td>
<td>$10,769</td>
<td>9,111</td>
<td>$1,658</td>
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<tr>
<td></td>
<td>Implementation</td>
<td>$84,393</td>
<td>84,280</td>
<td>$113</td>
<td>Minor variance acknowledged and will endeavour to manage to zero over project duration.</td>
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<tr>
<td></td>
<td>ALUMON#7 ARCHAEOLOGICAL IMPACT ASSESSMENT - RESERVOIR</td>
<td>$124,208</td>
<td>73,271</td>
<td>$50,937</td>
<td>Minor variance acknowledged and will endeavour to manage to zero over project duration.</td>
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</tr>
<tr>
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<td>Direct Management</td>
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<td>7,211</td>
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<td></td>
<td>Implementation</td>
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<td>116,080</td>
<td>$322</td>
<td>Minor variance acknowledged and will endeavour to manage to zero over project duration.</td>
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</tbody>
</table>