Columbia River Project Water Use Plan

Heritage Management Plan
Annual Report: 2009

- CLBMON-50 Arrow Lakes Reservoir Heritage Monitoring Wind and Wave Erosion
- CLBMON-51 Kinbasket and Revelstoke Archaeological Overview Assessment
- CLBMON-52 Arrow Archaeological Site Overview Assessment

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

This document represents a summary of the status and key results of monitoring programs being implemented under the Heritage Management Plan of the Columbia River Water Use Plan (WUP), as per the Columbia River Order under the Water Act, dated 26 January 2007. This includes work completed under the following monitoring programs to 31 January 2010:

- CLBMON-50 Arrow Lakes Reservoir Heritage Monitoring Wind and Wave Erosion
- CLBMON-51 Kinbasket and Revelstoke Archaeological Overview Assessment
- CLBMON-52 Arrow Archaeological Site Overview Assessment

2 Background

The water use planning process for BC Hydro’s Columbia River project was initiated in August 2000 and completed in June 2004. The conditions proposed in the WUP for the operation of the project reflect the June 2004 consensus recommendations of the Columbia River WUP Consultative Committee (CC).

In July 2006, the Columbia River Draft WUP was submitted to the Comptroller of Water Rights (CWR). The draft WUP was sent out to regulatory agencies, First Nations and interested stakeholders for review. In January 2007, the CWR approved the final WUP and issued an Order to BC Hydro to implement the conditions proposed in the Columbia River WUP and prepare the monitoring programs and physical works Terms of Reference (TOR).

An addendum to the Columbia River WUP was submitted to the CWR in July 2007 after an Environmental Assessment Certificate was issued for the Revelstoke Unit 5 Project. The addendum proposes additional terms and conditions for the Columbia River WUP, as recommended by the Revelstoke Unit 5 Core Committee in December 2006, to address incremental impacts of the operation of the fifth generating unit at Revelstoke Dam.

In August 2007, the CWR accepted the Columbia River Project WUP Addendum resulting from the Revelstoke Unit 5 Project, and issued amendments to the Columbia River Implementation Order to include the commitments made by BC Hydro to undertake additional monitoring programs and physical works associated with the Revelstoke Unit 5 Project.

As outlined in the Columbia River WUP, the CC recommended a full review of the Columbia River Water Use Plan 13 years after implementation, unless results of the monitoring program suggest an earlier review is appropriate or significant risks are identified that could result in a recommendation to change operations.
BC Hydro will convene a multi-party panel five years after commencing the implementation of this WUP to evaluate the effectiveness of operations and physical works in meeting the stated objectives for Arrow Lakes Reservoir and the lower Columbia River. The outcomes from this process will be used to assess any potential need to review the Arrow Lakes Reservoir component of this WUP. If a replacement Non-Treaty Storage Agreement (NTSA) is negotiated within this 5-year period, it is also recommended that agreement provisions and implications be reported out through this panel. Signing of a new NTSA is not a trigger for panel evaluation or a review of this Water Use Plan recommendation to change operations.

The following table outlines the dates that TOR for the Heritage Management Plan monitoring programs were submitted to and approved by the CWR.

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<thead>
<tr>
<th>Physical Works TOR</th>
<th>Date Submitted</th>
<th>Date Approved</th>
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<td>03 December 2007</td>
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<td>04 April 2007</td>
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<td>04 April 2007</td>
<td>19 April 2007</td>
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3 Schedule

The following table (Table 3-1) outlines the current schedule for the monitoring programs being delivered under the Heritage Management Plan of the Columbia River Water Use Plan.

Table 3-1: Schedule of Columbia River WUP Monitoring Programs Implementation under the Heritage Management Plan

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<tr>
<td>CLBMON-52 Arrow Archaeological Site Overview Assessment</td>
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</tbody>
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Legend:
- ■ = Program to be undertaken/initiated in identified year
- u/w = Project is underway
- ✓ = Program completed for the year
- ★ = Program started, but encountered operational or hydrological delays

4 Columbia River WUP Monitoring Programs - Heritage Management Plan

This section summarizes the status of the monitoring programs being implemented under the Heritage Management Plan of the Columbia River Water Use Plan, as per the Order under the Water Act, dated January 26, 2007 and amendments to the Order as per the CWR letter to BC Hydro, dated 23 August 2007.
4.1 Arrow Lakes Reservoir Heritage Monitoring Wind and Wave Erosion

4.1.1 Overview

During the Columbia River WUP process, the CC was unable to fully evaluate the potential effects of Arrow Lakes Reservoir operations on archaeological sites within the drawdown zone due to the lack of information regarding location and nature of existing sites. As part of addressing this information gap, it was recommended that a study be implemented to directly monitor the effects of wind and wave erosion on the stability of a significant escarpment in the reservoir, which is predicted to contain a large number of intact and actively eroding archaeological sites.

The objective of the erosion monitoring study is to collect quantitative measures of the magnitude, severity, rate of change and estimated duration of erosion effects caused by reservoir operations on selected portions of escarpment and other significant landforms situated within the drawdown zone of the Arrow Lakes Reservoir. The monitoring program is expected to provide information that can be used in future WUP discussions regarding operation of Arrow Lakes Reservoir.

This monitoring program involves research and analysis and an in-field component for establishing monitoring stations and subsequent data collection. Erosion monitoring stations will be established at a minimum of six locations within the reservoir drawdown zone divided between the Narrows locale and the Revelstoke Reach. Archaeological sites identified in Revelstoke Reach during the Arrow Lakes Reservoir Archaeological Site Overview Assessment (CLBMON-52) will be selected for monitoring to the extent possible to meet BC Hydro’s commitment to assess the effects of winter flows related to the Revelstoke 5 Project.

4.1.2 Status

This monitoring program was initiated in 2009, and will continue for five years. The 2009 program report will be submitted to BC Hydro in March 2010.

4.1.3 Interpretation of Data

Year 1 (2009) field work focussed on the selection of monitoring stations and the collection of baseline information against which the data gathered over the course of the project will be compared. Within the monitoring stations, terrain features identified by the project geologist and cultural materials marked by the archaeological crew were captured by the LiDAR scan and mapped using a total station. A Digital Elevation Model (DEM) of the ground surface at each monitoring station was generated from the raw data. The DEM, which interpolates the ground surface between the lowest points in the point cloud, can be used over the course of the project to quantitatively assess changes in the ground surface due to erosion.

All previously recorded sites within the study area were assessed according to a set of criteria defined in reference to the TOR and in consideration of optimal conditions for LiDAR data acquisition. The resulting ranked list of sites guided the selection of actual monitoring locations during fieldwork. Six monitoring stations were established (EaQl-15, EaQl-16, Eaql-17, EfQn12, EfQm4, and EfQm-3), and one previously unrecorded site was recorded (EfQm-8).
4.2 Kinbasket and Revelstoke Archaeological Overview Assessment

4.2.1 Overview

During the WUP CC discussions, it became clear that a data gap existed regarding the number and condition of actively eroding archaeological sites in the drawdown zones of Kinbasket and Revelstoke reservoirs. The contents and significance of documented sites within the reservoirs have not been comprehensively reviewed, and it is likely that additional undocumented archaeological sites exist in areas that have not been previously surveyed.

Several concerns were raised during the consultative process related to the potential effects of physical works projects being implemented on Kinbasket Reservoir (i.e., revegetation program, debris management and boat ramp improvement projects) on known and yet-to-be discovered archaeological sites. It was recognized that archaeological assessments would be required to ensure that the physical works projects are undertaken in a compatible manner with archaeological site protection requirements and that opportunities to incorporate archaeological site mitigation measures be considered in the design of these works (e.g., specific revegetation techniques to increase site stabilization).

The objective of this archaeological overview is to identify and assess archaeological resource potential or sensitivity within portions of the drawdown zones of the Kinbasket and Revelstoke reservoirs within the context of the terrain analysis framework outlined in the WUP report with a primary focus on those areas with potential for revegetation, and develop recommendations for subsequent archaeological work, as well as possible mitigative options for identified potential conflicts with the WUP physical works programs.

This monitoring program involves documentary research and analysis, as well as an in-field survey component. The preliminary field reconnaissance is designed to encompass a sample of each reservoir drawdown zone during a single field season.

4.2.2 Status

This monitoring program was initiated and completed in 2007. The final program report was received by BC Hydro and submitted to the CWR in January 2008.

4.2.3 Interpretation of Data

A total of 12 archaeological sites were identified in Kinbasket Reservoir during a survey of 13 vegetation polygons. No archaeological sites were observed in the surveyed areas of the Revelstoke Reservoir drawdown zone.

Prior to this study, only one stone artifact had been documented in the vicinity of the Kinbasket Reservoir. Consequently, these newly discovered archaeological deposits are considered to be highly significant from an archaeological perspective as well as their value in better understanding the effects of reservoir operations on archaeological sites.
The archaeological sites were identified within areas noted as having potential for re-vegetation. The presence of these sites will be considered in the design of vegetation programs.

Vegetation polygon #80, where 11 of the 12 archaeological sites are situated, is currently supporting significant vegetal cover and the potential for vegetation to be used in archaeological site protection in this location appears to be promising. Closer monitoring of the sites in this area to further evaluate the potential for vegetation as a mode of site protection is recommended. It is also recommended that an archaeological inventory of both Kinbasket and Revelstoke reservoirs be undertaken to support informed assessments of operational impacts in these reservoirs.

4.3 Arrow Archaeological Site Overview Assessment

4.3.1 Overview

During the WUP CC discussions, it became clear that a data gap existed regarding the number and condition of actively eroding archaeological sites in the drawdown zone of Arrow Lakes Reservoir. The content and significance of documented sites within the reservoir has not been comprehensively reviewed, and it is likely that additional undocumented archaeological sites exist in areas that have not been previously surveyed.

Several concerns related to the potential effects of physical works projects being implemented on Arrow Lakes Reservoir (i.e., wildlife habitat physical works, revegetation program, debris management and boat ramp improvement projects) on known and yet-to-be discovered archaeological sites were raised during the consultative process. It was recognized that archaeological assessments would be required to ensure that the physical works projects are undertaken in a compatible manner with archaeological site protection requirements and that opportunities to incorporate archaeological site mitigation measures be considered in the design of these works (e.g., specific revegetation techniques to increase site stabilization).

The objective of this archaeological overview is to identify and assess archaeological resource potential or sensitivity within portions of the drawdown zones of the Arrow Lakes Reservoir within the context of the terrain analysis framework outlined in the WUP report with a primary focus on those areas with potential for revegetation, and develop recommendations for subsequent archaeological work, as well as possible mitigative options for identified potential conflicts with the WUP physical works programs.

A further objective of this study is to evaluate the possible effects of incremental increases in water levels and water velocities associated with five-unit operations at Revelstoke Dam on archaeological values, as it pertains to potential bank erosion within the Revelstoke Reach portion of the study area.

This monitoring program involves documentary research and analysis, as a well as an in-field survey component. Year 1 of the program is focused on portions of the drawdown zone within Revelstoke Reach, while Year 2 focuses on portions of the
drawdown zone of Arrow Lakes Reservoir with special attention to the narrows that demarcate the joining of Upper and Lower Arrow Lakes.

4.3.2 Status

This monitoring program was initiated in spring of 2007 and was completed in 2008. The final program report is appended to this Annual Report.

4.3.3 Interpretation of Data

Over the course of this two-season study, a total of 26 new archaeological site locations were identified and documented. During the 2007 field survey, nine proposed vegetation polygons, seven potential wildlife habitat physical works sites and 12 bank erosion loci (delineated by Northwest Hydraulic Consultants (NHC) in 2006) within Revelstoke Reach were traversed on foot. A total of 13 archaeological sites were discovered during the field visits. Seven of these sites were located within proposed vegetation areas, and six were located in bank erosion loci.

Cultural deposits exposed on the surface of all 13 sites contain fire altered rock. Three sites also contain lithic (stone) artifacts, and segments of large mammal bone were also observed at one of these lithic sites. Of the 13 newly identified sites, 12 are considered to be of potentially high archaeological significance and one appears to be largely disturbed.

Four of the newly discovered archaeological sites are situated in bank erosion loci identified by NHC as having potential to be affected by increased water level fluctuations associated with five-unit operations at Revelstoke Dam. The study report recommends that monitoring of these locations be undertaken to better assess the potential effects of Revelstoke 5 flows on these archaeological resources. These sites will be considered as monitoring stations for the Arrow Wind and Wave Erosion Monitoring Study (CLBMON 50).

In 2008, portions of four large proposed vegetation polygons situated in the southern two thirds of the reservoir were surveyed along with several other localities in the higher elevations of the reservoir draw down zone.

A total of 13 archaeological sites were recorded in 2008. Three sites are situated within proposed vegetation areas at East Arrow Park. These three newly recorded sites are represented by extensive scatters of fire altered rock and lithic artifacts. A number of previously documented sites are reported to exist in this area but these could not be accurately located.

Relic delta-fans at Taite, Octopus, Johnston, Bowman, Sunshine, Mosquito, McDonald and Twobit Creeks were also examined. Archaeological materials comprising the remaining ten sites recorded during 2008 were observed in the vicinity of McDonald, Taite, Twobit and Mosquito Creeks. Cultural depression features were observed along with artifacts and other archaeological materials at Taite and Twobit Creeks.
Twelve of the 13 sites identified in 2008 are considered to be of high scientific significance according to the evaluation matrix designed as part of the study. One site at McDonald Creek is considered to be of lower scientific significance due to a high degree of disturbance.

The study recommends that BC Hydro further consider the potential use of vegetation as a means of protecting two of the archaeological sites where an ongoing program of seeding has resulted in successful establishment of reed canary grass. The study further recommends that coordination of the archaeology and vegetation work in Arrow be continued and improved to ensure the maximum benefit to the archaeological protection. BC Hydro will consider this recommendation in developing site-specific prescriptions/treatments as part of the WUP revegetation program and other longer term initiatives being undertaken by BC Hydro (i.e., Reservoir Archaeology Program). Further work will be required in consultation with the Archaeology Branch and interested First Nations to investigate the suitability of these sites for revegetation as a means of site protection.

The study further recommends that BC Hydro undertake an archaeological inventory of the Arrow Lakes Reservoir to support informed assessments of operational effects on archaeology sites. It is expected that the Reservoir Archaeological Program will address this need as part of its comprehensive management plan for the reservoir. A focus on delta-fans and high lacustrine terraces is recommended by the study as archaeological materials are observed to be actively eroding at these locations.

5 Columbia River Project WUP Monitoring Programs Costs

The following table summarizes the approved costs associated with implementation of the monitoring programs under the Heritage Management Plan of the Columbia River WUP, as well as the Actual Costs to 31 January 2009.
Table 5-1: Columbia River Monitoring Program Costs

<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>
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<td>HERITAGE MANAGEMENT PLAN</td>
<td>CLBMON#50 ARROW HERITAGE MONITORING WIND &amp; WAVE EROSION</td>
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