Columbia River Project Water Use Plan
Monitoring Program Terms of Reference

LOWER COLUMBIA RIVER
FISH MANAGEMENT PLAN

- CLBMON-42 Lower Columbia River Fish Stranding Assessment and Ramping Protocol

31 August 2007
LOWER COLUMBIA RIVER
FISH MANAGEMENT PLAN
TERMS OF REFERENCE

1.0 OVERVIEW

This document presents Terms of Reference for the effectiveness monitoring programs for the Lower Columbia River Fish Management Plan (Table 1). These programs will evaluate the effects of whitefish and rainbow trout flow conditions on the lower Columbia River and provide a physical and ecological health barometer against which the lower Columbia River monitoring programs can be evaluated.

This document provides detailed Terms of Reference for the following programs:

1) CLBMON-42 Lower Columbia River Fish Stranding Assessment and Ramping Protocol: a 13-year program to monitor planned and opportunistic flow reductions to establish impacts of flow reductions on fish populations in the lower Columbia River and the required operational procedures to mitigate ramping impacts.

2) CLBMON-43 Lower Columbia River Sculpin and Dace Life History Assessment: a 5-year program to monitor the life history and habitat use of sculpin and dace, in particular species listed under the federal Species at Risk Act and the BC Wildlife Act, in the lower Columbia River in relation to seasonal operations at Keenleyside Dam.

3) CLBMON-44 Lower Columbia River Physical Habitat and Ecological Productivity Monitoring: a 12-year program to monitor physical habitat parameters, periphyton and benthic invertebrates below Keenleyside Dam to evaluate net change in trophic productivity and overall ecological health in relation to rainbow trout and mountain whitefish flow regimes.

4) CLBMON-45 Lower Columbia River Fish Population Indexing Surveys: a 13-year program to monitor trends in the biological characteristics, distribution and abundance of mountain whitefish, rainbow trout and walleye populations in the lower Columbia River in relation to rainbow trout and mountain whitefish flow regimes.

5) CLBMON-46 Lower Columbia River Rainbow Trout Spawning Habitat Assessment: a 10-year program to monitor the relative abundance, distribution, spawning site selection and timing of rainbow trout spawning in the lower Columbia River in relation to rainbow trout and mountain whitefish flow regimes.

6) CLBMON-47 Lower Columbia River Whitefish Spawning Ground Topographic Surveys: a 3-year program to monitor spawning locations of whitefish in the lower Columbia River using detailed topographic surveys to improve the effectiveness of the whitefish flow regime in the lower Columbia River.

7) CLBMON-48 Lower Columbia River Whitefish Life History and Egg Mat Monitoring: a 5-year program to monitor whitefish life history, including spawning and egg mat sampling in the lower Columbia River, to establish the effectiveness of the current whitefish flow regime on egg survival, juvenile recruitment, and adult populations.
8) **CLBMON-49a Lower Columbia River Effects of Whitefish Flows on Great Blue Heron Use of Waldie Island:** a 3-year program to monitor the effects of whitefish flows on the availability of Great Blue Heron habitat in the vicinity of Waldie Island.

9) **CLBMON-49b Lower Columbia River Winter Use of Waldie Island by Great Blue Heron:** a 3-year program to determine the importance of Waldie Island as an overwintering site for juvenile and adult heron from the Revelstoke colony.

### Table 1

<table>
<thead>
<tr>
<th>Name of Monitoring Program</th>
<th>Order Clause Fulfilled</th>
<th>Submitted with this Package</th>
<th>Previously Submitted To CWR</th>
<th>Submission Date</th>
<th>Leave to Commence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CLBMON-42 Lower Columbia River Fish Stranding Assessment and Ramping Protocol</strong></td>
<td>Schedule E: 2.a</td>
<td>Yes</td>
<td>No</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td><strong>CLBMON-43 Lower Columbia River Sculpin and Dace Life History Assessment</strong></td>
<td>Schedule E: 2.b</td>
<td>No</td>
<td>No</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td><strong>CLBMON-44 Lower Columbia River Physical Habitat and Ecological Productivity Monitoring</strong></td>
<td>Schedule E: 2.c</td>
<td>No</td>
<td>No</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td><strong>CLBMON-45 Lower Columbia River Fish Population Indexing Surveys</strong></td>
<td>Schedule E: 2.d</td>
<td>Yes</td>
<td>No</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td><strong>CLBMON-46 Lower Columbia River Rainbow Trout Spawning Habitat Assessment</strong></td>
<td>Schedule E: 2.e</td>
<td>No</td>
<td>No</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td><strong>CLBMON-47 Lower Columbia River Whitefish Spawning Ground Topographic Surveys</strong></td>
<td>Schedule E: 2.f</td>
<td>No</td>
<td>No</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td><strong>CLBMON-48 Lower Columbia River Whitefish Life History and Egg Mat Monitoring</strong></td>
<td>Schedule E: 2.g</td>
<td>No</td>
<td>No</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td><strong>CLBMON-49a Lower Columbia River Effects of Whitefish Flows on Great Blue Heron Use of Waldie Island</strong></td>
<td>Schedule E: 2.h</td>
<td>No</td>
<td>No</td>
<td></td>
<td>No</td>
</tr>
<tr>
<td><strong>CLBMON-49b Lower Columbia River Winter Use of Waldie Island by Great Blue Heron</strong></td>
<td>Schedule E: 2.h</td>
<td>No</td>
<td>No</td>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>
Monitoring Study No. CLBMON-42
Lower Columbia River Fish Stranding Assessment and Ramping Protocol

2.0 MONITORING PROGRAM RATIONALE

2.1 Background

The Columbia River Water Use Plan Consultative Committee (WUP CC) agreed on four actions that could provide the greatest potential gains to wild indigenous fish populations in the lower Columbia River (BC Hydro 2005a, 2005b). Two of these actions were related to fisheries impacts associated with flow regulation at Hugh L. Keenleyside Dam (HLK) and included:

- Look for opportunities to minimize the frequency and magnitude of flow reductions and develop a flow reduction protocol and standard methods for assessment, data collection and mitigation responses to manage fish stranding impacts.
- Conducting flow ramping studies to determine appropriate ramping rates to minimize pool and interstitial stranding.

It was recommended that the following strategy and associated monitoring program was an acceptable approach to addressing the impacts of flow reductions at HLK on fish stranding in the lower Columbia River.

A. STRANDING PROTOCOL

To date, a fish stranding protocol has been developed for the lower Columbia River that provides for interim flow reduction strategies and fish salvage/monitoring activities related to planned flow decreases (Vonk 2003). It is expected that the implementation of the protocol will reduce fish stranding, decrease the level and frequency of effort required in response to flow reductions over time, and ensure effective communication between BC Hydro and fisheries regulatory agencies regarding mitigative efforts associated with flow reductions.

A working version of the protocol is currently being implemented, and it is expected that the protocol will be updated as new data is collected through ongoing monitoring and ramping experiment efforts.

B. RAMPING RATES

In July of 2001, a major fish stranding event occurred on the lower Columbia River due to a flow reduction at HLK, BC Hydro and Fisheries and Oceans Canada (DFO) reached an agreement that required BC Hydro to undertake a number of studies related to fish stranding. As part of this agreement, BC Hydro has conducted three years of flow ramping studies on the lower Columbia River to determine the effect of different flow reduction strategies on the stranding rates of fish. To date there have
been studies in the winter and summer of 2004, 2005, and 2006\(^1\). All phases of the work have been agreed to by the fisheries regulatory agencies.

It is anticipated that there will be a need to continue ramping rate studies, as recommended by the Columbia River WUP CC, to determine if ramping rates or alternative operations are available to reduce the level of fish stranding.

2.2 Management Questions

The key management questions addressed by this monitoring program are:

1) Is there a ramping rate (fast vs. slow, day vs. night) for flow reductions from HLK that reduces the number of fish stranded (interstitially and pool) per flow reduction event in the summer and winter?

2) Does wetted history (the length of time the habitat has been wetted prior to the flow reduction) influence the number of fish stranded (interstitially and pool) per flow reduction event for flow reductions from HLK?

3) Can a conditioning flow (a temporary, one step, flow reduction of approximately 2 hours to the final target dam discharge that occurs prior to the final flow change) from HLK reduce the stranding rate of fish?

4) Can physical habitat works (i.e., recontouring) reduce the incidence of fish stranding in high risk areas?

5) Does the continued collection of stranding data, and upgrading of the lower Columbia River stranding protocol, limit the number of occurrences when stranding crews need to be deployed due to flow reductions from HLK?

2.3 Detailed Hypotheses

Five key hypotheses, corresponding to the management questions above, will be tested using data collected during the lower Columbia River Fish Stranding Assessment and Ramping Protocol Monitoring Program. These hypotheses are related to the relative stranding rates of fish in the lower Columbia River: 1) at different flow reduction rates, 2) for flow reductions at different times of the day; 3) with the implementation of a conditioning reduction prior to the actual flow change; 4) before and after physical habitat manipulation in the lower Columbia River; and, 5) whether the number of actual fish salvage events can be reduced through adaptive adjustments made as a result of ongoing data collection. For fish stranding in the lower Columbia River, the following hypotheses will be tested:

\(H_0_1\): The number of stranded fish in independent of either the ramping rate or time of day of flow reductions in the summer and winter.

\(H_0_2\): Wetted history does not influence the stranding rate of fish (both interstitially and pool stranding) for flow reductions from HLK.

\(^1\) Flow management in the winter of 2006 did not allow completion of the full number of experiments. BC Hydro is expected to continue this work in 2007.
2.4 **Key Water Use Decision Affected**

The key operating decision affected by this monitoring program is the discharge reduction ramping rate selection criteria for HLK to minimize fish stranding impacts. The current interim rates were selected by the WUP CC to reduce fish stranding in the Lower Columbia River (see Table CLBMON-42-1 for ramping rate selection criteria) based on limited information. Through experimental flow reductions and monitoring, a best management practice will be developed to include the combination of an appropriate ramping rate, monitoring and salvage (as required) and will be documented in an updated fish stranding protocol document.

<table>
<thead>
<tr>
<th>Risk Period</th>
<th>Ramping Rate Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate to High Risk Period:</td>
<td>For discharge changes ≤ 5 kcfs, use a 1.25 to 2 kcfs per hour ramp rate (although some situations may require a higher ramp rate).</td>
</tr>
<tr>
<td>Spring, Summer, Fall</td>
<td>For discharge changes greater than 5 kcfs, query the stranding database for risk, select a rate depending on risk, and consult DFO as required.</td>
</tr>
<tr>
<td>Low to Moderate Risk Period:</td>
<td>For discharge changes ≤ 10 kcfs, use a ≤ 5 kcfs per hour ramp rate (although some situations may require a higher ramp rate).</td>
</tr>
<tr>
<td>Winter</td>
<td>For discharge changes greater than 5 kcfs, query the stranding database for risk, select a rate depending on risk, and consult DFO as required.</td>
</tr>
</tbody>
</table>

3.0 **MONITORING PROGRAM PROPOSAL**

3.1 **Objective and Scope**

The primary objective of this monitoring program is to continue to collect fish stranding data to assess the impact of flow reductions and flow ramping rates from HLK on the native fish species of the lower Columbia River. Secondary objectives include: 1) reducing (through risk management strategies) the number of occurrences when stranding crews need to be deployed with flow reductions; 2) determining ramping rates for flow reductions that reduce the stranding rate of fish at different times of the year; 3) determining whether the wetted history influences the stranding rate of fish for flow reductions; 4) determining whether a conditioning flow reduction from HLK reduces the stranding rate of fish; and, 5) determining whether physical habitat manipulation reduce the incidence of fish stranding in the lower Columbia River?
The geographic scope of this monitoring program is the approximate 56 km long section of the lower Columbia River from HLK to the US border. The priority area for assessment is the portion of the river from the dam to Genelle, but will also include the lower Kootenay River from the confluence with the Kootenay River to Brilliant Dam.

3.2 Approach

The approach of this monitoring program is to continue stranding surveys within the study area over the period of the Columbia WUP review. These stranding surveys will be undertaken as required through the implementation of the lower Columbia River Stranding Protocol – including future updates.

In addition, flow ramping studies will continue for a period of time as warranted by interpretation of the results. The flow ramping program was initiated through negotiation with Fisheries and Oceans Canada (DFO), and the program was further examined by the Columbia WUP CC. BC Hydro meets with the Columbia Operations Fish Advisory Committee annually to review the results of the flow ramping program and to receive direction on future study/monitoring requirements. As such, the primary objective of the monitoring program is to meet the requirements of the regulatory agencies, and, if agreed to by the regulatory agencies, to approach the Comptroller of Water Rights for sign off on meeting the requirements of this component of the Columbia WUP in an earlier time period.

Finally, where appropriate, physical habitat works in the form of gravel bar recontouring will be considered for areas where a high rate of fish stranding occurs. Similar work has been undertaken previously in the study area, and further work will be considered if proposed flow ramp rates do not reduce the rate of stranding, or high risk areas are identified through the stranding surveys.

3.3 Tasks

3.3.1 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 selection, 3) making flow change recommendations, logistic coordination and querying of the stranding database, 4) technical oversight of field and analysis components, and 5) facilitation of data transfer among other investigations associated with the Lower Columbia River Fish Management Plan.

3.3.2 Task 2: Field Data Collection

Stranding Surveys

The objective of the stranding survey component is to continue the collection of fish stranding data in the lower Columbia River (where dictated by the lower Columbia River Stranding Protocol) when flow reductions occur from HLK. The sampling program will be designed to meet the following objectives:
Through querying the stranding database, identify locations where fish may be stranded using historic data, or where there is no data, assess risk and add to the available information;

Deploy crews to areas where stranding is expected, salvage fish and return to river where practical, and collect data on the number of stranded fish; and

Enter collected data into the stranding database to keep the database up to date.

As the methodology for this sampling program has been established under the lower Columbia River Stranding Protocol, sampling, database query and data entry will follow these already established methods.

Flow Ramping Studies

Since February 2004, BC Hydro has been undertaking a series of flow ramping studies, as required under agreement with DFO. BC Hydro has met its obligations under this agreement after completion of 3 years of field studies and submission of project reports. BC Hydro has recognized there are remaining questions regarding the effectiveness of certain flow ramping strategies (conditioning flow concept) and is committed to providing a detailed summary report to DFO upon completion of the studies under this program. It is anticipated that there will be a need to continue flow ramping studies for a period of time during the 13 year review period of the Columbia WUP, but work may not need to be undertaken for the entire 13 years. For the purposes of budgeting, it is anticipated that up to five years of detailed ramping studies would be required, and that the sampling program will build on past work conducted under the agreement with DFO; however, specific methodologies can not be described (as they have continually evolved throughout the program).

In a general sense it is expected that the monitoring program will be designed to meet the following objectives:

- Determine the impact of ramping rate and time of day on the stranding incidence of fish in pools and interstitially, by season;
- Determine the impact of a conditioning flow on the stranding incidence and behaviour of fish in pools and interstitially;
- Determine the impact of wetted history on the stranding incidence of fish in pools and interstitially; and,
- Develop a prioritized list of areas where physical habitat manipulation could be implemented to reduce stranding and associated salvage requirements.

Physical Habitat Manipulation

Feasibility of implementing physical works to reduce stranding will be assessed throughout the detailed ramping studies in consultation with DFO, and works could be initiated as early as the second or third year of the program (pending DFO approval). Budget has been provided to conduct physical works in Year 2 or 3, and in Years 7 through 13 of the Columbia WUP. Budget has also been provided for
effectiveness monitoring to facilitate adaptive management in Years 6 through 13, after the detailed ramping studies are completed.

3.3.3 Task 3: Analysis and Reporting

To facilitate effective management of data from the monitoring program, an annual technical report will be prepared, which will include:

- an executive summary;
- a description of the methods employed;
- a data summary;
- a detailed discussion of the findings as they relate to the management questions and hypotheses; and,
- any recommendations for the refinement of field sampling protocols and for modifications to the ramping protocol.

Separate reports will be produced for the stranding surveys, the flow ramping studies, and any physical habitat manipulation. The reports will follow the standard format that is being developed for WUP monitoring programs. 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 either as embedded objects in the Word file or as separate files.

3.4 Interpretation of Monitoring Program Results

Data from the flow ramping studies and stranding surveys (i.e., the number of fish stranded per flow reduction event and the number of times that stranding crews are deployed) will be utilized to assess the effectiveness of the lower Columbia River Stranding Protocol. In addition, data from the stranding surveys will be used to measure the success of physical habitat projects (e.g., bar recontouring) at reducing fish stranding. Some recontouring projects have already been undertaken, and results from stranding surveys suggest that stranding has been reduced. Numbers of stranded fish at different flow reduction treatments will be analyzed to determine if any particular flow reduction strategy (fast vs. slow, day vs. night, conditioning flow) can reduce the incidence of stranding.

3.5 Schedule

The lower Columbia River Stranding Surveys component of the monitoring program will be conducted annually during the 13-year review period for the Columbia WUP. Currently, the Flow Ramping Assessment component of the program is scheduled to be conducted annually during the 13-year review period for the Columbia WUP. However, it is anticipated that continued implementation of the detailed program will only be conducted for a period of up to five years, with less detailed studies continuing for the duration of the program. Feasibility to identify and assess potential areas for physical habitat manipulation would be conducted using information from the ramping studies and stranding surveys, with physical habitat manipulation being implemented (pending DFO approval) in eight of twelve years (from Years 2 or 3 to
Year 13). Effectiveness monitoring would be conducted in Years 6 through 13 (note that for budgeting purposes the 13-year review period has been used).

3.6 Budget

The annual cost budget estimated by the WUP CC in 2004 was $180,000. A review of the budget suggested that this may have been a slight underestimation of costs, and Table CLBMON-42-2 provides a detailed estimate of the distribution of annual costs of monitoring program implementation, assuming a 2% rate of inflation and 5% contingency. The estimated annual cost for the monitoring program is estimated at $255,006 (in 2004 dollars) with an average annual cost of $181,869 (including 2% inflation and 5% contingency).

4.0 References


