

## **Campbell River Water Use Plan**

### **Monitoring Program Terms of Reference**

- **JHTMON-2 Upper Campbell, Lower Campbell and John Hart Reservoirs and Elk Canyon Public Use And Perception Survey**

**September 20, 2013**

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### **1 Program Rationale**

#### **1.1 Background**

During Step 4 of the Campbell River Water Use Plan WUP), an objective for recreation and tourism was articulated. This objective; to enhance and protect the quality of recreation and tourism amenities and increase the quality of recreation and tourism opportunities with sustainable carrying capacity; recognizes the extensive use of the Campbell River system area for recreation activities. In order to ensure that this objective is reflected in the Water Use Plan, performance measures were devised that defined preferred reservoir elevation ranges and flow rates. Weighting was used to account for both seasonality and flow/elevation levels. Preferred elevations, flow rates, weighting, seasons etc. were determined, firstly on the basis of professional judgment and local experience, and secondly through a public perception study and interviews with local experts.

Despite these efforts, it was recognized that a more systematic and robust approach to valuing the recreation resource is possible. For example the approach used in the WUP did not take into account such things as the economic benefits of recreation and tourism, potential changes in recreation activities, substitution of activities between opportunities, demographics, values and future development possibilities. The current approach did include a methodology to absolutely exclude independent variables (i.e., prevailing weather, economic conditions, etc.) from the evolution.

It was therefore recommended that studies be undertaken to:

- 1) Devise a systematic approach to establishing recreation and tourism performance measures based on a full range of recreational aspects; and
- 2) Evaluate the recreation and tourism opportunities through an ongoing perception study.

A contractor undertaking this study will not be able to create performance measures for the government agencies responsible for recreation in the Campbell River watershed. Rather the contractor will be expected to approach the relevant agencies to determine their performance measures and incorporate those into this study where they are applicable to BC Hydro operations.

#### **1.2 Management Questions**

The Campbell River Recreation Technical Committee (RTC) identified three management questions to be addressed through the present monitoring study. These questions stem from the primary objective of this monitor to 1) develop a more rigorous approach to determining recreation and tourism PMs for future WUP reviews (for the Campbell River system and elsewhere); and 2) carryout an explicit evaluation of the recreation quality achieved and the trade offs made during the this WUP. These are manifested in the following area-specific management questions:

- 1) For Reservoirs (Upper and Lower Campbell Lake reservoir, John Hart Reservoir<sup>1</sup>):

*What is the relationship between reservoir operations and overall recreation benefit and does it lead to competing trade-offs between reservoir based and river based benefits?*

- 2) For Rivers (Lower Campbell River, Quinsam River, Salmon River):

*What is the relationship between river discharge and respective riverine recreation/tourism benefits and is it such that it would necessitate trade-offs between recreation, fish and power benefits?*

- 3) For Elk Canyon Falls:

*Is there a significant relationship between recreational value and incidence of high spill events and does this support the presently held belief that higher flows should be considered in the future?*

Though not specifically identified by the Consultative Committee (CC) or the RTC, but implicit in the questions above, the following management questions are also addressed:

- 1) Does both perceived recreational value and actual recreational use increase following implementation of the Campbell River WUP?
- 2) Should an increase (or decrease) be observed, can this be directly attributed to WUP implementation or is it the result of other non-WUP related factors (demographic or otherwise)?

These last two questions can be asked regarding individual components of the Campbell River system, or collections of components (e.g., all reservoirs).

### 1.3 Impact Hypotheses

Impact hypothesis testing will be carried out as required based on the questionnaires used to gauge public opinion on recreational values as well as recreation use. It will be up to the contractor to develop the questionnaires, group them based on themes and develop appropriate impact hypotheses. As a result, specific impact hypotheses cannot be prepared at this time. However, the contractor should consider the following when formulating the questionnaire and devising appropriate impact hypotheses:

- 1) A concerted effort should be made to identify non-WUP related confounding factors that may mask, modify or govern changes to recreational value and use in the area. It will be important to identify these factors so that they can be factored out of any analyses that test the impact of WUP operations on recreation and/or they can be taken into account when interpreting analytical results.
- 2) A set of impact hypotheses should be identified prior to any consideration to questionnaire development. The hypotheses can serve as the foundation for the formulation of pertinent questions and will ensure that all questions provide useful information for analysis. This will also help ensure that the questions are

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<sup>1</sup> Note, public access to John Hart Reservoir is currently restricted; however there is historical recreation use data available for this reservoir (A. Leake, BC Hydro, pers. comm., 27 Oct 2011).

unbiased. In some cases, the impact hypothesis could be reworded into questions.

- 3) Questions should be answerable using categorical answers such as yes/no (binary) and scales of agreement or ranking and minimize open-ended questions. This will simplify later analysis and minimize observer bias when attempting to collate data (i.e., through interpretation of open-ended questions).
- 4) Questions and related impact hypotheses should be structured such that the results can be easily tracked through time. To avoid problems with interpretation through time, the questions should not be modified once they have been finalized, which should be completed within the first year of the monitor. However, questions can be added to the survey if they are informing an agency's performance measures (NB: performance measures that are related to BC Hydro operations).
- 5) The scope of the questions should only be directly relevant to the WUP, and that no other values or uses should be considered. This will minimize the risk of scope creep, confusion over the purpose of the monitor, and problems with interpretation of the monitoring data through time.

The contractor will meet with the relevant agencies to ascertain if an agency's performance measures, as they relate to BC Hydro operations, can be included in the questionnaire without compromising the integrity, or budget of the study.

#### **1.4 Key water Use Decision**

Difficulties were encountered when trying to identify relationships between system operations, perceived recreational value, recreational use, and the possible trade-offs with other non-power values in the system (e.g., fish and wildlife values, safety, and flood control). These difficulties were mainly the result of a lack of useful information which sometimes made it difficult to accurately capture the true nature of recreational value in the systems, particularly in the performance measures used during trade-off analyses. The RTC believed that that this lack of accuracy allowed recreational use to sometimes be undervalued or improperly represented when assessed in the WUP trade-off analyses. Because this risk could not be properly characterized during the WUP (is it low or high?), the RTC recommended that the appropriate information be collected in the years leading to the WUP review so that 1) the risk of inaccuracy can be properly identified; and 2) should the risk prove high, have the information necessary to develop more useful performance measures. The RTC also recognized that in the intervening years between WUP reviews, recreational values may change, and that these changes should be captured in future WUP review processes.

## **2 Program Proposal**

### **2.1 Objective and Scope**

The objective of this Monitor is to address the management questions presented in Section 1.2 by collecting data necessary to draw inferences and to test the impact hypotheses outlined in Section 1.3. The following aspects define the scope of the study:

- 1) The study area will consist of all recreational areas within the Campbell River system as identified in the Campbell River CC Report (Anon 2004).
- 2) The Monitor will be carried out annually for the duration of the monitoring study, which is to conclude just prior to the next WUP review period 10 years following WUP implementation.
- 3) The relevant agencies will be contacted initially in the first year of study to determine the agencies' performance measures and incorporate those measures within the survey where they are applicable to BC Hydro operations. To assist with identifying performance measures, some initial baseline data may also be collected in the first year of study.
- 4) Study data will be collected in phases throughout the year, as recreation activities are to be found year round in the system. The phases include winter (October 22 to March 31), spring (April 1 to June 20), summer (June 21 to September 10) and fall (September 11 to October 21).
- 5) All recreational activities that are potentially impacted by facility operations will be considered as identified in the Campbell River CC Report (Figure 1, Anon 2004). However, any additional recreation activities that are identified as a result of this monitoring study can also be included throughout the study period.
- 6) Sampling will be carried out in a standardized manner and follow a specified, reproducible plan to ensure consistency in data quality and collection procedures. All data will be archived according to BC Hydro protocols.
- 7) A fixed level of sampling effort (interview-days) for each year of study has been assumed for budget estimation purposes. However, the contractor is expected to come up with a sampling plan and the sample size needed to minimize error. An appropriate level of error is considered to be  $\alpha = 0.05$  and  $\beta = 0.8$ . Care should be used to ensure consistency through the 10 year study program so that time trends can be tracked. The sampling plan and sample size calculations will be submitted to BC Hydro for approval each year prior to the consultant starting the field season.
- 8) A clear set of impact hypotheses and related questionnaires are to be prepared in consultation with BC Hydro staff, interested RTC members (as identified in the Campbell River CC Report (Anon 2004)), and appropriate agency personnel. This will be the focus of Year 1 work. Different flow or reservoir elevation states should be communicated by a series of photographs, which must also be developed at this time.
- 9) A data report will be prepared each year of the study that collates, summarizes, and compares all the data collected to date. The Year 1 report will include a final version of the questionnaires to be used in the monitor, as well as a listing of all impact hypotheses (including a rationale for their inclusion in the monitor)
- 10) In Year 5 of the monitor, an interim report will be prepared that summarizes the results collected to date, discusses inferences that can be drawn pertaining to the impacts of the WUP over time, and presents conclusions concerning the management question in Section 1.2 and the impact hypotheses in Section 1.3.
- 11) A final report will be prepared at the end of the Monitor that summarizes all of the data and analytical results collected to date, discusses inferences that can be drawn pertaining to the impacts of the WUP over time, and presents conclusions

concerning the management question in Section 1.2 and the impact hypotheses in Section 1.3.

## **2.2 Approach**

The monitor will be carried out as a series of phased, questionnaire-based interviews of recreational users throughout the Campbell River recreational area. The questionnaires will be intimately linked to a set of impact hypotheses that will be tracked each year for the duration of the monitor. The contractor can assign the level of effort as required, but keeping in mind the need for inter-annual consistency of data collection. The interviews will be carried out in phases throughout the year, and at several key locations in the Campbell River system. The duration of each interview phase and the location of the interview points will be established by the contractor.

## **2.3 Methods**

### **2.4 Data Capture**

Initially, the contractor will approach the relevant agencies to determine the agencies' performance measures and incorporate those measures within the survey where they are applicable to BC Hydro operations. The contractor may also collect baseline data within the first year of study to assist agencies in identifying specific performance measures related to BC Hydro operations.

Data capture will be primarily through interviews of area-specific recreational users intercepted at key points of entry and departure. The interviews will be almost exclusively questionnaire driven with most answers being categorical in nature (e.g., Yes/No, Low/Medium/High, Agree/Uncertain/Disagree). As noted above, the questionnaire will be developed based on a set of predetermined impact hypotheses that are to be tested each year of the monitor to track temporal patterns in perceived value and actual use. The impact hypotheses and related questions should be stated in such a way that they are testable using Chi-Square analyses for statistical comparison. Both impact hypothesis and questionnaire development should be done in consultation with BC Hydro staff, interested members of the WUP RTC (Anon 2004), and the appropriate agencies to ensure broad acceptance of survey results and that the survey is informing the performance measures of the relevant agencies where applicable to BC Hydro operations.

Sampling effort (interview days) is to be distributed across four seasons (winter (October 22 to March 31), spring (April 1 to June 20), summer (June 21 to September 10) and fall (September 11 to October 21) and several entry/departure points in the area. For planning purposes, it is assumed that there will be eight interview points, but in practice there may be more or less depending on the requirements of the monitor. Exactly how the effort is to be distributed among time and space categories will be at the discretion of the contractor, but should include input from BC Hydro staff and interested members of the WUP RTC (Anon 2004) to ensure broad acceptance of survey results. Total effort has been assumed to be 128 interview days for budgeting purposes; sufficient to provide four interview days per site for eight sites across four recreation seasons. The contractor must provide a sampling plan showing the sample size needed to answer the management questions to an appropriate level of significance (e.g., an appropriate level of error is considered to be  $\alpha = 0.05$  and  $\beta = 0.8$ ).

Only two constraints will be imposed on questionnaire development, the first being that it remain largely unchanged through time once finalized in Year 1 so that results are comparable from year-to-year and that its scope remains strictly WUP-based. Because of this constraint, it is imperative that careful thought be put into the questionnaire; hence the need to have it linked to specific impact hypotheses. Because recreational activities may differ between sites, some of the questions will be site specific. Some questions however, should be generic enough to integrate recreational experiences across all sites to help draw out general conclusions regarding the impact of the WUP on recreation and tourism in the area. The same questionnaire should be used for all seasons so that the seasonal data can be rolled up into annual summaries. Additional questions can be incorporated throughout the study period in order to inform an agency's performance management targets. However, adding questions can impact the existing survey design; therefore, rigorous pre-testing must occur before launching any versions of a survey.

The other constraint pertains to how specific reservoir levels or river discharges are to be communicated to the interviewee. Rather than specify specific values, which may have no practical meaning to the interviewee, water levels or discharges should be communicated in the form of a series of large (e.g., 8½" x 11") high resolution photographs. For each point of entry and departure where interviews are to be conducted, a set of photographs should be taken from the same vantage point and magnification where water levels or discharges are varied at known intervals. The number of photographs in the series should be as high as practical to ensure a high resolution of responses. For example, questionnaire responses based on photographs taken at a 1 m<sup>3</sup>/s interval of discharge will be more useful in setting future recreation requirements than those based on a series taken at a 10 m<sup>3</sup>/s interval. Consider that other variables such as cloud cover, ripples, debris, etc. must be carefully controlled for within the pictures.

Because of the large geographic area that must be covered in this study, the contractor should consider using more than one interviewer to cover all interview locations. This will help minimize the proportion of each interview-day that is used for travel between sites. In cases where an interviewer must cover multiple sites, interview days should alternate on a daily basis so that there is temporal overlap between sites during each of the recreation seasons (i.e., do not spend one week at one site and then move to another, rather alternate days between sites so that both are covered during the same two week period). Once a plan for site visits has been developed for each season in Year 1, it should be considered for all subsequent years of survey. This will maximize the comparability of data between survey years. However, please note that a stratified random sample plan may be necessary to ensure adequate sampling effort during known periods of high activity such as weekends, holidays, summer season, etc. and also to control for weather conditions.

In addition to the questionnaire, other data to be collected as part of this monitor includes average reservoir levels, river discharge, local climate data (e.g., number of sunny days), and population census data from Statistics Canada. The contractor may add to this list of parameters as necessary in order to assess the role of WUP versus non-WUP determinants of perceived recreational value and actual recreational use.

## **2.5 Safety Concerns**

A safety plan will have to be developed for all aspects of the study in accordance with WorkSafe BC and BC Hydro procedures and guidelines. It is important to note

that, because of the remoteness of some of the study areas and the large geographical area that must be covered, appropriate check-in and checkout procedures must be followed. The safety plan should include Working Alone Procedures if surveyors are not working in teams.

## 2.6 Data Analysis

All data will be entered into a common database with the format to be developed in consultation with BC Hydro staff. The data should be entered in a structured table suitable for Chi-square (or similar) analysis; the principle means by which all hypotheses will be tested. The Chi-square tests should use correction factors as required to correct for statistical bias (Zar 1974). Because impact hypotheses are not specified *a priori*, specific requirements for data analysis cannot be made at this time. However, some form of trend analysis is anticipated, which may require the use of either parametric or non-parametric regression statistics to draw statistical comparisons. Correlation analysis may also be required to assess time trends, including how they may correlate with other variables (particularly those that track WUP related operations such as reservoir level or discharge). Correlation analysis can also be used to assess the impact of non WUP factors (local demographics, climate, quality or availability of recreational facilities) so that they may be ruled out as possible causes for observed changes.

## 2.7 Reporting

Reporting will consist of annual data reports that summarize all data up to that point in time (e.g., the Year 2 report will show Year 1 and Year 2 results), a summary report in Year 5, and a final report at the conclusion of the Monitor.

Annual data reports will summarize the year's findings and include a short discussion of how the year's data compare to that collected in previous years. It will include a brief description of methods, present the data collected that year, and report on the results of all analyses. The Year 1 report will also include:

- 1) Final version of impact hypotheses, including the rationale for their inclusion in the monitor,
- 2) Final version of the questionnaire with a rationale of how the questions relate to the impact hypotheses,
- 3) Identification of all recreation entry/departure points to be used as interview locations, and
- 4) Final version of the sampling plan showing how the annual sampling effort (interview-days) will be distributed among recreation seasons and interview sites.

This information will serve as the final study design that is to be repeated in subsequent years for the duration of the monitor.

Each report will be due shortly after completion of one full year of data collection. This should provide sufficient time to analyze and integrate findings based on the previous year's data collection.

The CC have requested that a summary report be prepared in Year 5 that collates all the data collected to date, summarizes all the analyses and presents a discussion of results as they pertain to the impact hypotheses in Section 1.3, and more importantly, to the management questions in Section 1.2. This will provide an early



assessment of WUP operations in each study stream, though the implementation interval would likely be too short to determine with certainty whether the WUP was successful in meeting the intended benefits.

At the conclusion of the Monitor, a final comprehensive report will be prepared from all of the data and/or annual reports written to date that:

- 1) Re-iterates the objective and scope of this component of the monitor,
- 2) Presents the methods of data collection and data analysis,
- 3) Describes the compiled data set and present the results of all analyses,
- 4) Discusses the results as they pertain to the hypotheses in Section 1.3 and the Management Questions in Section 1.2.
- 5) Discusses the consequences of these results as they pertain to the current WUP operation, and how it may influence future WUP decisions, and
- 6) Includes an executive summary that summarizes the results of the monitor and their consequences as they relate to the success/failure of the WUP decision. It should include recommendations for the development of recreation based performance measures, if any, as well as the scope for future study work.

## **2.8 Interpretation of Results**

Because impact hypotheses have not been prepared *a priori* as part of the terms of reference, specific concerns or issues pertaining to the interpretation of results cannot be made at this time. However, the following should be considered when interpreting the data:

- 1) Rejection of null hypotheses should always be accompanied with an analysis of whether it was the result of a WUP related change in operation (direct or indirect) or the result of other factors. A properly designed questionnaire should have the information necessary to carry out this type assessment.
- 2) Hypothesis testing should be accompanied by at least rudimentary analysis of statistical power to determine the magnitude of change necessary in order to statistically detect a significant change or difference.
- 3) Results of all hypothesis testing should be used as the basis for addressing the management questions in Section 1.2, which could include recommendations for the development of new, more meaningful performance measures for use in the WUP review process.
- 4) Results of the hypothesis testing should also be used to evaluate the success of the WUP in meeting expected recreation objectives as identified in the Campbell River WUP CC Report (Anon 2004).

## **2.9 Schedule**

The John Hart Generating Station upgrade project includes recreation access changes that could bias the results of this Monitor. Commencement of the Monitor and subsequent public survey will need to be timed so that the information collected captures the effects of the WUP on recreation use rather than the effects related to the upgrade project.

The recreation use and public perception monitor is to be carried out annually for the duration of the 10 year monitoring period. The work is to be repeated each year following a specified plan to be developed in year 1 by the contractor. Also due in Year 1 is a finalized list of impact hypotheses designed to address the management questions in Section 1.2, a finalized questionnaire that is to guide for all interviews with recreational users in the project area, and a specific study design showing how the interview effort is to be distributed across the four recreation seasons and the sites of interest. The interview process is expected to start in Year 2, though an earlier start would be desirable if it is possible. A data report is to be prepared each year, following the fall period of data collection.

In Year 5, the data report will be more comprehensive, summarizing all of the data and analyses collected to date, including all study components in this monitor, and provide a preliminary discussion of the findings, particularly as they pertain to the implementation of the WUP.

Data collected in Year 10 will be the last under the present program. A final report will be due the following year. It will summarize all of the data and analyses collected to date and provide a comprehensive discussion of the findings, particularly as they pertain to the implementation of the WUP and the management questions in Section 1.2.

## **2.10 Budget**

The total cost of the recreation use and public perception monitor is estimated to be \$1,228,661 based on a 2014 start.

## **3 References**

Anon. 2004. Campbell River Water Use Plan: Consultative Committee Report. Prepared on behalf of the Consultative Committee for the Campbell River Water Use Plan. 132 pp. + App.

Zar, J.H. 1974. Biostatistical Analysis. Prentice-Hall Inc. N.J. 620 p.