Campbell River Water Use Plan

Monitoring Program Terms of Reference

- **JHTWORKS-3 Upper Campbell Reservoir Drawdown Zone Revegetation Program**

June 28, 2016

Upper Campbell Reservoir Drawdown Zone Revegetation Program

1.0 Introduction

This Terms of Reference (TOR) is for the identification and prioritization of highly visible reservoir perimeter sites, within the drawdown zone of the Upper Campbell Lake and Buttle Lake Reservoir (Upper Reservoir) for re-vegetation. The sites selected will be areas determined to have the highest potential for natural vegetation recolonization success. This project has two components: a physical works component, and a monitoring component. The physical works component will involve three phases. This initial version of the TOR includes the first two phases, after the first two phases are complete; a third phase will be included in an addendum.

The project physical works phases are structured to include a trial approach targeting visible sections of the drawdown zone within established high-use recreation areas, with the purpose of determining successful revegetation treatments in the Upper Campbell Reservoir environment. Revegetation trials will treat a large enough area to allow for a response to be monitored ("operational trials"). The efforts will be focused on the areas determined to have the highest potential for natural recolonization success. Once the trials in the first two phases have concluded, a final revegetation program will be developed based on the successes of the trials and will make up the third and final phase of the project.

This Terms of Reference is submitted in response to the Water Act Order issued by the Comptroller of Water Rights on November 21, 2012, Schedule C, Clause 1(c). The Order requires terms of reference to "identify, prioritize and revegetate highly visible reservoir perimeter sites within the drawdown zone" in the Upper Campbell.

1.1 Background

In 1996, under the Campbell River Interim Flow Management Strategy (IFMS), an increase in the annual water budget for the Upper Campbell Reservoir raised seasonal full pool levels by up to two meters (from a summer minimum of 217 m to 219 m, and summer maximum of 220.5 m to 221 m). As a result, wind and wave action reached above the previously normal maximum reservoir level causing impacts along some shorelines.

The Consultative Committee (CC) in 2004 recommended changes to the operation of the Upper Campbell Lake Reservoir and Campbell Lake Reservoir that were incorporated into the Water Use Plan (WUP). By Order of the Comptroller of Water Rights (issued November 21, 2012), the Upper Campbell Lake Reservoir now operates at a lower level than it had since 1996[1] for the summer recreational season from June 21 to September 10 with a maximum 220.5 m and a minimum of 217 m (Figure 1-1).

[1] Recommended maximum water level of Upper Campbell Reservoir: 222.0 m June 1 to September 30 (Campbell River Interim Flow Management Strategy, Table 14, May 1997)

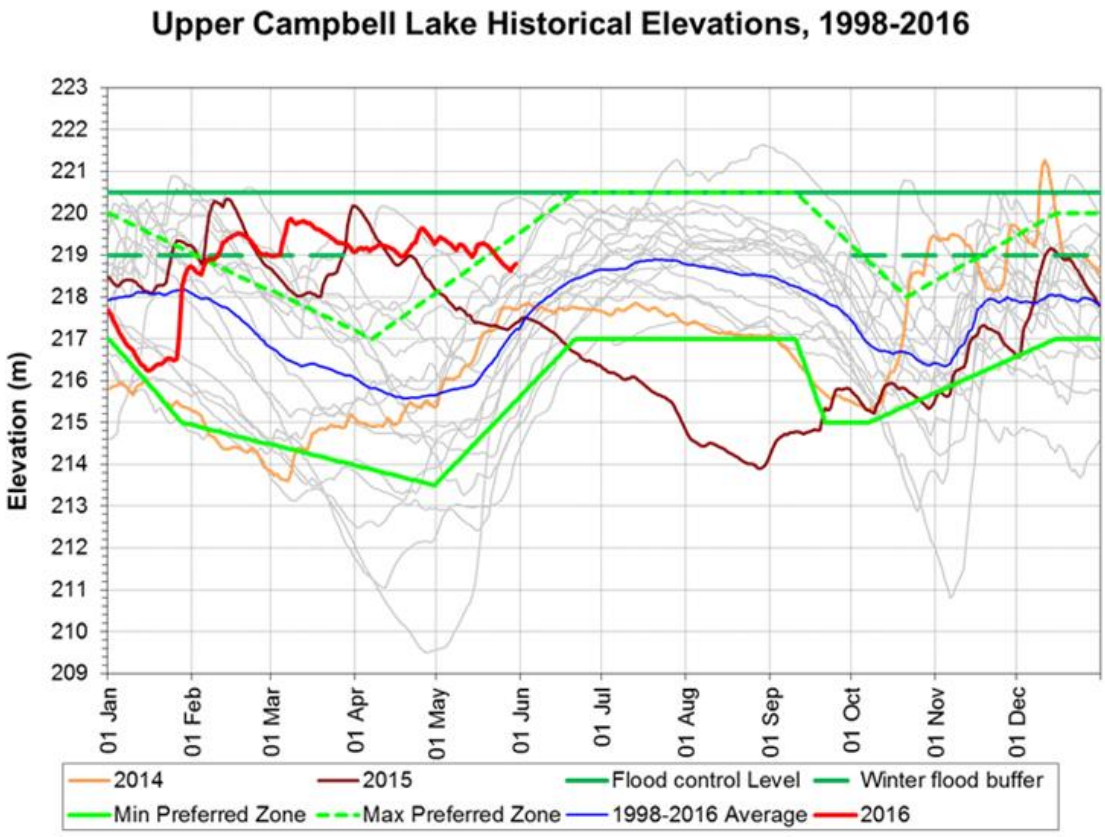

Figure 1-1. Current Upper Campbell Reservoir operations elevations.

This drop in water elevation was expected to expose up to 440 hectares of shoreline causing a bare “bath tub ring” appearance around the reservoir that could diminish the aesthetic experience for tourists and recreational users frequenting the reservoir.

As part of the WUP Consultative Committee (WUP CC) process, the importance of a shoreline-revegetation program for highly visible areas around the Upper Campbell Reservoir was recognized. Improving the aesthetics of exposed reservoir shorelines as viewed from high-use aquatic recreation areas and roadside viewpoints was identified as a priority through preliminary consultations with representatives of recreational user groups. As an added benefit, vegetated areas may result in improvements to terrestrial and aquatic habitats.

1.2 Description of Project

1.2.1 Location

The Upper Campbell Reservoir is comprised of two lakes:

- Buttle Lake (a 4202 ha reservoir located in Strathcona Provincial Park); and
- Upper Campbell Lake (a 2526 ha reservoir to the north of Buttle Lake).

From the Upper Campbell Reservoir, water flows eastward into two other reservoirs (the Lower Campbell and John Hart) supplying a series of generating stations (from west to east these are the Strathcona, the Ladore, and the John Hart dams respectively).

2.0 Project Goal and Objectives

The goal of this program is to:

Improve the habitat values and visual quality of high profile reservoir shoreline areas impacted by fluctuating reservoir system operations.

The primary objective to support the goal of this program is to:

Assist the natural recolonization of native vegetation communities in the drawdown zone of the Upper Campbell Reservoir that will improve the visual quality of shorelines for recreational users and will enhance riparian habitat values.

The primary target of this project is to treat high-use recreation areas along the shoreline that has or will be visually impacted by current operations. For boaters and recreational users, stumps within the drawdown zone pose safety hazards within these high-use areas, integrating stumps into revegetation program treatments is favourable.

Revegetation treatment may also benefit First Nations values, wildlife habitat, and potentially benefit shoreline stability. However, these additional benefits are not the primary purpose of this project.

2.1 Approach to Physical Works

The physical works component of the project will be completed in three phases: Identification/Prioritization, Planning/Trial and Implementation. This Terms of Reference includes the Identification/Prioritization and Planning Trial phases. CWR approval will be sought before proceeding to Implementation Phase. These phases are described further below.

2.1.1 Identification/Prioritization (Year 1):

This phase will include the identification and prioritization of highly visible reservoir perimeter sites for treatment, within the drawdown zone, that are determined to have the highest potential for natural recolonization success. Specific sites will be selected in targeted areas with the best opportunity for success for physical works operational trials. Identification of treatment areas was initiated as part of the WUP development process, as the Consultative Committee identified the need to address the aesthetics of the exposed reservoir shorelines as viewed from high-use aquatic recreation areas. Trial locations will most likely focus in the drawdown areas of the Buttle Lake Narrows recreation sites (i.e., Upper Campbell Marine Site, Driftwood Bay Group Site, Buttle Lake Campground, Rainbow Island and the Narrows Boat Launch and Picnic Ground).

This phase will require consultation with members of the John Hart monitoring committee, BC Hydro, First Nations, the local recreation community, Parks BC staff at Strathcona Provincial Park, local Ministry of Forests, Lands, and Natural Resource Operations officers, and others. Recommended treatment site options and treatment methods from stakeholder and First Nations engagement will be incorporated into a deliverable for this phase: Revegetation Treatment Plan: Trials Phase (RTP) report. The draft RTP will be reviewed by BC Hydro and the monitoring committee prior to moving to the next phase.

2.1.2 Planning/Trial Phase (Years 2 to 6):

This phase includes planning associated with the recommended options emerging from the Identification/Prioritization phase RTP report. Incorporating the knowledge gathered in Phase 1, the consultant will complete recommended operational trials proposed in the RTP report at the selected high priority sites. The RTP report will be a living document which will be updated at the end of each year of this phase, the updated RTP report will be reviewed by BC Hydro and the monitoring committee prior to the next year's operational revegetation trial implementation. The operational trials will consider logistics related to the annual hydrograph (Figure 1-1), provincial and federal regulatory requirements where applicable, private land boundaries, BC Parks requirements, archeological sites, and work with BC Hydro to obtain any permits required to complete the trial works.

BC Hydro will seek CWR approval at the end of the Planning/Trial Stage, prior to proceeding to the Implementation phase of work. The final deliverable at the end of this Phase will be a Final RTP report outlining the full implementation treatment plans of the revegetation physical works based on the annual hydrograph and the successes and learnings from the operational trials. The RTP will also include the design of the monitoring component for effectiveness monitoring of implementation phase of the revegetation program (see Section 3.2).

2.1.3 Implementation Phase (Years 7 to 10)

To be completed under future TOR addendum at the end of Year 6): In the subsequent TOR, BC Hydro will submit for the completion of the following:

- Implementation of the Final RTP including detailed treatment plans, cost estimates and implementation schedule;
- Program assessment to determine if goals and objectives are being met, this will guide an adaptive management approach which will be integrated into the program;
- Permitting as required;
- Completion reporting including effectiveness monitoring results, adaptive management strategies and ongoing maintenance, as required.

2.2 Approach to Monitoring

To fulfill the goals/objectives of this program, the operational trials design and the implementation design will include a design for effectiveness monitoring (i.e., control plots in treatment areas). The control plots will be established in the Spring of Year 2, at the same time as the operational trial plots. Effectiveness monitoring will be conducted in the spring and fall of each treatment year (monitoring will begin in the fall of Year 2 and spring of Year 3, and extend up to Year 10); however, the current scope of the TOR includes effectiveness monitoring of physical works Phase 2 (up to Year 6 only). Effectiveness monitoring results and recommendations will be included in the RTP reports starting in the fall of Year 2.

3.0 Linkages with Other Campbell River Water Use Plan Projects

In 2012, the Campbell River WUP CC recommended a monitoring program comprised of a series of interlinked studies (listed below); the consultant should be familiar with other

WUP projects being conducted on the shorelines of the Upper Campbell Reservoir to avoid undue duplication of effort (i.e., aerial photo analysis of the reservoir shoreline).

- **JHTMON-1** Upper and Lower Campbell Lake Reservoirs Digital Elevation Model: Aerial photo interpretation, digital elevation and computer modeling to determine submerged stump heights and hazard level at various reservoir elevations.
- **JHTMON-2** Upper and Lower Campbell and John Hart Reservoirs Public Use and Perception Survey: Workshops and questionnaires will be developed to measure public response to the operation of the System and additional works constructed within the area influence by the System.
- **JHTMON-10** Upper and Lower Campbell Lake Reservoirs Shoreline Vegetation Model Validation: To determine if the upper and lower limits of shoreline vegetation bands (i.e., communities) are significantly different from those predicted by the shoreline vegetation model; to determine if particular vegetation communities or ecosystem types occurring within predicted elevation bands are determined by shoreline gradient; to determine if plant community distributions differ after implementation of the WUP regime changes. Aerial photo interpretation and analysis will categorize vegetation communities within the Campbell River Reservoir system.
- **JHTMON-11** Upper Campbell Lake Reservoir Erosion Assessment: Assess the shoreline adjacent to private properties on the Upper Reservoir and determine shoreline erosion risks relative to private property boundaries.
- **JHTWORKS-2** Upper Campbell Lake Reservoir and Campbell Lake Reservoir Recreation Facility Upgrade Feasibility: Determine the feasibility of upgrading boat ramps and beaches in Provincial Park sites and Forest recreation sites in the Upper Reservoir, and Campbell Lake Reservoir, to prioritize and upgrade as ordered by Comptroller.

4.0 Methods

4.1 Physical Works Component

4.1.1 Identification/Prioritization (Year 1)

It will be important for the consultant to review parallel reservoir shoreline revegetation program information (such as the CLBWORKS-1 and -2 and CLBMON-9, -10, -12, -33 and -35 projects conducted on the Arrow Lakes and Kinbasket reservoirs in the Upper Columbia River region, and the BRGWORKS-1 and BRGMON-2 programs in the Bridge River Region). This will ensure that the development of operational trials and measures in this project incorporate successful methods and measures previously learned from past treatments at other locations. The review of parallel projects should be an iterative process to incorporate new information as it is developed. This program has been phased to take advantage of this iterative process.

Summarize and analyze the information already collected under the different monitoring and physical works studies listed above and use those data to observe larger scale trends in vegetation composition, structure and spatial extent to inform the revegetation program to help target revegetation treatment areas. The following tasks should be completed as part of Identification/Feasibility:

- Review the categorization of existing vegetation community types and locations (GIS data from JHTMON-10 aerial photo and vegetation typing analysis);
- Community Engagement: design and facilitate a workshop to identify priority revegetation treatment areas from a riparian habitat and visual quality recreational perspective;
- Observe the Upper Campbell Reservoir hydrograph (Figure 1-1) and relate how annual elevation fluctuation in the reservoir will impact the program;
- Design a field program to assess priority sites in the field – collect baseline data;
- Determine the constraints which are preventing vegetation development in the Upper Campbell Reservoir;
- Describe the natural succession process associated with the reservoir area;
- Refine sites based on field data;
- Identify potential vegetation donor sources in the field;
- From the workshop and the field program, further identify revegetation treatment sites within the priority areas; design operational trials (treatment prescriptions) which will address factors limiting growth within the reservoir that could determine the success of the revegetation program (i.e., deposition/erosion);
- Establish a schedule for the operational trial and monitoring design; and
- Prepare a trial Revegetation Treatment Plan (RTP) report for the Upper Campbell Reservoir including an appropriate operational trials design (goals, objectives, methods, treatments, etc.) and an effectiveness monitoring design (appropriate number of control plots to statistically analyze the success of the operational trails, see Section 5.2). Revegetation treatments should include treatments such as (but not limited to):
    - bioengineering,
    - soil amendments,
    - erosion protection,
    - treatments around stumps to decrease hazards,
    - log booms,
    - windrows,
    - topography treatments,
    - staking and native species planting, and
    - methods to discourage recreation or wildlife damage.

4.1.2 Planning/Trials (Years 2 to 6)

Implement the operational trial design as described in the Revegetation Treatment Plan, and adjust the Revegetation Treatment Plan as required from effectiveness monitoring results. The following tasks should be completed as part of the Planning/Trials phase:

- Implement operational trial and treatment prescription design and the effectiveness monitoring design from Phase 1, for Years 2 to 6.
- Collect appropriate baseline data in all selected treatment sites to use in treatment response analysis in the effectiveness monitoring component.

- Adjust operational trial and treatment prescriptions based on the results of effectiveness monitoring.
- Collaborate with JHTMON-10 and JHTMON-11 contractors to monitor and document changes in plant community distribution and diversity around the reservoir, and to relate these changes to reservoir site conditions and inundation regimes where appropriate.
- Continue to identify donor sites for vegetation and seed sources.
- Prepare annual RTP reports reflecting status changes of the program, and including effectiveness monitoring results and recommendations (Section 5.2).

4.1.3 Implementation (Years 7 to 10)

The following tasks should be completed as part of Implementation (and will be addressed in a TOR addendum):

- Implement treatment prescriptions from Phase 2, for Years 7 to 10.
- Collect baseline data in new treatment sites to use in treatment response analysis in the effectiveness monitoring component.
- Implement an adaptive management approach using regular evaluations of the program.
- Consult with stakeholders and adjust plan as required.
- Incorporate learnings from other programs as applicable.
- Provide adaptive management targets, and adjust programs as required to support the overall program goal and objectives, including recommendations from the effectiveness monitoring component.
- Prepare annual reports to reflect status changes of the program.

4.2 Monitoring Component (Years 2 to 10)

The following tasks should be completed as part of the Monitoring Component (only Years 2 to 6 are currently budgeted in this TOR, the remaining Years 7 to 10 will be included in a TOR Addendum):

- An effectiveness monitoring design is included in the RTP from Phase 1 (see Section 7.1.1). This design will include the appropriate methods required to measure a treatment response.
- Establish reference sites with similar ecological features as selected treatment sites and determine appropriate parameters to measure (reference sites should be based on existing vegetated sites within the drawdown zone).
- Reference site selection should be based on vegetation community information from JHTMON-10 and local knowledge.
- Survey the reference sites to record baseline parameter levels and to set feasible targets for the revegetation program within the RTP, spring of Year 2.
- Parameters measured could be similar to CLBMON and CLBWORKS programs such as (but not limited to): cover %, species composition, vegetation height, soil substrate, survival of planted species, plant vigour and health, stem density,

permanent photodocumentation points, growing degree days, and erosion and deposition observations.

- Set targets to measure success (i.e., the target cover % after five years of treatment), these targets will be reviewed by BC Hydro.
- Bi-annually collect field data (fall and spring) to monitor effectiveness; fall effectiveness monitoring will include photodocumentation from permanent photo plots to assess impacts of inundation and drought through the summer (starting in Year 2). Spring effectiveness monitoring will measure all established parameters for statistical analysis (starting in Year 3). Photos from the fall monitoring program will help to interpret results from analysis.
- Use appropriate statistical methods for analysis to evaluate the success of treatment prescriptions within the operational trials and implementation, provide recommendations in the Revegetation Treatment Plan.

5.0 Project Coordination

Project coordination involves the general administration and technical oversight of the program, which will include, but not be limited to: 1) budget management, 2) study team oversight, 3) logistics coordination, and 4) technical oversight in field and analysis components.

5.1 Project Safety

Safety and Environmental Management Plans will be developed for all aspects of the works in accordance with BCH procedures and guidelines. It is important to note that, because of the remoteness of some of the work areas all field work must be carried out by a minimum two-person crew and that appropriate BC Hydro check-in and checkout procedures must be followed.

The Contractor shall take all reasonable and necessary measures to ensure that any activities undertaken in the performance of the Work are conducted in such a way as to minimize any disturbance or damage to the environment. This includes protecting the natural ground surface, vegetation, wetlands, watercourses, wildlife and fish. It also includes minimizing disturbance to neighbours and the general public.

5.2 Reporting

The consultant is expected to adhere to annual reporting processes as required by the BC Hydro contract manager for this project. Reports will follow the standard format that has been developed for WUP studies. All reports will be provided in hard-copy and as Microsoft Word and unprotected Adobe Acrobat (*.pdf) format, and all maps and figures will be provided either as embedded objects in the Word file or as separate files. All map data, including meta data, will also be provided electronically in ARC GIS compatible format. Data (including photographic time-series) will be maintained in a relational database with a full description of the contents of each attribute.

5.3 Physical Works Component

5.3.1 Identification/Prioritization

This Revegetation Treatment Plan report should include (but not be limited to):

a) summary of relevant background information;

b) reservoir vegetation ecology summary and the identification of filters that are preventing recovery of vegetation;

c) a ranking of identified priority sites from the consultation process with interest groups and other JHTWORKS and JHTMON contractors;

d) a summary of the preliminary field assessment of the identified shoreline treatment areas within the priority sites;

e) a map of Operational Trial locations and design rationale including effectiveness monitoring design;

f) an outline of the planting and treatment prescriptions for the Operational Trials;

g) outline of potential revegetation treatments for the remaining priority sites; and

h) a year-end budget summary.

5.3.2 Planning/Trials

In the first four years of this phase, annual RTP reports should include (but not be limited to):

a) prioritization of revegetation work based on trials information including mapping of proposed sites;

b) summaries of results of operational trials monitoring;

c) continued inventory of donor plant stock and/or other supply sources;

d) effectiveness monitoring analysis and results;

e) adjustments to the Revegetation Treatment Plan based on effectiveness monitoring results; and

f) annual budget summaries.

In the final year of this phase, Implementation RTP report should include (but not be limited to):

a) summary results of all the operational trials monitoring;

b) effectiveness monitoring analysis and results;

c) summary of feedback and recommendations from monitoring committee meetings;

d) implementation plan for the next phase of the physical works program based on effectiveness monitoring results; and

e) annual budget summary, projected budget for the Implementation Phase and cost effectiveness evaluation.

5.3.3 Implementation

In this four-year Implementation Phase, annual RTP reports should include (but not be limited to) progress on:

a) implementation of the RTP, including successful treated area and proposed treatment areas for the following year;

b) continued inventory of donor plant stock and/or other supply sources;

c) effectiveness monitoring analysis and results;

d) proposals for adjustments and rationale based on effectiveness monitoring results of treated areas;

e) adaptive management strategies; and

f) annual and projected budget summaries.

5.3.4 Monitoring Component

The monitoring component report will be included with the annual RTP report, and should include (but not be limited to):

a) monitoring methods and mapping;

b) reference sites and measured parameters and targets;

c) effectiveness monitoring photodocumentation and statistical analysis;

d) results comparison to established parameter targets; and

e) program treatment recommendations based on effectiveness of treatments.

5.4 Final Report

A Final Report will be due at the end of Year 10. The Final Report should include data summaries and analysis, success of the project, as well as detailed descriptions of all the iterative evaluation processes, effectiveness monitoring results and adaptive management strategies employed (and documented) in the annual reports over the course of this project. Background research and rationale for the design and implementation of all experimental measures (i.e., operational trials and other treatment areas) should be summarized along with the results of the revegetation treatment plan. Recommendations for future treatment areas, or follow-up treatments should be included in an appendix, with detailed treatment prescriptions to enable other authorities (i.e., BC Parks) to implement revegetation works on their own.

5.5 Presentations and Workshops

Initially, assist in the planning and attend the Primary Stakeholder Workshop to identify priority treatment areas for this program as part of Phase 1: Year 1. This task includes the preparation of a PowerPoint presentation, liaison with BC Hydro, and attendance in the initial stakeholder workshop meeting to discuss priority areas to target for the physical works component of the project. The RTP report will be prepared after this meeting.

Annual Monitoring Committee meetings with BC Hydro and the stakeholders will be required. The purpose of these meetings will be to report and present this program to the committee. Knowledge gained from the committee and committee recommendations will be incorporated into the annual RTP reports. An additional meeting may be required prior to the implementation phase (Phase 3) to discuss physical works component success to date, and gather feedback for the last phase of the project.

6.0 Schedule and Budget

Phase 1 and Phase 2 Total Program Cost: $681,545. Costs of Phase 3 will be provided in a TOR addendum. The schedule in Table JHTWORKS-3-1 provides a schedule overview of Phase 2, starting in Year 2.

Table JHTWORKS-3-1. Annual Schedule for Phase 2 (Years 2 to 6).

Program Tasks	Spring	Summer	Fall	Winter
Treatments	X			
Effectiveness Monitoring	X		X	
Analysis			X	X
Reporting				X
Annual Monitoring Committee Meetings				X