Bridge-Seton Water Use Plan

Monitoring Program Terms of Reference

- BRGMON-10 Carpenter Reservoir Productivity Model Validation and Refinement

Addendum 1

BRGMON-10 Carpenter Reservoir Productivity Integrated Response Model and Refinement Program

October 14, 2014

A1 Addendum to BRGMON-10 Carpenter Reservoir Productivity Model Validation and Refinement

A1.1 Addendum Rationale

During BRG WUP processes a simple reservoir productivity model was developed to predict how different reservoir operations influence physical conditions in the reservoir. In that model, reservoir productivity predictions were largely driven by light penetration alone because light penetration was identified as the key variable regulating primary and secondary productivity in glacially turbid lakes and reservoirs.

This WUP model did not incorporate the dynamics of other key variables, such as temperature and nutrient dynamics that are known to influence productivity in both pelagic and benthic habitats in lakes and reservoirs. This simplistic modeling option was adopted mainly because it was judged unfeasible to develop models that relate the complex hydrodynamics of the reservoir to nutrient and temperature dynamics due to cost, time and data availability constraints.

The contribution of variables such as temperature and nutrient dynamics is required in order to adequately answer the management questions. Recent advancements in water quality and ecosystem modeling allows for inclusion of these variables. Hence revision to the modeling approach is required to be able to comprehensively model the complex hydrodynamics of Carpenter Reservoir, including nutrient and temperature effects on plankton production. TOR sections revised in this addendum as outlined below will supersede the old sections in the original TOR. Sections that are not addressed in this addendum are still valid and will be adhered to in future contractor proposals.

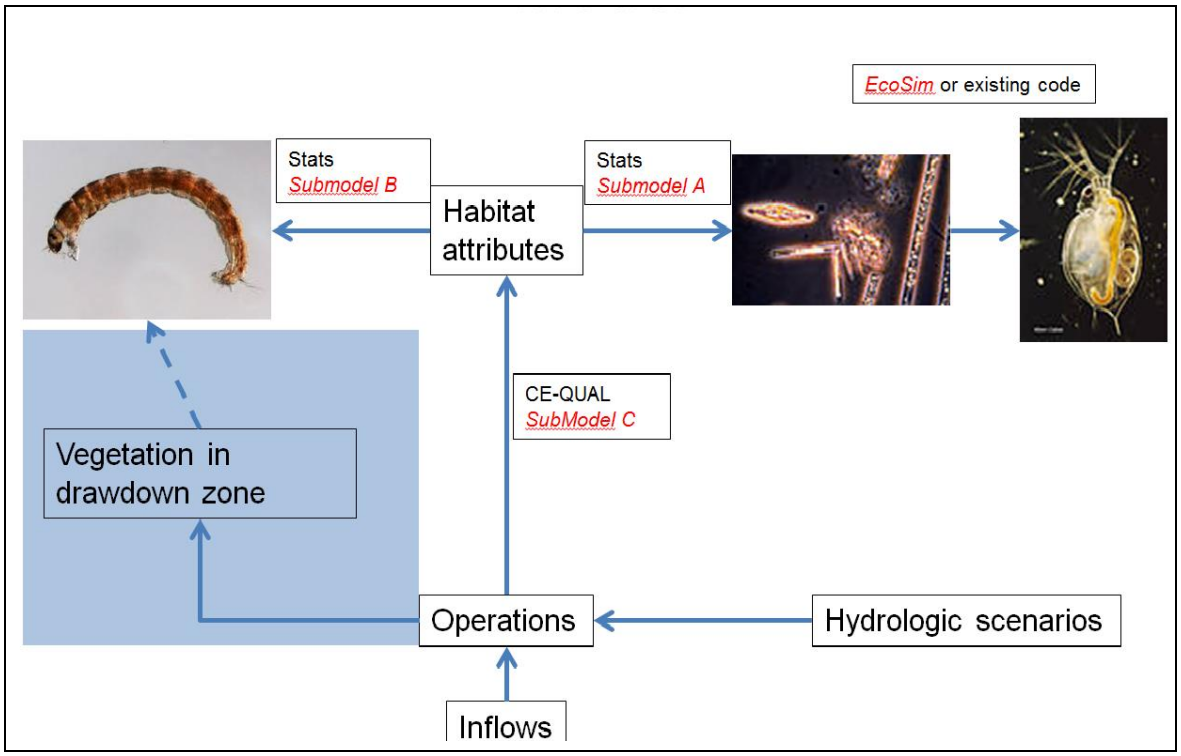
A1.2 Approaches

Recent progress in reservoir productivity modeling approaches, such as *CE-QUAL* water quality modeling tool (developed by Water Quality Research Group at Portland State University, USA) and *ECOSIM* ecosystem dynamics modeling techniques (developed by the University of British Columbia, Canada) provide greater opportunities for simulating complex hydrodynamics, nutrient and temperature dynamics and resulting habitat attributes and associated primary and secondary productivity in reservoirs and lakes. These simulation models are widely used around the world for modeling complex reservoir hydrodynamics, water quality and ecosystem dynamics. The revised approach, termed Bridge River Integrated Response Model (BRGIRM), will make use of these state-of-the-art modeling tools and other relevant statistical packages to predict how different reservoir operations influence bio-physical conditions in littoral and pelagic habitats, and predict reservoir productivity under a range of reservoir operation and hydrologic scenarios.

The complex hydrodynamic and water quality conditions will be modeled using the *CE-QUAL* modeling tool to predict habitat attributes. Statistical sub-models will be used to investigate functional relationships between habitat attributes and productivity in both pelagic and littoral habitats. The resulting food-web dynamics in the reservoir will be simulated by use of the *ECOSIM* modeling tool or other alternative modeling tool. Consistent with the intent of the original study plan, the scope of ecosystem modeling will be limited to fish-food dynamics. However, results from this study are also expected to inform interpretation of data from Carpenter Reservoir and Middle Bridge River Fish Habitat and Population Monitoring (BRGMON-4). Data analysis will involve comparisons between the results from the old model, the new revised model and other relevant models. The models will be calibrated to empirical observations and sensitivity analyses will be done to examine impacts of operational changes on reservoir productivity.

A conceptual diagram depicting components of the revised BRGIRM is shown in Figure 1 below.

Figure 1: Revised Bridge River Integrated Response Model



A1.3 Modeling Task

There will be three primary modeling exercises tasks:

1) Review results from reservoir productivity monitoring on other BC Hydro reservoirs to determine if and how these findings can be applied to improve the old Carpenter productivity model, or propose a new productivity model for the reservoir.

2) Use the updated and more comprehensive model input data (suspended sediment, flow) from tributaries, more extensive data from within Carpenter Reservoir, and associated output sediment concentration from the Bridge River 1 Generating Station tailrace to refine model structure/parameters. This will provide calibrated estimates of seasonal changes in suspended sediment concentration in the reaches of the reservoir, as well as sediment load that is discharged into Seton Lake.

3) Assemble and analyze additional field data to:

   a) use the additional field data to test predictions of the new and the old models, and

   b) use the additional field data to re-evaluate functional relationships between light and other habitat variables to observed benthic or pelagic standing crop biomass. This analysis will be implemented to test the quality of the “old” model and to use the new data to refine either the structure and/or parameter estimates or propose refinements.

A1.4 Schedule

Field sampling is scheduled to occur during Years 1 to 3. Review of reservoir productivity models will occur in Year 1. Concurrently, the model building task will commence in Year 1 and will be completed in Year 2. Final modeling tasks will occur during Year 3 once all of the field data have been collected. The tentative schedule is detailed in Table 1 below.

Table 1: Tentative Schedule for Implementation of BRGMON-10

Task	Tentative schedule
Confirm modeling approach	December 2014
Year 1 data collection and preliminary model building	2015
Finalize model building and Year 2 data collection	2016
Year 3 data collection and data analysis	2017

A1.5 Budget

The total budget of the program remains the same as the original TOR.

References

Bridge River WUP Consultative Committee Report (WUP CC), 2003. Compass Resource Management and BC Hydro. A report produced for BC hydro Water Use Planning group. (Executive Summary available on website: http://www.bchydro.com/content/dam/hydro/medialib/internet/documents/environment/pdf/wup_bridge_river_executive_summary_pdf.pdf)

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