Notice of the Final Oral Examination
for the Degree of Master of Science

of

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BSc (University of Victoria, 2014)

“Application of the Snowmelt Runoff Model to Projecting Climate
Change Impacts on Flow in the Upper Athabasca River Basin”

Department of Geography

Tuesday, September 24, 2019
10:00 A.M.
David Turpin Building
Room B215

Supervisory Committee:
Dr. Terry Prowse, Department of Geography, University of Victoria (Supervisor)
Dr. Yonas Dibike, Department of Geography, UVic (Member)

External Examiner:
Dr. Rajesh Shrestha, Water and Climate Impacts Research Centre, Environment and Climate
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Chair of Oral Examination:
Dr. Annalee Lepp, Department of Gender Studies, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies
Abstract

The projected rise in global temperatures will shift runoff patterns of snowmelt dominated basins, resulting in earlier spring peak flows and reduced summer runoff. Projections of future runoff are beneficial in preparing for climate change induced changes in streamflow, which may necessitate the construction of additional artificial reservoirs to compensate for the reduced natural storage in the form of snow. In this study, the Snowmelt Runoff Model (SRM) was applied to projecting future runoff in the Upper Athabasca River after assessing its ability to simulate historical flows in the basin. SRM utilizes the data-light degree day approach to modelling snowmelt, assuming melt to be proportional to the temperature above freezing through the degree day factor (DDF). Nevertheless, the model performed very well in simulating flows over both the calibration (2000-2002) and validation (2003-2010) periods. The inclusion of a separate DDF for glaciated areas was found to be essential in accurately simulating over multiple years with varying snow conditions. The increased melt rate of glacial ice due to its lower albedo relative to snow could explain most of the elevation dependence of the DDF. The SRM with glacier component was applied with four future (2070-2080) climate change scenarios representing uncertainty in climate change projections over the basin. The results show a consistent pattern of change in runoff across all scenarios, with substantial increases in May runoff, minor increases over the winter months, and decreased runoff in summer months (June-August). Projected flows are consistent with past modelling studies for the region and with historical trends. In general, the SRM performed very well in simulating historical flows and provides useful runoff projections while having light data requirements and being relatively easy to use.