EXECUTIVE SUMMARY

1. **FSP Project number**: M075036

2. **Project Title**: Using GIS and Time Series Analysis to Evaluate Impacts of Large-Scale Forest Logging on Hydrology in the BC Interior

3. **Project purpose and management implications**
The impact of timber harvest on hydrology has long been the subject of considerable study. However, much of the previous research into hydrological impacts has focused on small watersheds (<100 km²) and the results from them are difficult to apply to large-scale watersheds. Lack of information on ecological impacts of large-scale forest disturbance greatly constrains our ability to plan forest management strategies at large spatial scales. The project is expected to provide important, very timely information on impacts of large-scale salvage logging or disturbance (wildfire or mountain pine beetle infestation) on hydrology (peak flows, low flows and mean flows) for designing forest management strategies at large watersheds or landscapes.

4. **Project start date and length of project**
This one-year project was started in March, 2006, and was completed in March 2007.

5. **Methodology overview**

1). Research hypotheses
Bowron and Willow watersheds are two neighboring watersheds located in the central interior of British Columbia. Their areas are 3590 and 3110
km² for the Bowron and Willow watersheds, respectively. Both watersheds experienced a large-scale forest harvesting, with accumulated equivalent clear-cut area (ECA) percentages of 30% and 25% for the Willow and Bowron watersheds, respectively. Availability of long-term (50 years) hydrology and historic harvesting data provided us a unique opportunity to evaluate the impacts of forest harvesting on hydrology at large-scale watersheds.

Two research hypotheses were: (1) large-scale salvage logging had significant impacts on hydrological variables (peak flow, mean flow and low flow) in the Bowron watershed; and (2) large-scale forest harvesting significantly affected hydrology in the Willow watershed.

2). Data collection

Streamflow data from the two selected hydrometric stations (one for each watershed) were used to calculate hydrological variables of mean, peak and 7-day low flows. In order to account for various hydrological processes within a year, the annual stream flow hydrographs were divided into three periods including spring snowmelt (April to June), summer rain (July to October) and winter baseflow (November to March).

Climate data (precipitation and temperature) from the weather station located in Barkeville and Prince George airport were used to interpret the results from this project.

Annual forest harvesting records for both watersheds were used to calculate equivalent clear-cut area (ECA) to account for hydrological recovery due to regeneration of key tree species following timber harvesting in the studied watersheds.
3). Statistical tests

Various statistical analysis methods were used to assess the impacts of the large-scale forest disturbance on watershed hydrology.

Time series analysis (cross-correlation analysis and intervention analysis) and non-parametric tests (Spearman and Kendall correlations) were used to study the hydrological effects of forest logging in both watersheds. Wavelet analysis was used to evaluate influence of harvesting on cyclic properties of stream flows at various time scales.

6. Project scope and regional applicability

The scope of the project covers two large-scale watersheds located in the central interior of BC. The results from this project are expected to be applicable to the watersheds with similar conditions. In particular, the conclusions from this research can be useful for BC to design management strategies to deal with widespread mountain pine beetle infestations in the BC interior.

7. Conclusions

Our analysis showed that forest harvesting in the Willow watershed significantly increased mean and peak flows for annual and spring snow-melt (April to June) periods, but it did not have any significant changes on low flows in all study periods. In contrast, our tests on the hydrological variables in the Bowron watershed showed either no significant response
to large-scale logging or were inconclusive. The contrasted hydrological responses to large-scale forest harvesting were mainly due to differences in topography, forest disturbance characteristics and climate between two watersheds. Our results clearly demonstrate that any attempt to generalize hydrological response to forest harvesting in large watersheds or to extrapolate the results from one watershed to others must be done with caution.

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