CEF Cumulative Effects Framework

BRITISH COLUMBIA

2019 Analysis of the Kettle River Watershed: Streamflow and Sedimentation Hazards

FAQs

B.C. Ministry of Forests, Lands, Natural Resource Operations and Rural Development

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1. What is the process for initiating a CE study for a community watershed? What other areas will be done and in what order?

The GIS Indicator-Based Protocol for Assessing Cumulative Watershed Effects (hereon after referred to as the Watershed Assessment Protocol) has been refined for the Kootenay Boundary Region (KBR) and can now be applied to other watersheds within the KBR. Applying the protocol to other areas within the KBR requires significant capacity and time to source and prepare input data as well as troubleshooting unexpected issues and compiling the results. Key factors that are considered when prioritizing areas to be completed include level of operational activities, decision-support needs, community identified needs and regional level capacity for implementation. The KBR Cumulative Effects (CE) team is currently working to determine where the protocol will be applied to next. As new information becomes available updates will be provided through the KBR Cumulative Effects webpage.

2. How is the information from a hazard assessment such as this used to help inform decision making and land management efforts?

The Cumulative Effects Framework (CEF) Interim Policy was approved for implementation by all provincial natural resource ministries and agencies effective November 18, 2016. Section 13 of the CEF Interim Policy says the following:

13. Considering Cumulative Effects in Natural Resource Decision-Making

13.1 Operational Decision-Making and Associated Activities

13.1.1 Natural Resource Authorizations

13.1.1.1 Available CEF assessments should be considered by government staff and decision-makers when reviewing applications for the use of land and natural resources that could potentially affect the condition of CEF values[4.]

13.1.1.2 The following should be considered by government staff and decision-makers when reviewing and considering applications for the use of lands and natural resources in relation to 13.1.1.1:

a) the assessed condition of CEF values, as documented in current condition reports or CEAM reports

b) the assessed management review class for CEF values, if applicable, as defined in CEAM reports

c) the potential future condition of CEF values, or near-term trends, as documented in approved CEAM reports

d) the potential impacts of the proposed activity on the condition of the CEF values

e) management responses identified in the approved CEAM report that may be relevant for mitigating potential impacts of the proposed activity

f) additional measures for mitigating the potential impacts of the proposed activity that are consistent with the goals of the assessed CE management class (see Section 11.2.1)

To ensure consistency with Section 13 the CEF Interim Policy, available CEF assessments and/or other CE-related information may be considered by Ministry referrals staff when reviewing applications for the use of land and natural resources that could potentially affect the condition of CEF Values (in CE analysis, Values refer to things that the people and government of British Columbia care about and see as important for assuring the integrity and well-being of the people, communities, economies and ecological systems). Current condition assessments provide staff with an understanding of the current level of hazard on the landscape. It allows them to assess proposed projects against that current hazard level to more adequately identify and articulate how a proposed project may interact and affect the CEF Values. Importantly, cumulative effects assessments and their protocols are available to the public, and to development proponents to consider in their operation planning.

3. The hazard assessment protocol is only as good as the input data that is fed into it. With this in mind, what are the limitations of the datasets used in this assessment?

The input datasets used in the assessment are publicly available and thus allow for greater transparency and reproducibility of the analysis. Notably, data captured at such a coarse resolution tends to be less accurate when applied to smaller local areas of interest and may lack some of the details needed to answer more specific questions. In order to address local area questions, finer scale datasets are needed and created using a combination of photo interpretation, modeling, and sample plots or data to help calibrate. Therefore, the accuracy of the represented data is dependant on the quality of photos used for interpretation, skills of interpreters, and how well the field data can be used to calibrate the inventories. Additionally, some of the input datasets have not been updated recently.

Cumulative effects analysis tries to mitigate some of these issues by creating “consolidated” datasets that are an integration of several sources of information. This was the case for the road, harvested and disturbance datasets used in this analysis.

The roads dataset used a combination of the Provincial Digital Road Atlas, Forest Tenure roads and TRIM roads. The dataset on harvested areas included data from the Vegetation Resource Inventory (VRI), Forest Tenure licenses and RESULTS Openings. Disturbances were captured from the Baseline Thematic Land Use dataset, VRI and other specific provincial and regional human activity datasets. Unfortunately, the consolidation process can result in the overrepresentation of land use activities depending on the accuracy of the input datasets. Some specific areas of improvement for input datasets could be:

- Road type and condition – this information is either not available, not very accurate or not current in the provincial road datasets. Hence, all roads were treated equally in the analysis.
- Forest age and height information – this information is used for calculating Equivalent Clearcut Area (ECA) and it relies on how well the growth and yield models estimate annual tree growth.

Section 5 of the Kettle River Watershed Report also discusses shortcomings and possible improvements of the data.

4. How are the hazard ratings validated?

The GIS-based analysis used in this Watershed Assessment Protocol provides a snapshot in time of watershed conditions that affect peak flow generation and sedimentation processes. Some CE methods use monitoring and modeling to establish baseline conditions against which disturbance or development effects are compared. However, for much of British Columbia there is not enough data to describe a baseline so for cumulative effects analysis in the Kootenay Boundary Region a "current condition" reporting approach was adopted.

Some of the individual indicators can be compared to other studies (e.g. ECA maps can be compared to those in watershed assessment reports), and local knowledge can be used, for example, to verify locations where there are unstable or eroding slopes adjacent to streams. The quality of the input datasets has already been assessed by comparing them with other GIS data (the best or most suitable ones were used in the analysis).

5. What dataset was used to provide information on watersheds?

Freshwater Atlas Watersheds are used in this assessment. These data can be accessed here: https://catalogue.data.gov.bc.ca/dataset/freshwater-atlas-watersheds

6. What is the difference between hazard and risk, and how do they relate to this study?

Risk is the product of hazard and consequence as defined by the equation: Risk = Hazard x Consequence. Hazards in this case are a source of potential harm, or a situation with a potential for causing harm in terms of human injury, damage to property, the environment, and other things of value, or some combination of these. Consequence refers to change, loss or damage to a value, such as human life, property, infrastructure, habitat or species that may result from a hazard, and usually requires a socio-economic evaluation.

The Watershed Assessment Protocol is a high-level assessment that provides information on hazard levels for watersheds of different sizes. A hazards based approach was used given that (a) the number of combinations of hazards and consequences is immense, (b) the presence and vulnerability of downstream values change over time, and (c) there is considerable variability in how things are valued (e.g. socially, economically, biologically). This approach allows users to assess consequences for the elements that they are most concerned about or over which they have management responsibility thereby making the results of the assessment applicable to a wide range of risk analysis projects.

7. Why was equivalent clearcut area (ECA) chosen and what are some of its limitations? How is ECA calculated?

At the provincial scale, the most widespread human impact on hydrologic and sedimentation processes results from forestry operations. The ECA was developed to describe the extent of disturbance in a watershed and is commonly used in forest development planning in B.C., particularly in assessments of snowmelt-generated peak flow. The ECA has been adapted over time to account for forest growth (referred to as 'hydrologic recovery'), natural disturbance (insect outbreak and fire), and partial cutting techniques, and includes representation of land permanently converted to non-forest use (e.g. farmland and power lines). For some applications (e.g. forestry planning in fisheries-sensitive watersheds), an ECA threshold is identified based on the results of hydrologic studies. If the ECA of a watershed exceeded the threshold, it was assumed that there was an elevated risk to downstream resources. ECA is only one tool used by hydrologists to assess watershed risk.

The limitations of the ECA method fall under two categories: inconsistencies in calculation, and uncertainties in some of the elements. While ECA is used widely across B.C., it is not always calculated the same way. For example, in the Watershed Assessment Protocol used for the Kootenay Boundary Region, roads are not included in ECA calculations while other analyses do include roads within their ECA calculations. This decision may be made through consideration of the design of the original hydrologic studies that looked at forestry impacts on watershed. If a hydrologic study identifies an ECA threshold, that threshold can only be applied to other watersheds where ECA was calculated the same way (i.e. if the study did not include roads in their ECA calculations, then those values cannot be applied in areas where ECA has been calculated using roads). Including roads in the KBR Watershed Assessment Protocol, along with a buffer strip to account for clearing and ditching, would increase ECA in watersheds that have higher road densities.

Uncertainties in (and inconsistencies in use of) hydrologic recovery rates and how to represent natural disturbances and partial cutting techniques are additional limitations. ECA was used as the forest disturbance indicator in this assessment, despite its limitations, because of its history of use in B.C. and the number of studies that related ECA with changes in peak flow.

8. If I have an area I want to run the analysis in, am I able to access the code or scripts?

Work is underway to further refine the scripts and associated documentation before they can be shared or used by others. When this work is completed they will be posted on the KBR Cumulative Effects webpage.

9. What is the difference between this hazard assessment and hydrologic or hydraulic modelling?

The Water Assessment Protocol uses GIS data and simplified relationships between land cover, climate, watershed properties and disturbance to categorise potential effects on peak flow and sedimentation. This provides a snapshot of conditions and a qualitative description of hazard (very low, low, moderate, high, very high).

A hydrologic model combines measurements of weather conditions (e.g. daily air temperature, precipitation) with vegetation, soil, topography and/or aquifer maps to simulate elements of the water cycle (e.g. streamflow, evaporation, groundwater recharge). Hydrologic models can be very simple or they can be very complex depending on how much data is available and what objectives have been set, but the outputs are usually values (with associated uncertainty).

Hydraulic modeling usually refers to a specific type of hydrologic modeling that focusses on how water is routed through a watershed or through a particular section of a channel. Hydraulic modeling is often done to assess the capacity of a river channel to move water during flooding and is often strongly based in engineering principles.

10. Does this assessment consider extreme weather events or climate change?

This Watershed Assessment Protocol does not consider extreme weather or climate change. The intent of the CE assessment is to provide a 'current condition' report on the potential for peak flow and sedimentation hazards related to current human activity and natural disturbance in a watershed. It provides a snapshot of modern land use and land cover to aid in current decision-making, and so does not consider the effects of future changes in climate. With regards to the streamflow hazard, the Watershed Assessment Protocol was designed to focus on hydrologic processes that could be most affected by forest harvest and disturbance. In terms of sedimentation, the Watershed Assessment Protocol provides a snapshot of the landscape properties that make a watershed vulnerable to slope failure or erosion, regardless of the probability of an extreme weather event occurring.

11. What is the frequency of updates to CE analyses as new information becomes available?

Updates to current Watershed Assessment Protocol and resulting analyses are dependent on capacity and funding to undertake the work. A key consideration for when updates will occur include an assessment of the scope of new information and the predicted level of change/impact it will have on existing results.

12. When will a riparian function hazard be included within the protocol?

The cumulative effects team is currently working to expand the application of the current Watershed Assessment Protocol to other areas of the region while also working to develop the riparian portion of the protocol. At this time, due to capacity limitations we are not able to identify when a riparian hazard will be completed. The Provincial CE team did however release an Interim Assessment Protocol for Aquatic Ecosystems in British Columbia that provides assessment protocols for the following indicators:

- Riparian Disturbance (km/km) Streams
- Proportion of Riparian Disturbance (%) for Streams, Lakes, and Wetlands – Area Based Measurement
- Wetland Disturbance (%)

13. How can we access the data?

All data that was used in this study are identified within the GIS Indicator-Based Protocol for Assessing Cumulative Watershed Effects: Procedures Adapted for the Kootenay Boundary Region report and input data is available via the BC Data Catalogue. The output data layers from this study are currently available upon request by emailing Kenric.Walburger@gov.bc.ca.

14. What disturbances were included within this assessment?

The Watershed Assessment Protocol was developed with a focus on disturbance types that have the greatest or most widespread effect on hydrologic and geomorphic processes in B.C. In the case of snowmelt generated peak flow, this was forest disturbance (natural and human-caused), represented using ECA. The ECA indicator included logged, permanently deforested (mining, urban, agriculture and utility rights-of-way), insect-affected and burned areas.

For sedimentation, the dominant disturbance types were road development near streams and logging above steep slopes. This included assessments of the length of roads close to water, road length on steep slopes close to water and the area with logging above steep slopes. Consolidated roads and harvesting datasets were used to determine the disturbance types.

15. Does this assessment consider forest recovery?

The Watershed Assessment Protocol provides a snapshot in time of potential hazards and does not explicitly evaluate forest recovery. However, a related factor called hydrologic recovery is a component of calculating the ECA. ECA is calculated as the product of the disturbed area (A, km^2) and a hydrologic recovery factor (HR):

$$ECA = A \times (1 - HR)$$

HR is assigned based on tree height, which is derived from the Vegetation Resource Inventory (VRI) dataset. Higher recovery rates are applied as the mean tree height increases, with the assumption that the growing stands begin to act hydrologically more similar to a mature forest stand than to a recent clearcut. Tree heights in the VRI dataset are modelled with occasional validation using field surveys.