

Peer Review of WaterSmith (2025):
Hydrologic Risk Assessment for Rose Swanson Watersheds

By Dr. Younes Alila, P.Eng.

Introduction

WaterSmith Research Inc. conducted a hydrologic risk assessment (WaterSmith, 2025) for watersheds draining northward from Mount Rose Swanson for his client BC Timber Sales (BCTS). It is my understanding that this watershed assessment would have a “particular focus on groundwater”. Unfortunately, in my opinion WaterSmith (2025) is heavier on surface water and much lighter on groundwater when in fact the hydrology of Rose Swanson is dominated by groundwater. WaterSmith admitted that his limited scope of groundwater assessment is imposed by the bounds of his area of expertise.

I was asked by Armstrong Spallumcheen Trails Society (ASTS) to peer review the WaterSmith (2025) watershed risk assessment.

Areas Where We Agree

I made a field trip to Mt Rose Swanson from July 7 to July 12, 2024. Therefore, I am familiar with WaterSmith field observations and I agreed with what WaterSmith (2025) reported out of his field trip. In particular, I agreed with the following claims by WaterSmith:

1. WaterSmith admitted that there is a lot at stake downstream of the so-called Points of Interest (POIs) when he stated: “The points of interest (POI) for Basins A through E are located at the interface between the upslope forested areas and the downslope residential development areas bordering Salmon River Road”.
2. WaterSmith pointed out how “private land exists in the lower portions of the watersheds. A woodlot owned by Splatsin is located in the west of the AOI. It overlaps a substantial portion of Basin A, and small portions of Basins B and C.” In my opinion, BCTS should account for worst case scenario of the future of woodlots when making forestry decisions on Mt Rose Swanson because cumulative effects of disturbances do not recognize delineated boundaries between private and crown land.
3. I agree with WaterSmith when he stated: “Rural and agricultural development are extensive downstream from the study area, with a more limited amount of development in the study area (located primarily in Basin E). Numerous water licenses and groundwater wells are located within and/or in close proximity to the study area. The local community (including the Rose Swanson Select Committee) is concerned about surface water and groundwater supplies, and the potential for upslope forest development to impact these resources (e.g., downstream flooding, decreased water supply).”

4. WaterSmith admitted he is no expert in groundwater hydrology. Hence, I agree with WaterSmith when he stated his "...assessment addressed the potential impact of forest development on the quantity of groundwater supply (within the limit of the author's area of professional practice). The detailed assessment was limited to Area of Interest (AOI)." It is my opinion that there is a need for a detailed assessment by a qualified groundwater hydrologist of the effects of any logging on Mt Rose Swanson on downstream groundwater aquifers, especially when the hydrology within and outside the AOI is dominated by groundwater.
5. I agree with WaterSmith when he characterized the aquifers within or in close proximity to be of high or moderate vulnerability.
6. I agree with WaterSmith when he stated "Numerous water licenses are located within or in close proximity to the study area for multiple uses, including domestic consumption, private irrigation, and livestock and animal watering [iMapBC, 2025]. Numerous groundwater wells are also located within or in close proximity to the study area."
7. I agree with WaterSmith when he stated "Annual precipitation at the highest elevations in the study area is likely 25-50% greater than that recorded at the climate station, with a much larger portion falling as snow." This corroborates my opinion that Mt Rose Swanson is a significant groundwater recharge zone for downstream aquifers. This means forestry practices on Rose Swanson can have significant effects on downstream groundwater supply.
8. I agree with WaterSmith when he stated "The hydrologic regime of the study watersheds is snowmelt dominated, but periodically intense rainfall during spring freshet likely contributes substantially to peak flows." In my opinion, this raises more alarm bells because rain on melting snow is recognized in the literature as the most super sensitive to forestry practices.
9. WaterSmith admitted that "The ECA analysis was completed for assessing the potential impacts of current and potential future forest cover disturbance on the quantity and timing of runoff." This is what I meant when I state below that the WaterSmith assessment is magnitude-centric and therefore non-causal, as opposed to frequency-centric and hence causal. The magnitude and timing are not the only relevant flow metrics of concerns when it comes to forest developments. We need to evaluate the effects of current and future disturbances on magnitude, frequency, duration, volumes and flashiness.
10. WaterSmith stated "Determining the likelihood of a significant peak flow increase relied heavily on analyzing the distribution of ECA (calculation methods outlined in Section 4.2.2)." **I assert that there is no causal relation between ECA and the increase in the**

likelihood of an extreme peak flow event. Refer to details I provide below about the methodology adopted by WaterSmith in evaluating the hydrologic risk using ECA.

11. WaterSmith pointed out, and rightly so, that “A terrain risk assessment would need to be completed by a terrain specialist to evaluate the capacity for structures to accommodate terrain instability.”
12. WaterSmith stated “Table 2 summarizes the overall sensitivity of structures along the mainstem watercourses in the study watersheds, consistent with the scope outlined in the introduction (Section 1) and terms of reference (Section 2).” I agree with WaterSmith that he is bounded by the terms of reference imposed by BCTS. However, it is unfortunate that such terms of reference did not include the need to quantify how the pre-disturbance 100-yr event (for instance) might turn into a 10-yr event (i.e., becoming 10 times more frequent) as a result of future forest development.
13. I agree with WaterSmith when he stated “Low flow concerns could develop in the long-term once existing harvested stands reach a state of closed canopy (e.g., 30-50 years after disturbance), particularly for Basins D and E.” What I disagree with WaterSmith is his follow up claim that the future of low flows is uncertain. In my opinion, it is almost certain that historic harvesting and future forest development will exacerbate further the frequency, severity, and duration of low flows. This is over and above the effect of global warming on such low flows.
14. WaterSmith’s dramatic narrative about the effects of climate change on hydrology, wildfire, geomorphology is frequency-centric, as it should be, and as illustrated by these quotes from his writing: climate change can cause “**higher frequencies** of stand replacing wildfires, which could **increase the potential** for flash flooding...**higher rates** of natural stand mortality related to insect attack and disease...**higher frequencies** of terrain instability and surface erosion because of higher rainfall intensities and/or **higher wildfire frequencies**...these changes **could increase risks** to the study watersheds with respects to flooding, stream dewatering, and/or sedimentation...**An increased frequency and/or persistence** of drought could increase water supply constraints. Increase rates of sedimentation could impact the quality of the water supply.” Unfortunately, the same could not be said about the narrative WaterSmith used when it comes to the effects of forest cover disturbances on hydrology or geomorphology. WaterSmith’s narrative in the case of forest development effects is definitely magnitude-centric as never once he sated that a forest disturbance make the peak flows, low flows, or landslides more frequent.

Areas Where We Differ

Of course, there is much more to a watershed risk assessment than a single field trip. A watershed risk assessment is about the deeper understanding of the hydrologic functioning of a watershed under various forest conditions, in the background of an intensified climate by global warming.

It is about the framework used to evaluate the risk to hydrology under current and future conditions in the form of peak flows and low flows; and this is where WaterSmith (2025) and I differ and rather fundamentally.

WaterSmith (2025) Watershed Assessment followed a framework detailed in three of his references: (i) Watershed Assessment Procedure (WAP) Guidebook [BC Ministry of Forests, 1999]; (ii) Land Management Handbook 56 [Wise et al., 2004], and (iii) Hydrologic Recovery Curve [Winkler and Boon, 2017]. However, such framework and associated methodologies are non-causal and outdated and have been recognized in the science literature over the last two decades to underestimate the power of forests in mitigating hydrologic risk and, as a consequence, underestimate the effects of forest disturbances (current and future conditions) on such hydrologic risk.

WaterSmith (2025) risk assessment framework has two major draw backs, which in my opinion render such assessment indefensible.

1. WaterSmith methodology is reductionist and magnitude-centric and, hence, non-causal. It operates at the microscale (stand-level), failing to capture the causal power that arises at the macroscale (watershed-level). This methodology is also deterministic and as such not designed to reveal how forest disturbance affects the frequency of extreme events such as peak flows, low-flows, and landslides. Evaluating the potential increase in **the frequency** of extremes (i.e., increase in **the likelihood** to use WaterSmith's own terminology) caused by forest disturbances is fundamental to any evaluation of hydrologic risk (whether partial or full risk).
2. WaterSmith methodology is based to a large extent on the concept of the Equivalent Cut Area (ECA). ECA is a stand-level metric that attempts to quantify the level of disturbance in a given area (a whole watershed or part of it). ECA sums up all forest disturbances in an area while adjusting for hydrologic recovery caused by the regenerated forests in such disturbed area. ECA thresholds are used by WaterSmith to decide on the level of disturbance and associated hydrologic risk. Used in this context, ECA renders any watershed assessment scientifically indefensible for the following reasons:
 - a. Watersheds are holistic systems that manifest emergent responses (e.g., surface runoff in the channels, or groundwater), whereby the response of the whole is, more often than not, greater than the sum of its parts.
 - b. ECA does not account for the spatial organization of the disturbances within the watershed, when in fact a disturbance at higher elevation will have a different effect on hydrology than a disturbance in the lower elevation of the same watershed. A disturbance on a south-exposed slope will have a different effect on hydrology than a disturbance on a north-exposed slope of the same watershed etc. WaterSmith seemed to be aware of this fact, but he still used the ECA to assign hydrologic risk.

- c. The hydrologic recovery curves used to calculate ECA levels are at best misleading, because they account for only the 'recovery' of the above ground snow accumulation and melt while totally ignoring the below ground hydrology, which is dominant in Rose Swanson. The only relevant hydrologic recovery is surface and subsurface runoff which integrate the above and belowground hydrologic mechanisms across the entire watershed.
- d. ECA is also a deterministic construct operating at the smallest scales of a stand. Hence, not designed to tell us anything whatsoever about the hydrologic risk associated with a certain forest disturbance.

WaterSmith (2025) used the following ECA thresholds to decided on the hydrologic risks associated with forest disturbances: ECA < 20% hydrologic risk is very low; 20% < ECA < 30% hydrologic risk is low; 30% < ECA < 40% hydrologic risk is moderate; 40% < ECA < 50% hydrologic risk is high, and ECA > 50% hydrologic risk is very high.

WaterSmith (2025) didn't cite any reference from which these ECA thresholds and associated risks originated.

The hydrologic risk is not dictated only by how much we log from a watershed or an area. Check out this recent media release featuring one of our science journal articles where we demonstrate the fact that there is more to hydrologic risk than the percent of a watershed clearcut (ECA):

<https://theconversation.com/clear-cut-logging-is-making-floods-worse-but-its-not-just-about-how-many-trees-are-cut-289955>

My above critiques of WaterSmith (2025) risk assessment framework have recently been recognized by other consultants in BC, who in turn developed and adopted an alternative quantitative defensible risk assessment method as documented in this journal article:

Chernos, Green, & MacDonald (2023). Hydrological Modelling as an Improvement on ECA-Based Methods for Informing Risk-Based Forest Management. Volume 6 (1), Journal of Watershed Science and Management, doi:10.22230/jwsm.2023v6n1a47

WaterSmith (2025) acknowledged repeatedly how the likelihood of an extreme peak flow or low flow event occurring under current or future disturbed conditions is central to evaluating the hydrologic risk to downstream values whether in partial or full risk assessment.

WaterSmith (2025) assessed the risk to hydrology by parachuting ECA levels and their associated risk without citing a reference. I consider those qualitative risk values as subjective and are unlikely to be representative of the true risk to hydrology under current or future conditions. My work and that of others published in top journals over the last three decades taught me that the hydrology can be supersensitive when evaluated using the causal probabilistic-holistic framework, as opposed to the non-causal, outdated and ECA-based deterministic-reductionist framework adopted by WaterSmith (2025).

As a professional specialized in the hydrology of extremes such as floods and droughts, I can safely say that the likelihood of an extreme event occurring and how forest disturbance may affect such likelihood are not something that could be reliably guessed. I invite WaterSmith to read the following recent articles to appreciate how the natural and anthropogenic controls of extremes can be highly not intuitive!

1. Pham, H. C., Alila, Y., & Caldwell, P. V. (2025). Stochastic framework reveals the controls of forest treatment–peakflow causal relations in rain environment. *Journal of Hydrology*, 661, 133704.
2. Rong, W. N., Bishop, K. S., & Alila, Y. (2026). Stochastic Hydrology Reveals the Controls of Forest Harvesting–Peakflow Causal Relations in Snow-Transient Environment. *Advances in Water Resources*, 105432.
3. Kaluarachchi, S., & Alila, Y. (2025). Managing extremes in the Anthropocene: a causal, stochastic physics approach. *Frontiers in Environmental Science*, 13, 1643416.

Conclusion

In summary, but for the points of agreement, the conclusions of WaterSmith and his recommendations to BCTS can not be supported by the watershed risk assessment in the WaterSmith (2025) report.

Dr. Younes Alila, P.Eng.
Professor of Forest Hydrology
Faculty of Forestry
University of British Columbia
Vancouver, BC
V6T1Z4

Phone 604-822-6058

