



Village of Pemberton (pemberton.ca)

Jason Creek (Reid Road) Assessment

Presented by: Dr. Matthias Jakob, P.L.Eng., P.Geo., Lauren Hutchinson, M.Sc., P.Eng.

Client: Squamish-Lillooet Regional District

Date: March 26, 2022



Outline

- Introduction to BGC
- Background
- BGC's scope: review and key conclusions from Cordilleran December 13, 2021 report
- Risk-reduction options
- Recommendations for future work



Dr. Matthias Jakob



Kris Holm



Lauren Hutchinson

BGC Engineering is an applied earth science firm that specializes in geohazard assessment and management.

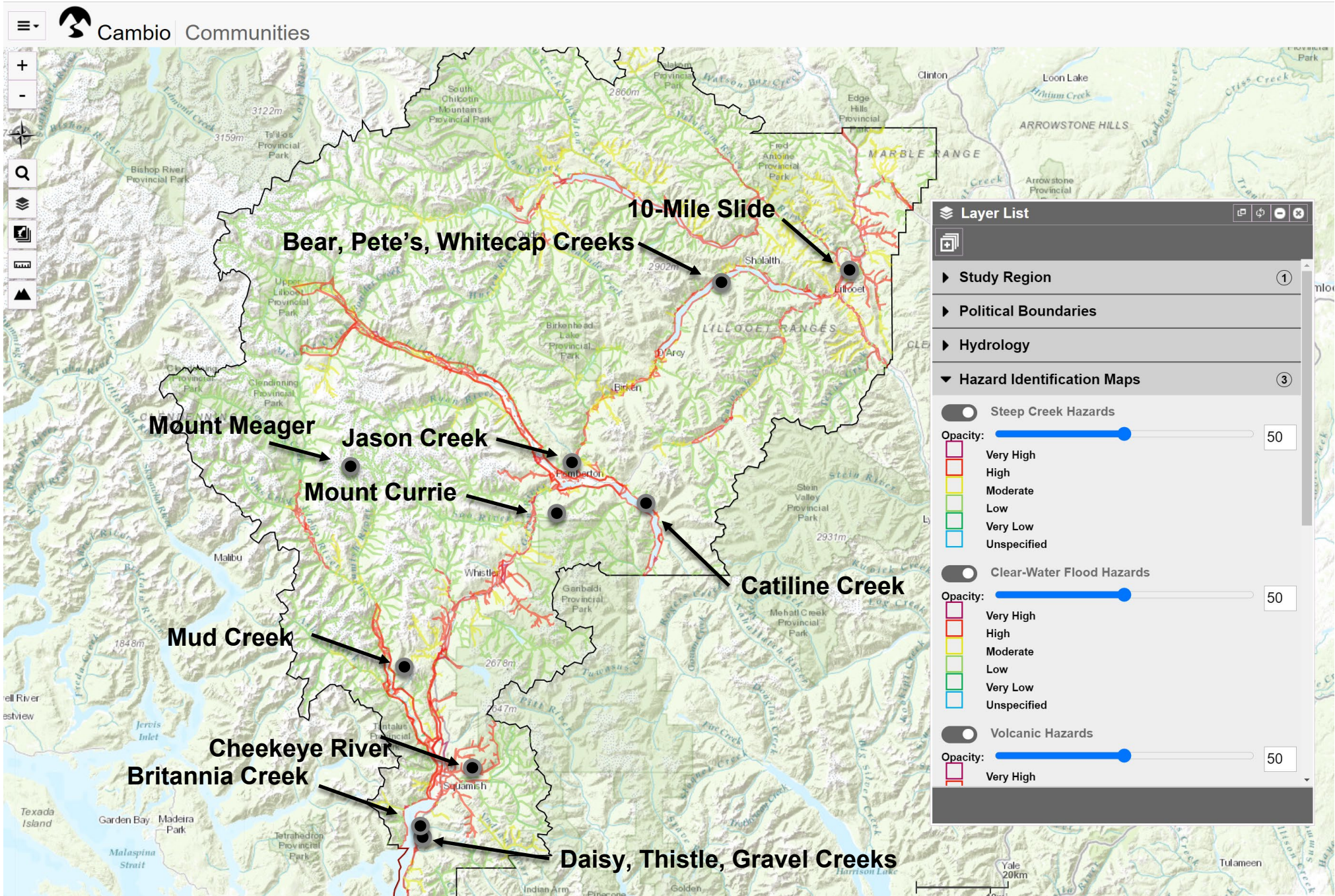


Catiline Creek, SLRD

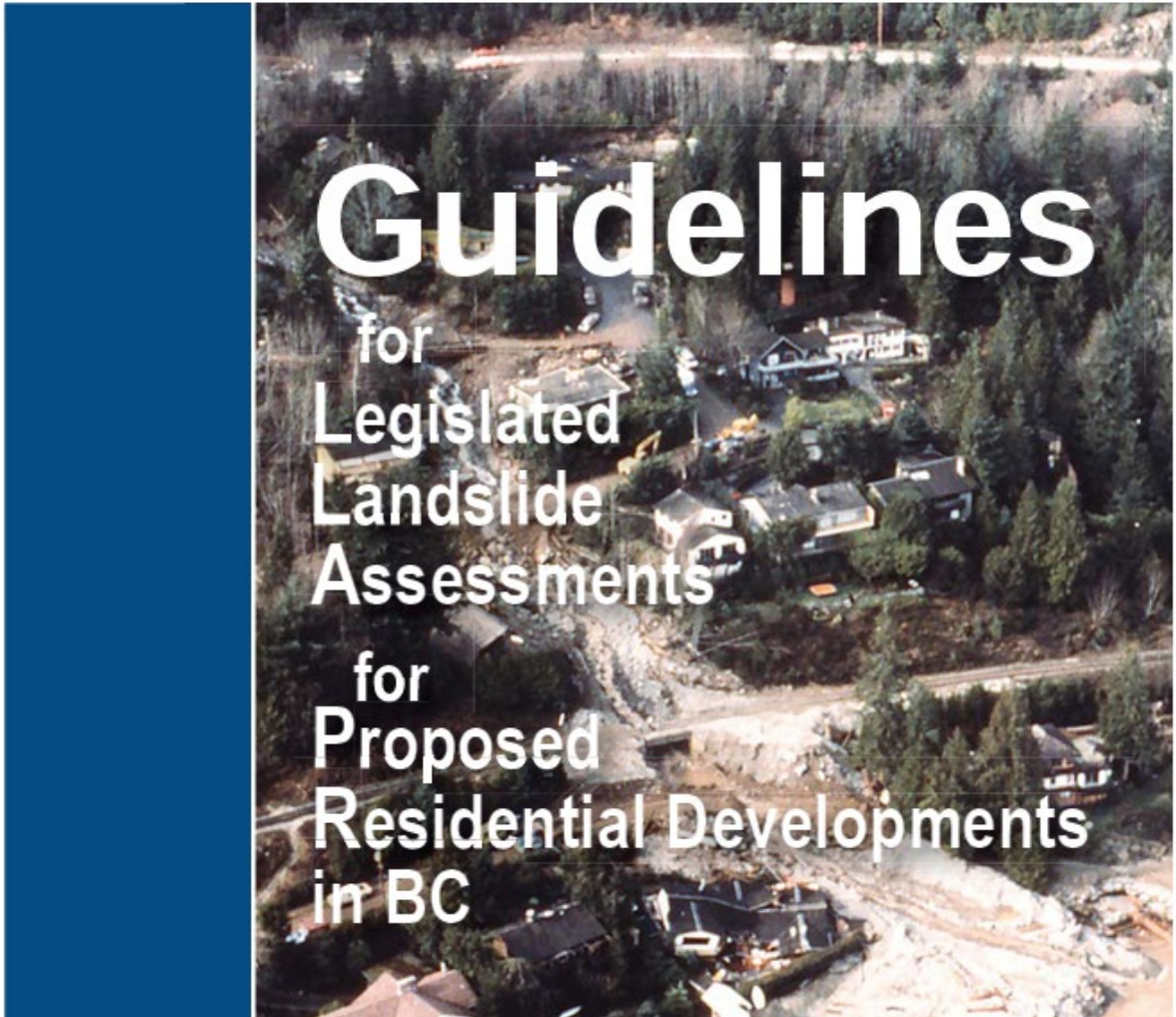
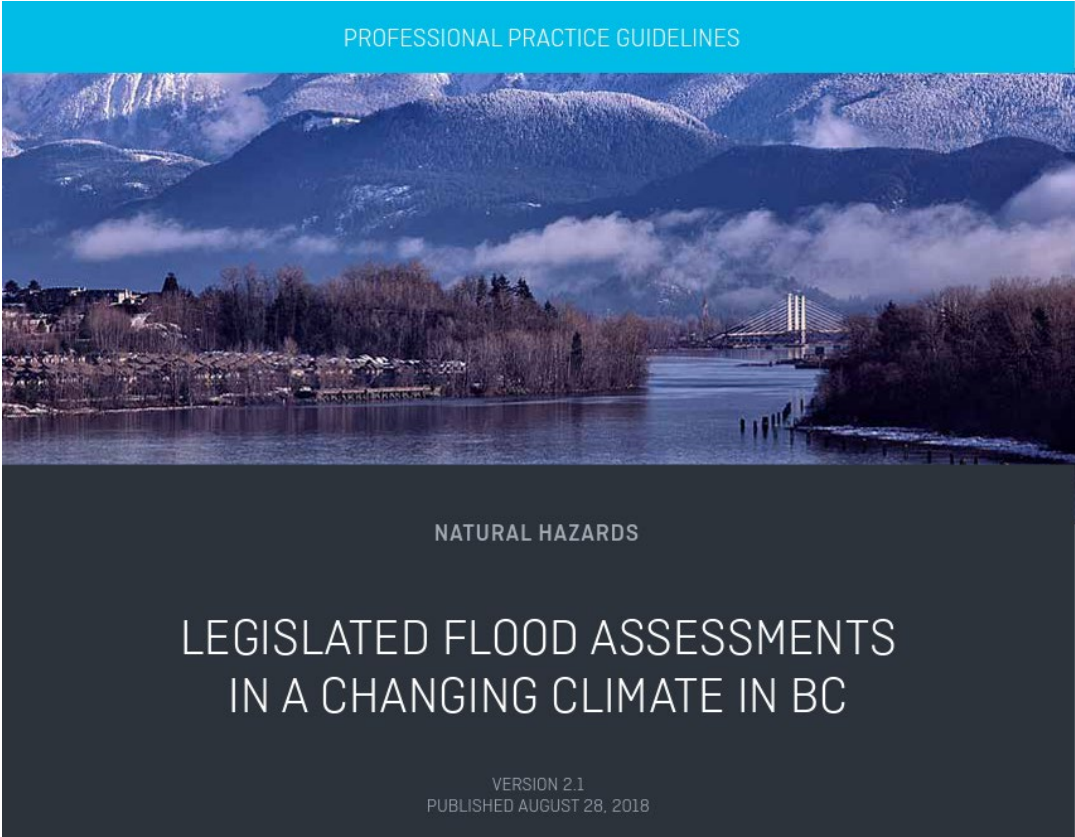
BGC has worked on geohazard assessments within the SLRD and across BC.

2020-2021
Geohazard Risk Prioritization:
2058 geohazard areas encompassing 1615 km²

2021-2022
Geohazard Risk Prioritization Update
Updated hazard and asset inventory
Prioritization of post-wildfire geohazards.

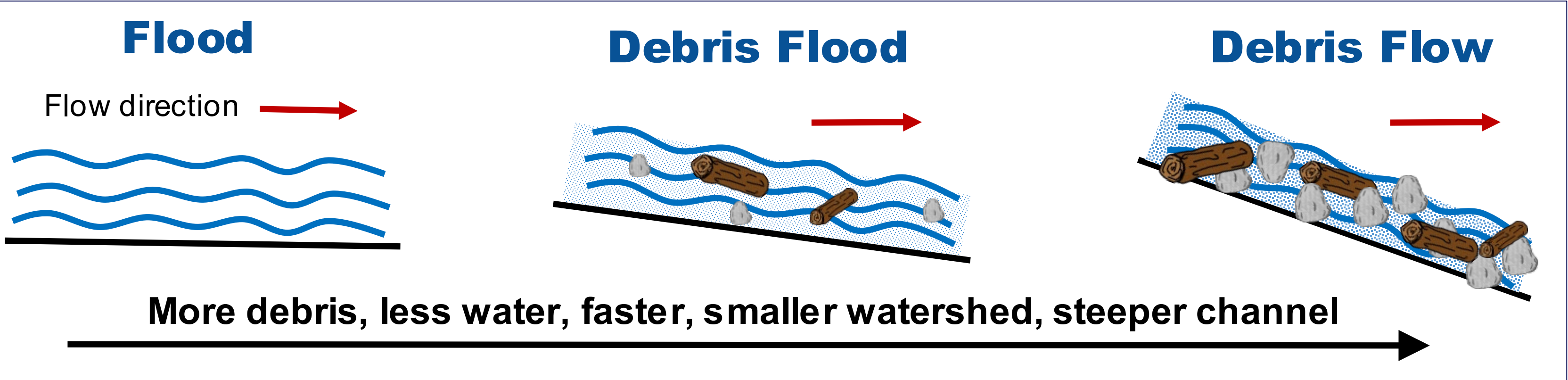


BGC is bringing perspective from our work on standards of practice in steep creek hazard processes and assessment.

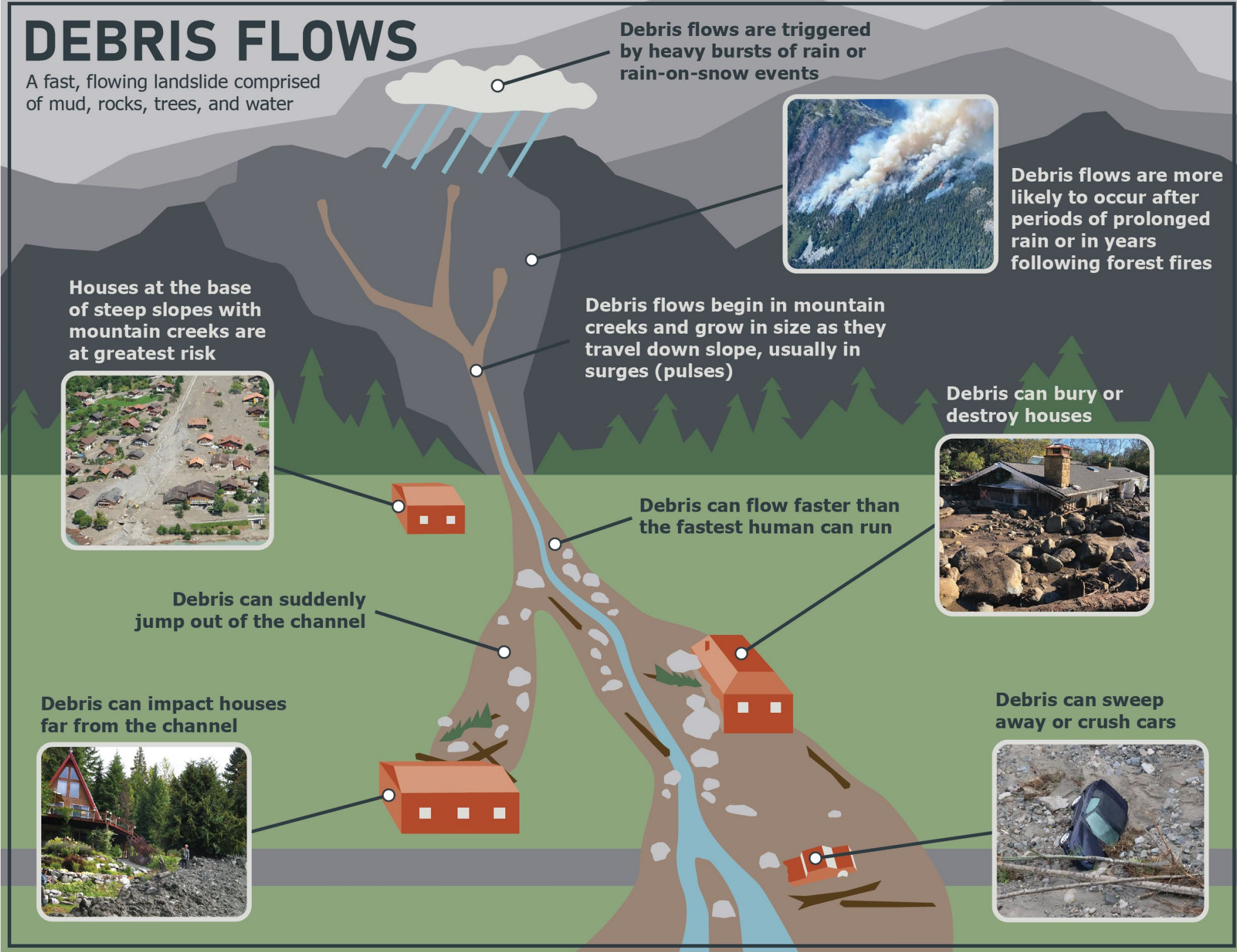


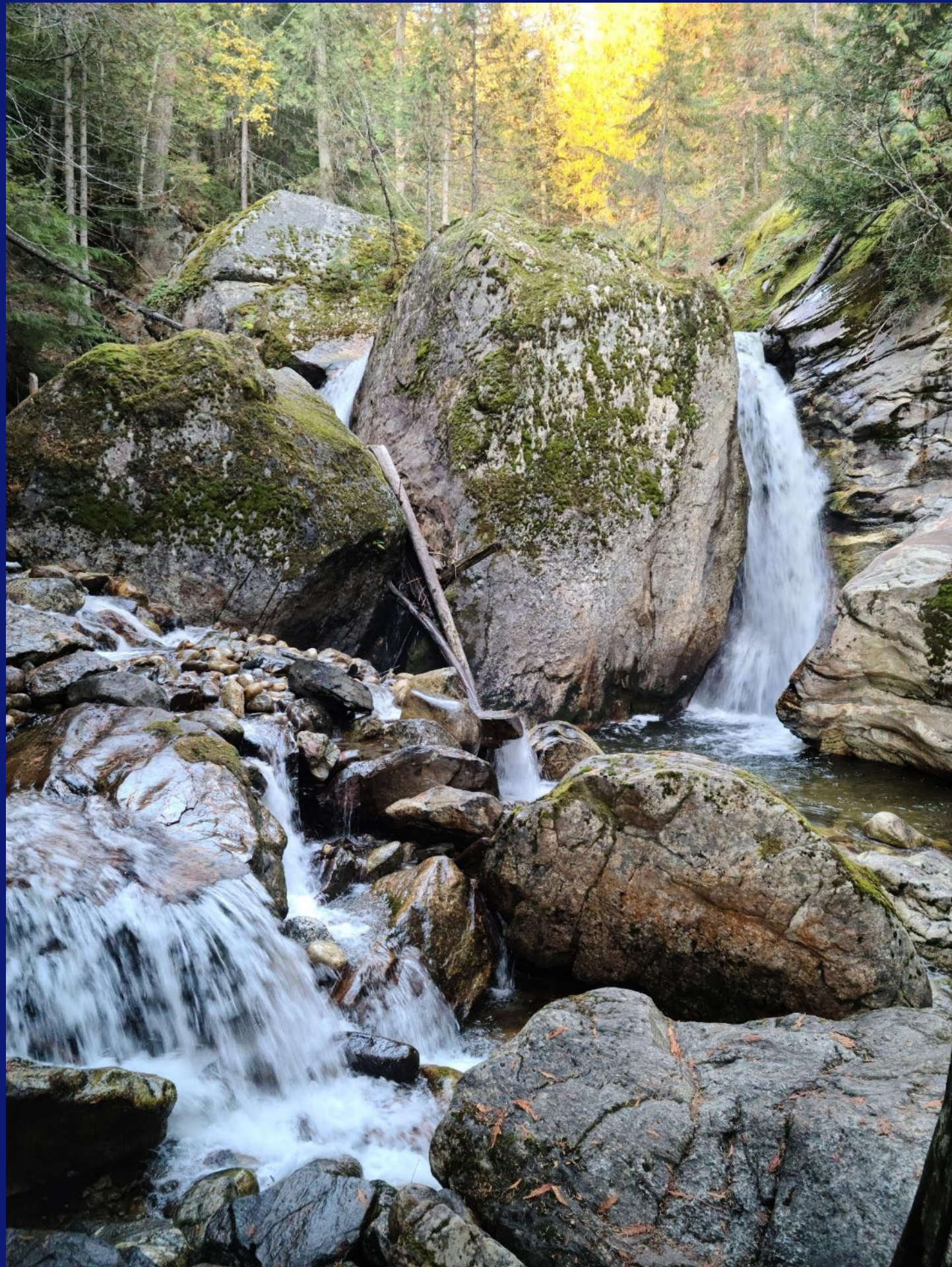
Updated version to appear in spring 2022

Steep creek hazards include a range of processes that involve water and debris.



Debris flows are fast, flowing landslides comprised of mud, rocks, trees, and water.



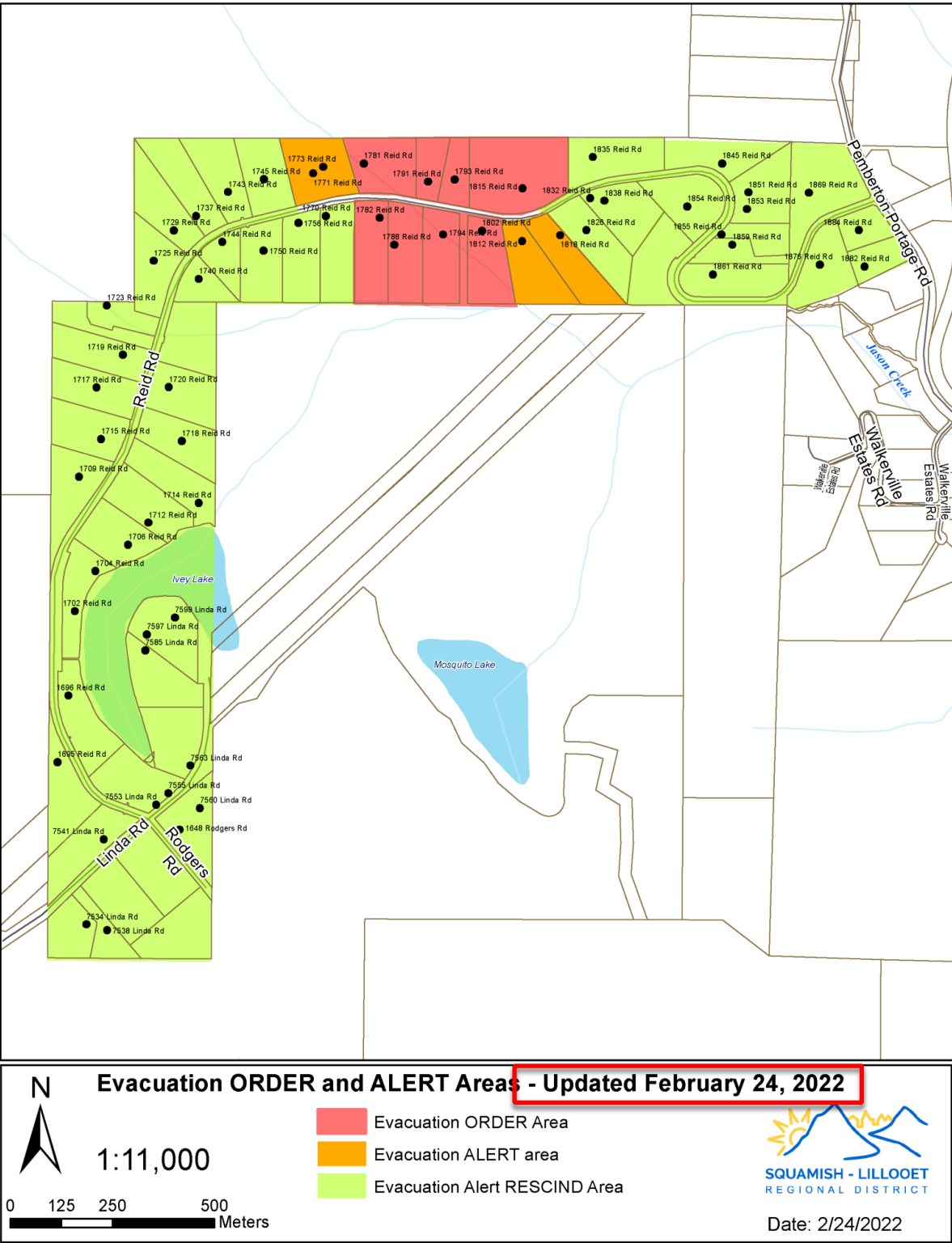
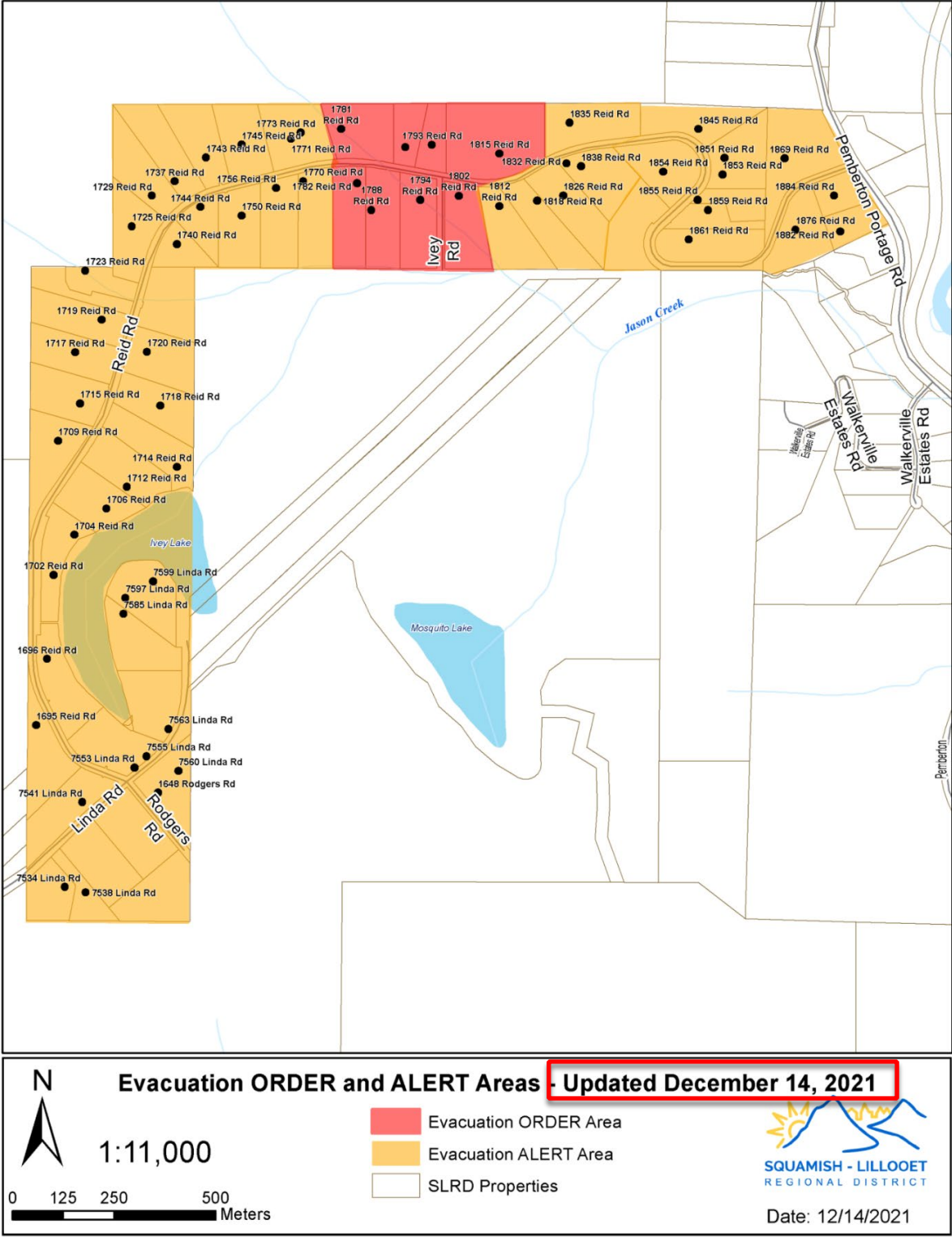


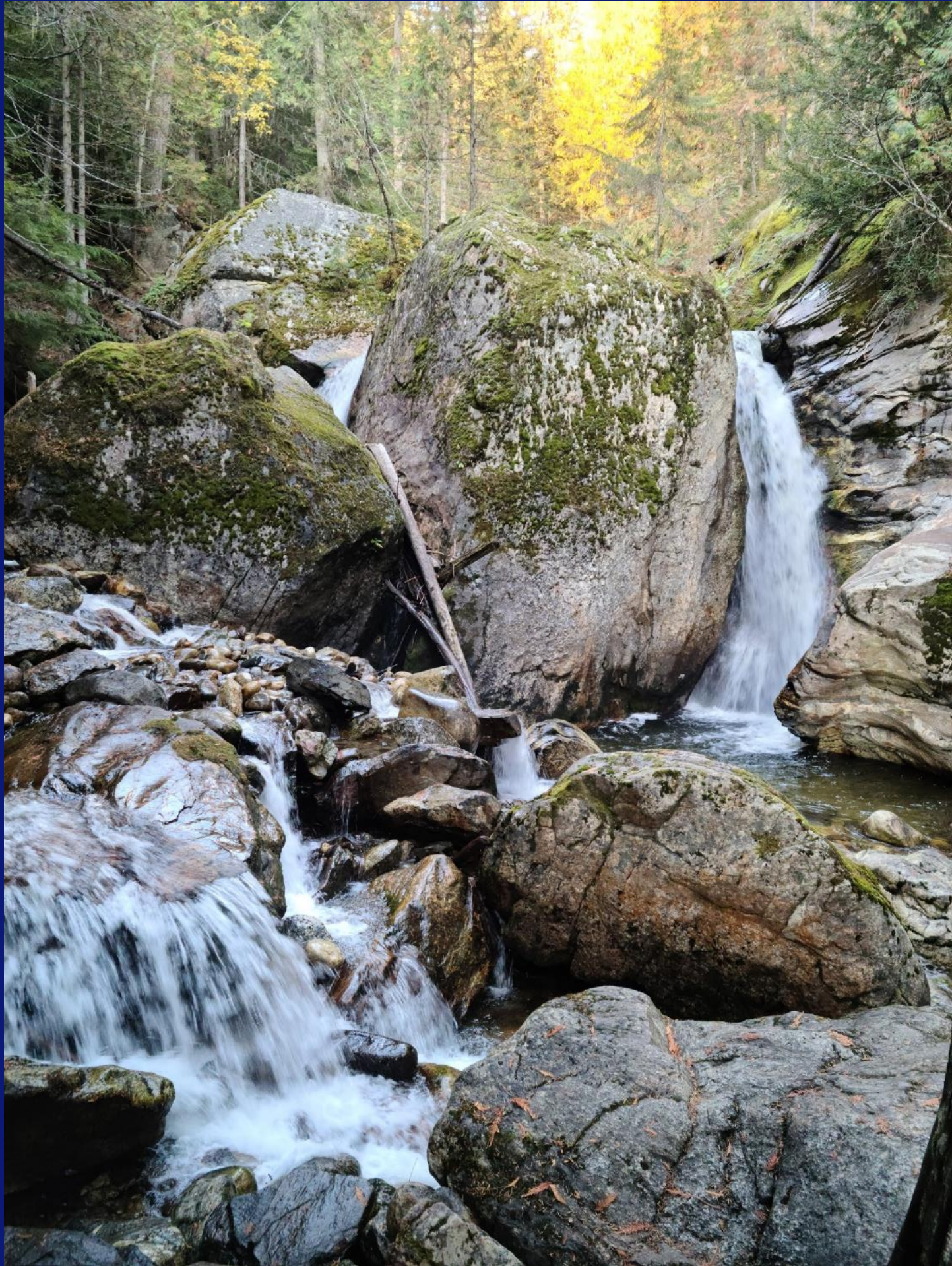
BACKGROUND

In late 2021, Jason Creek experienced events leading to evacuation orders and alerts for properties on Reid Road.



The current evacuation orders affect 8 properties with an additional 3 properties on evacuation alert.





BGC SCOPE

In January 2022, BGC was asked to provide third-party review of the Cordilleran report.

1. Desktop-level peer review of the information contained in the Cordilleran report (December 13, 2021).
2. Initial evaluation of geohazard mitigation options and associated costs at a conceptual level.
3. Presentation on the findings to interested parties.



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V1 December 10, 2021; V2 December 13, 2021

During the recent atmospheric river events (Nov 14-15; Nov 27-29; Nov 30-Dec 1; 2021), Jason Creek, at Ivey Lake, near Pemberton, BC experienced three extreme hydrogeomorphic events and washed out the Jason Creek culvert at Reid Road two times. The events were accompanied by overland flow flooding of several properties, localised bank erosion, minor damage to Portage Road, and threatened the CN Rail line.

On November 17-18, 2021, following the first washout at ~2100 hrs, November 15, Frontera Geotechnical conducted a site assessment documenting damages along the Jason Creek alluvial fan. Their report, dated November 23, 2021 provided the following conclusions and recommendations:

- Jason Creek may be vulnerable to debris flow activity, and such an event could force the creek to avulse directing it overland along a former course toward the properties 1781 and 1794 Reid Road.
- Debris jams along the lower reach of the Jason Creek above Reid Road should be cleared to reduce debris flow and avulsion hazard.
- A qualified professional should conduct a field review of upslope terrain to identify the source area and determine if a debris flow hazard exists.
- The SLRD approving officer should conduct a review of all background reports supporting subdivision and building permit applications to determine if development has followed professional advice.
- A hydrogeomorphic assessment should be conducted to ensure the Reid Road culvert is properly sized and to determine if a debris flow catchment structure may be required above Reid Road.

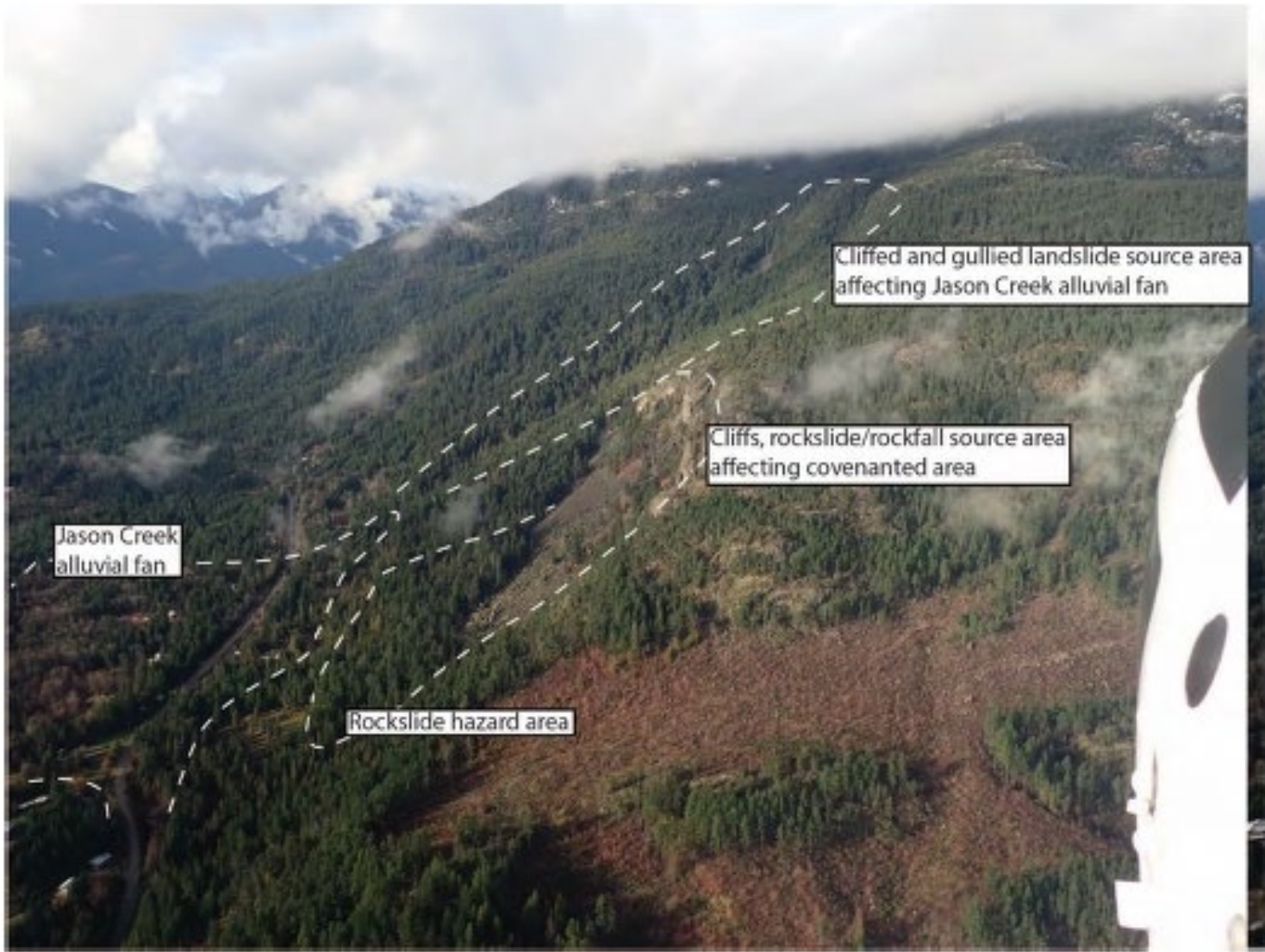
Subsequent to their report, the Reid Road culvert washed out again at ~0430 hrs on December 1, 2021. That morning Cordilleran Geoscience (Friele) was contacted by SLRD and asked to conduct an assessment of the upslope terrain, to determine if a landslide hazard existed and whether the risk merited evacuation alert and/or order. The field assessment was completed that afternoon, and an evacuation order was issued at 1500 hrs for lots 1793, 1794, 1781, 1788, 1791, 1802, 1812 & 1815 Reid Road. That evening at about 2200 hrs the creek washed out the road again, and overland flow affected many lots. On December 2, 2021 Cordilleran conducted a review of the affected areas on the Jason Creek fan, and recommended further channelization above Reid Road. That work was conducted December 3-5, 2021. December 8-9, 2021, Capilano



Key points from BGC's review:

- 1. Cordilleran completed emergency response work.**
The report is thorough, specific, and informed by review of previous assessments and three site visits.
- 2. There is a credible risk of significant harm or life-loss from debris-flow hazards on Jason Creek.**
The magnitude and intensity of the potential hazards can only be hypothesized from the limited available data. BGC agrees that the identified hazards may have sufficient intensity to cause significant harm.
- 3. Debris flows in the study area are seasonal. Rock slope failures are less seasonally controlled.**
Debris-flow activity is historically centered around late summer and fall to early winter. With climate change, patterns of precipitation, temperature (triggering snow melt), and wildfires may change in the future and affect debris-flow likelihood and magnitude.
- 4. Risk reduction is possible at Jason Creek. A detailed multi-hazard and risk assessment is required.**
Detailed assessment of hazards and the risk they pose to the development downstream of Jason Creek watershed is required to develop appropriate long-term risk management solutions. Risk-reduction techniques of these kinds of are intended to reduce (but not fully eliminate) such risks.

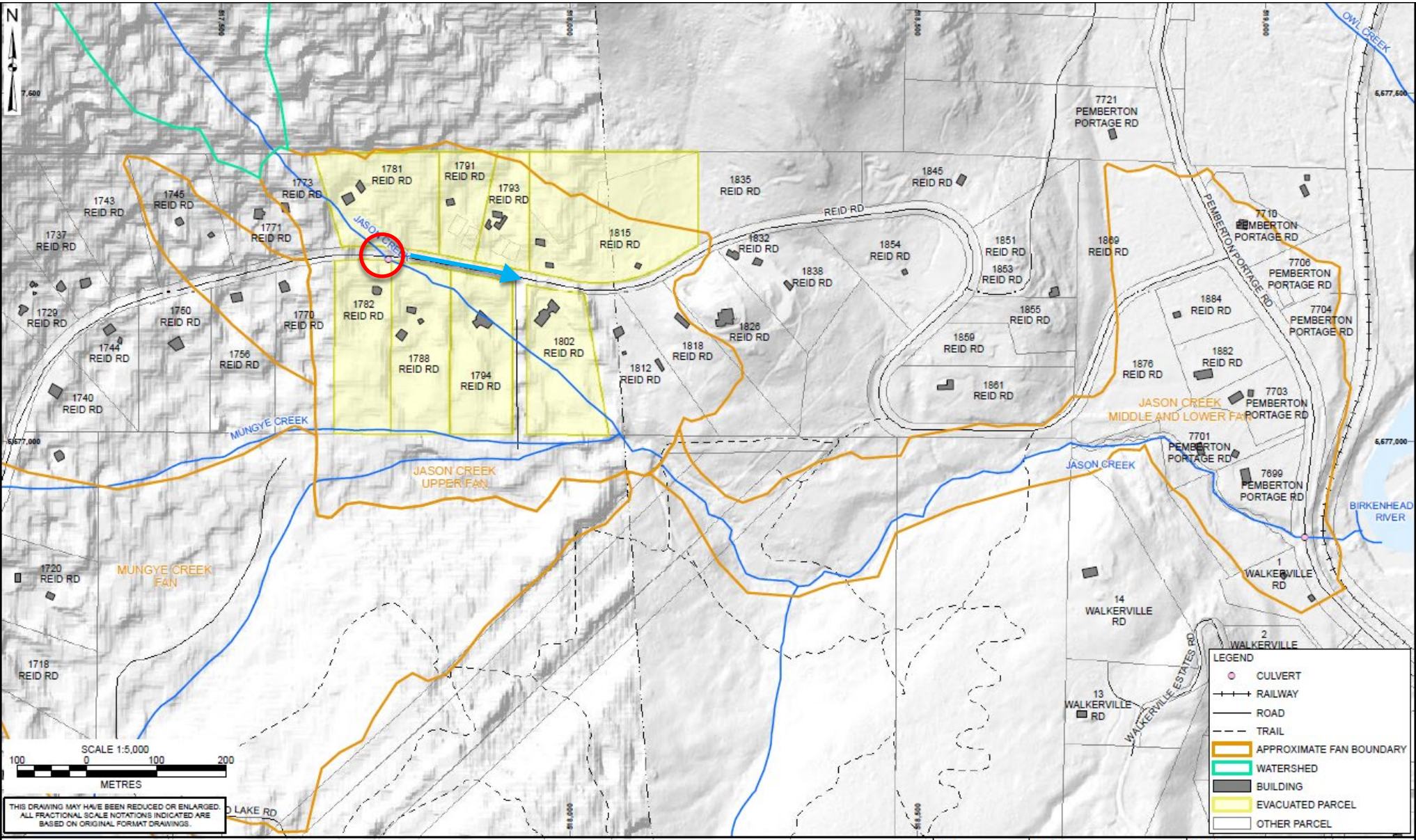
In the Jason Creek watershed, there are steep slopes with evidence of failures (debris-flow source areas).



Cordilleran (December 13, 2021)

Jason Creek watershed is subject to a range of hazard types, including rock slope failures and debris flows.
 Additional work is required to assess potential failure volumes, probabilities, and magnitudes.

The alignment of Reid Road increases the likelihood of flow along the road and associated downstream impacts.



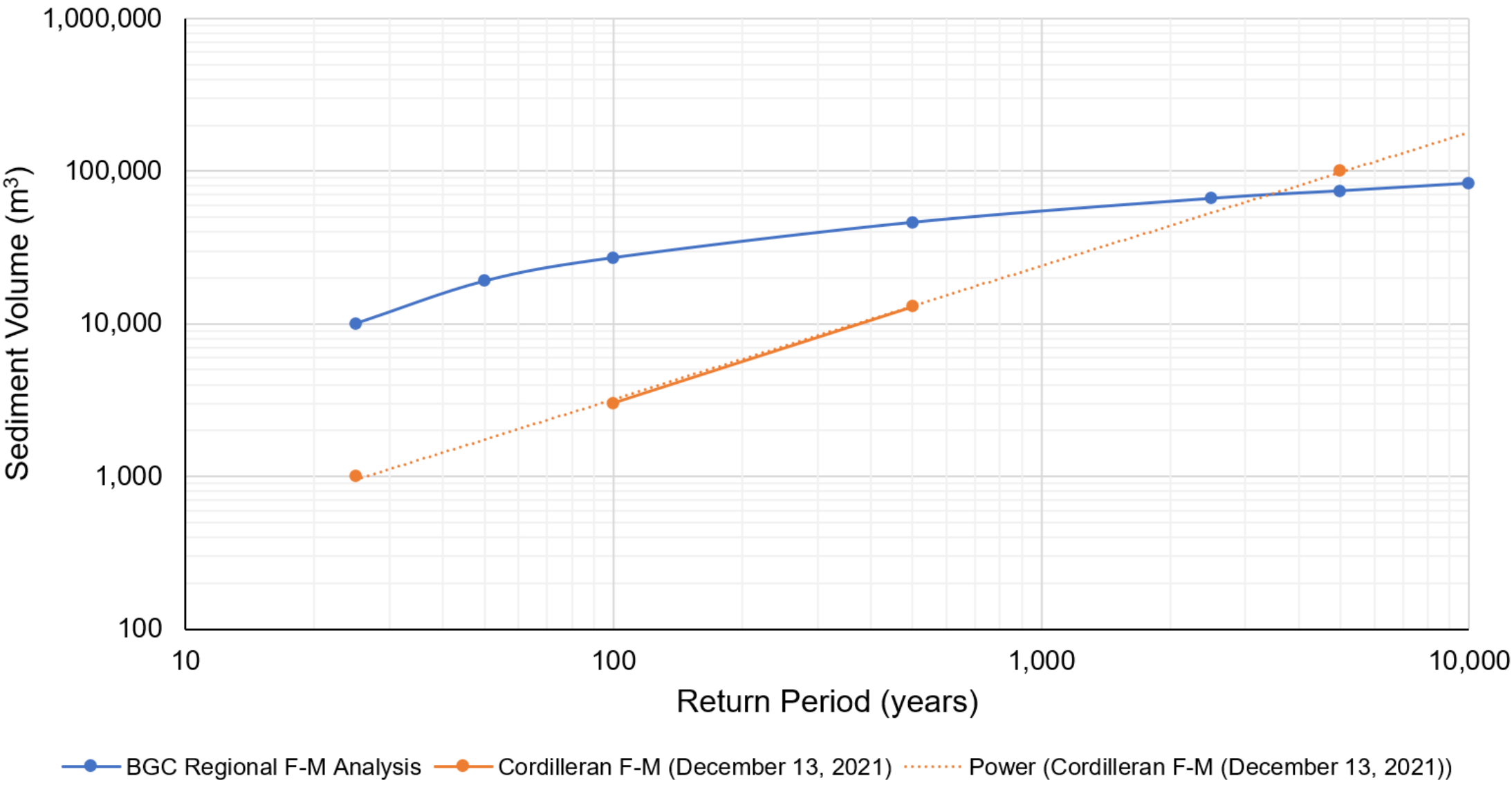
Reid Road Culvert (December 12, 2021)
Cordilleran (December 13, 2021)

A frequency-magnitude (F-M) relationship provides a basis for hazard and risk assessment.

The F-M relationships developed for Jason Creek are preliminary.

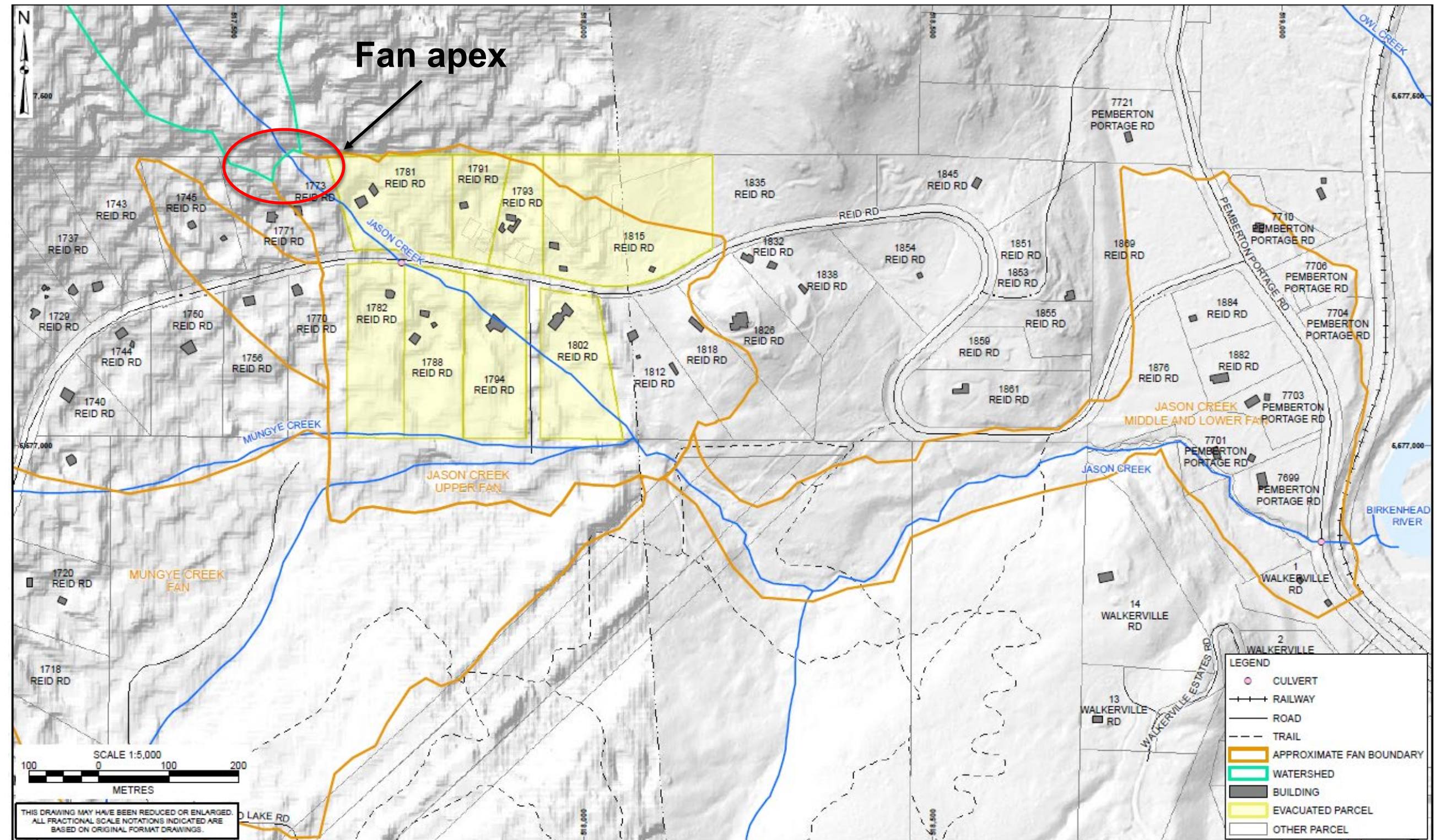
Future work should consider:

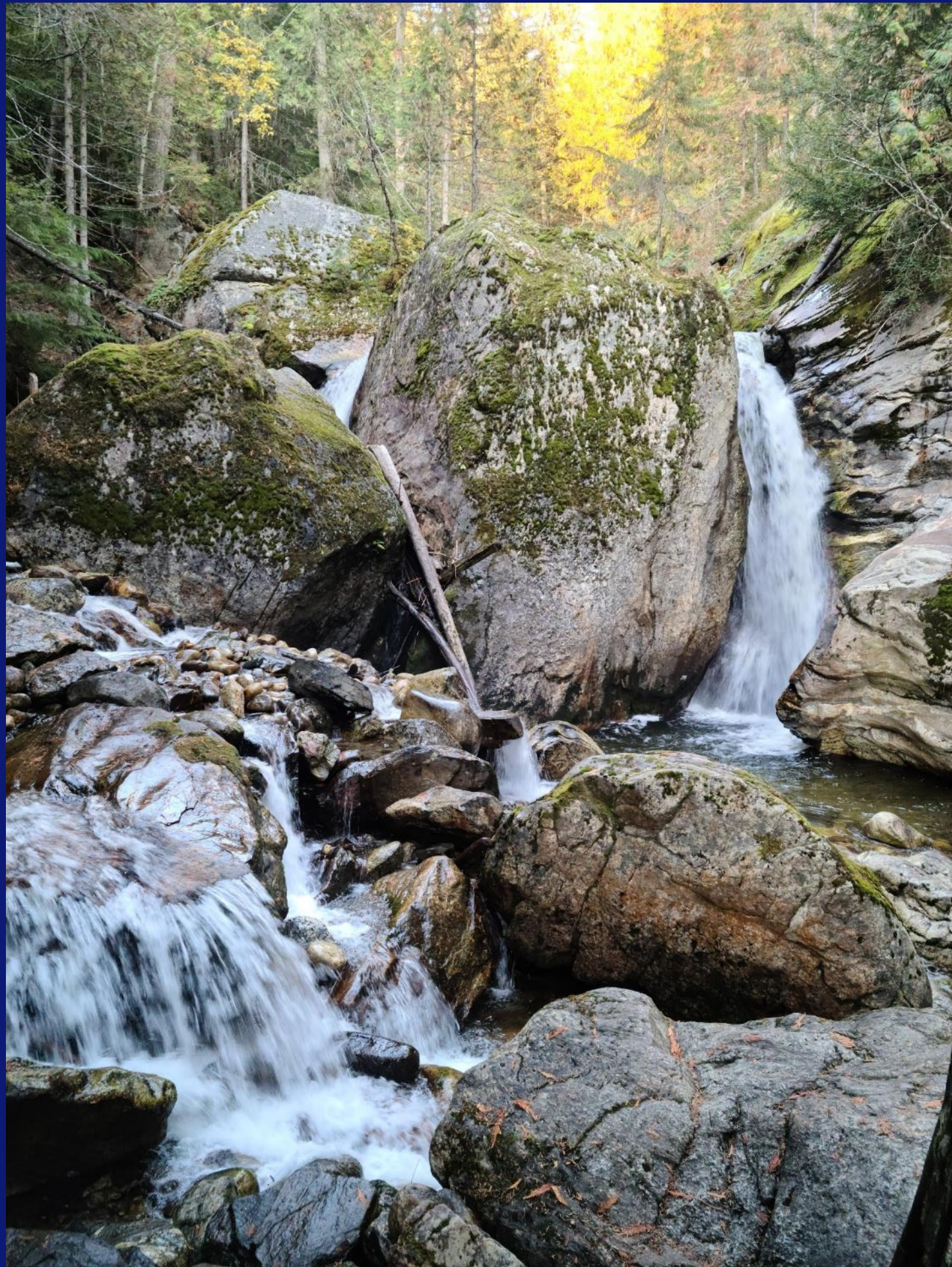
- Different triggering events (rainfall vs. rockslide)
- Climate change
- Post-fire debris flows



Debris-flow life-loss risk is highest near the fan apex and likely decreases with distance from the fan apex.

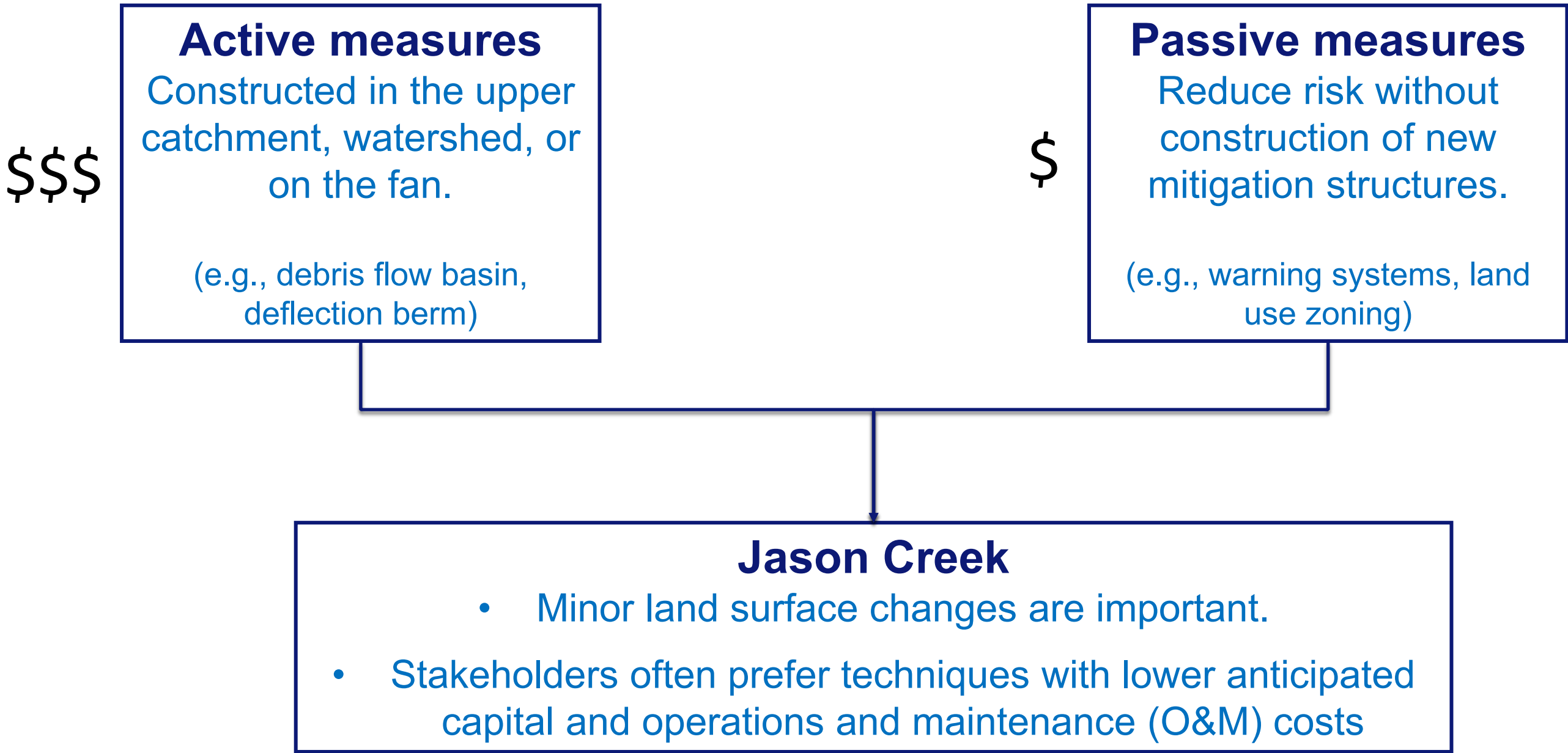
Extent of reduction in debris-flow risk with distance from the fan apex can only be hypothesized at this stage.



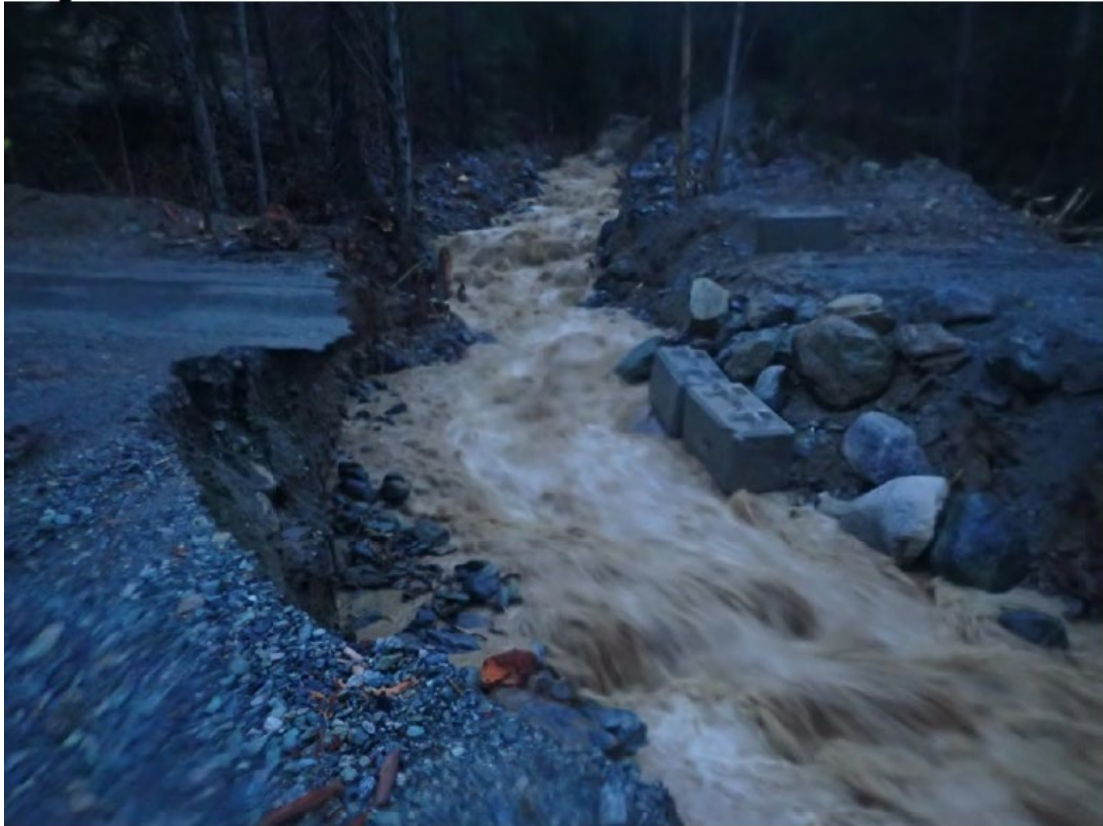
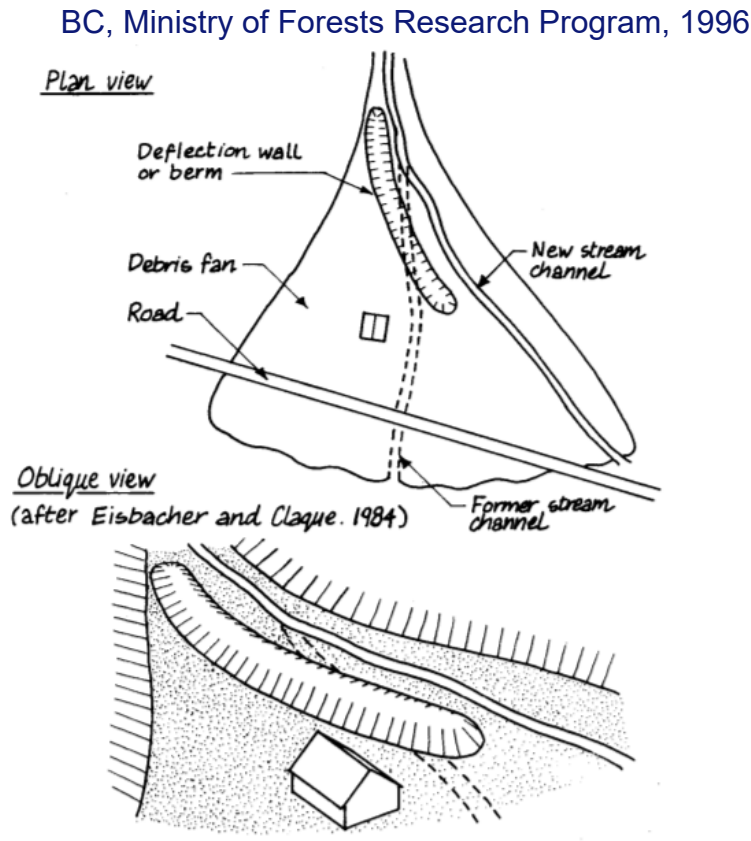
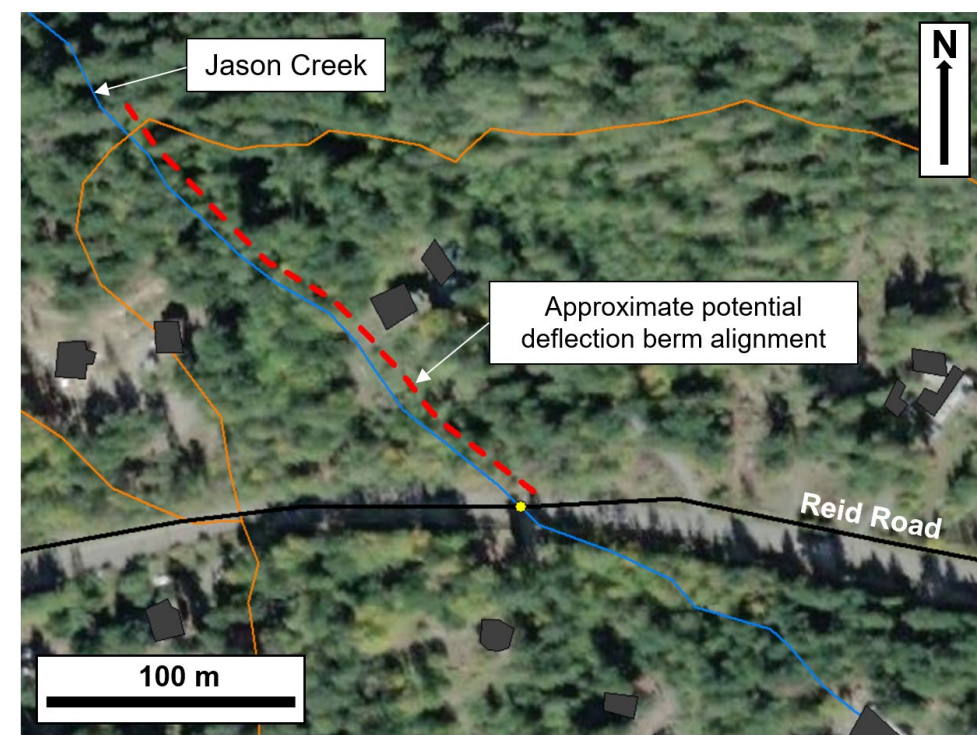


RISK REDUCTION OPTIONS

BGC considered a range of potential risk-reduction options on Jason Creek, including active and passive measures.



Potential risk-reduction system includes a deflection berm downstream of the fan apex and improvements to the Reid Road crossing.



December 1, 2021 (Cordilleran, 2021)

Deflection berm

Divert flow back into the channel with an erosion-protected earthen berm.

Reid Road crossing

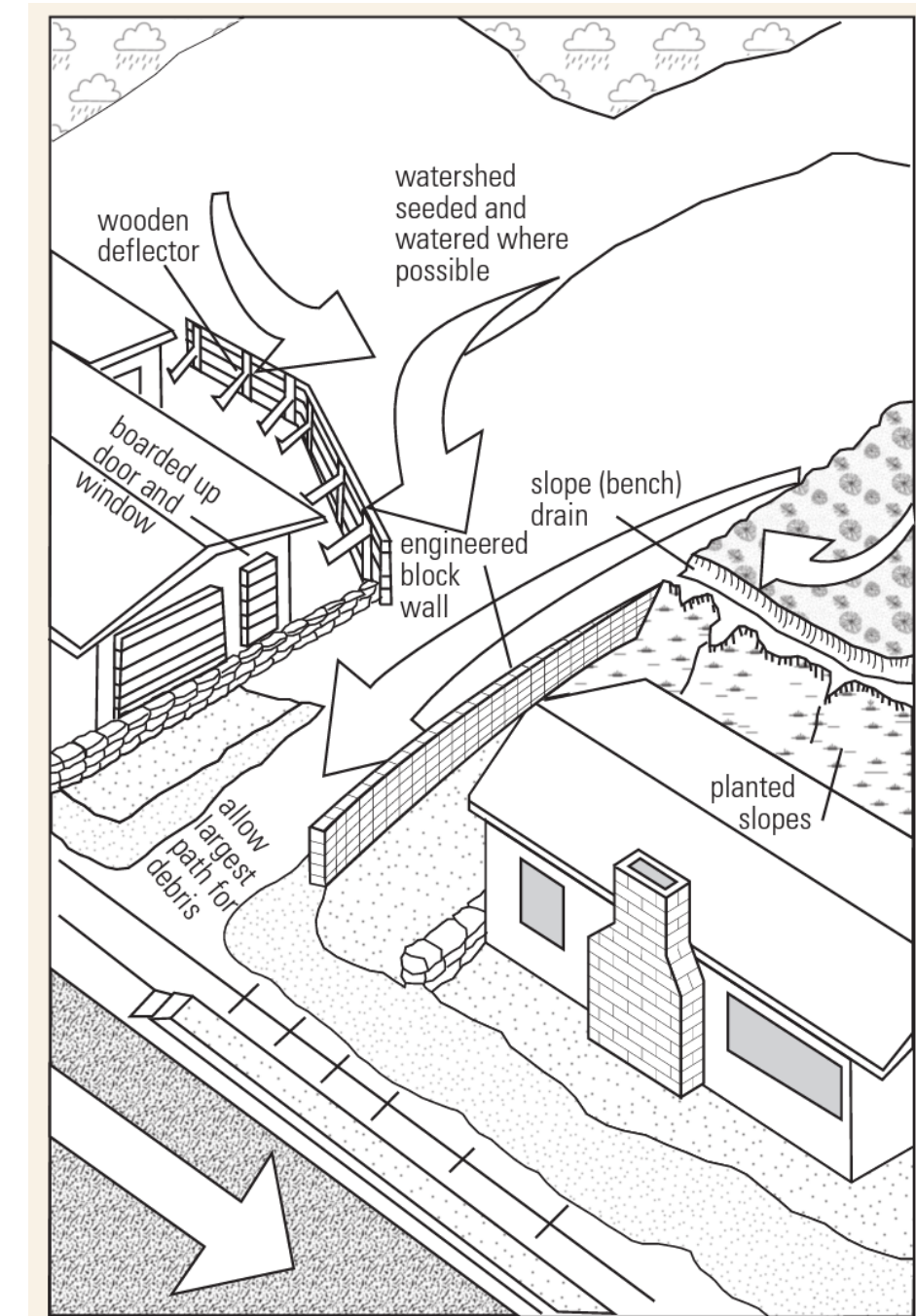
Increase capacity and resilience to debris flows.

(Design input from MoTI required)

Risk reduction on individual properties by homeowners could be considered in concert with improvements to the Reid Road crossing.

Site-specific risk-reduction measures would need to:

- Meet all SLRD and provincial permitting requirements
- Be informed by the detailed hazard and risk assessment to ensure any, and all, measures are sufficiently designed
- Ensure risk is not transferred to adjacent areas
- Where appropriate, be designed and stamped by a Qualified Professional
- The sketch on this slide is for illustration purposes only. Consult with a Qualified Professional for specific site requirements.



United States Geological Survey, 2008

Appropriate risk-reduction measures need to account for the likely flow depth and impact forces associated with the hazard at the site.



Small debris flow
(higher likelihood)



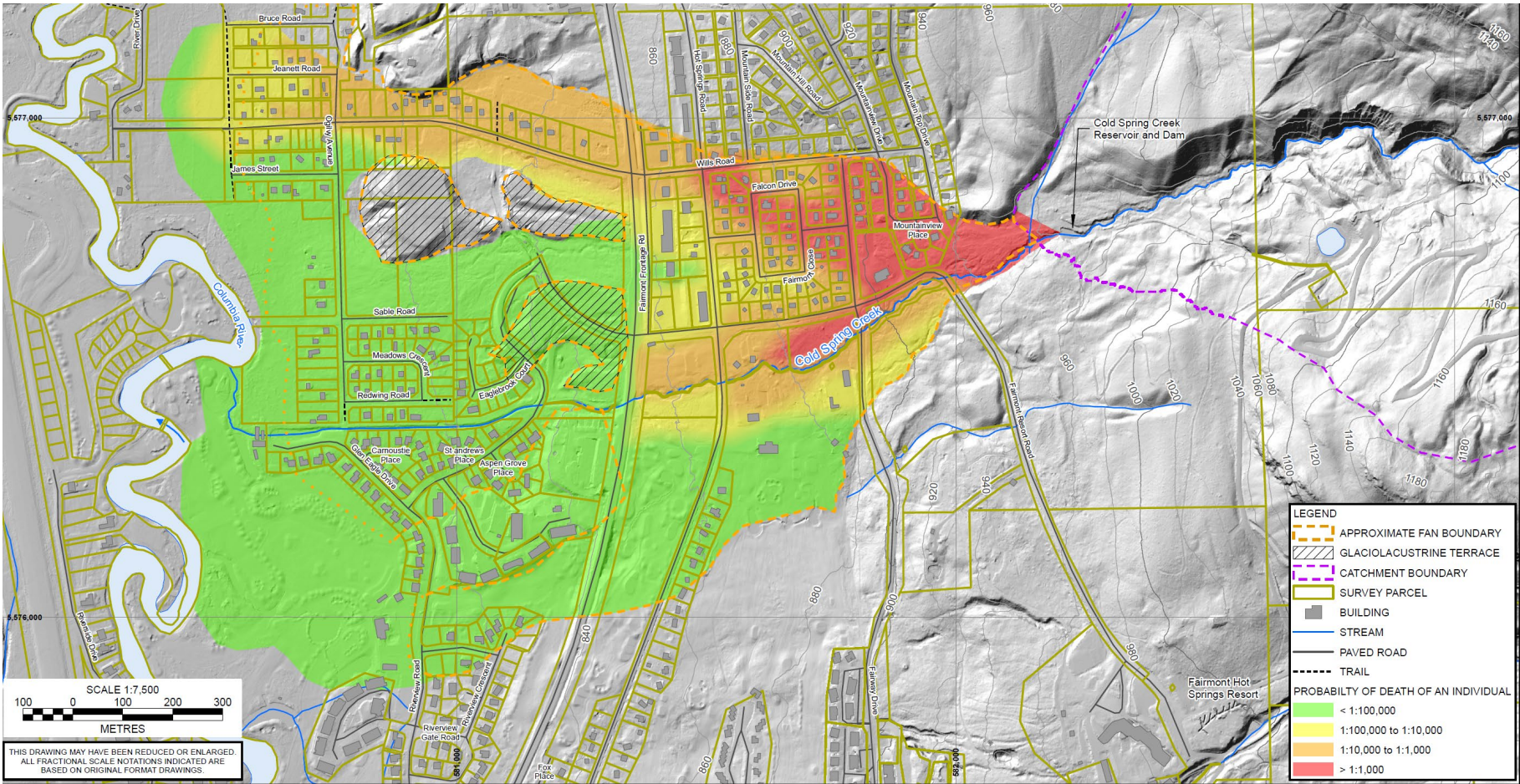
Moderate-size debris flow
(possible)



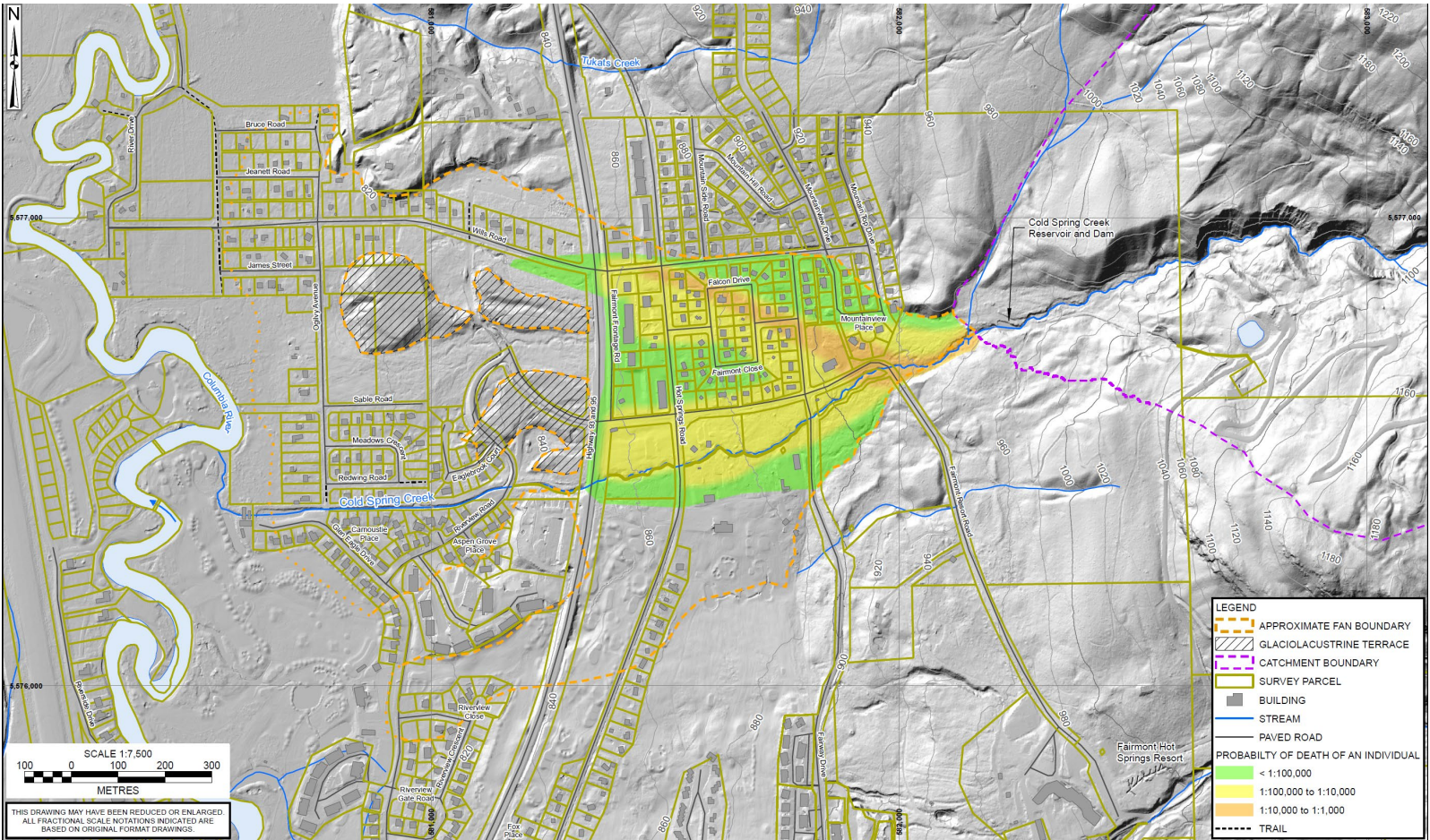
Large-size debris flow
(lower likelihood)

Level of design will differ based on the anticipated impact

Maps showing the hazard and risk help inform the techniques used and locations of risk-reduction measures.

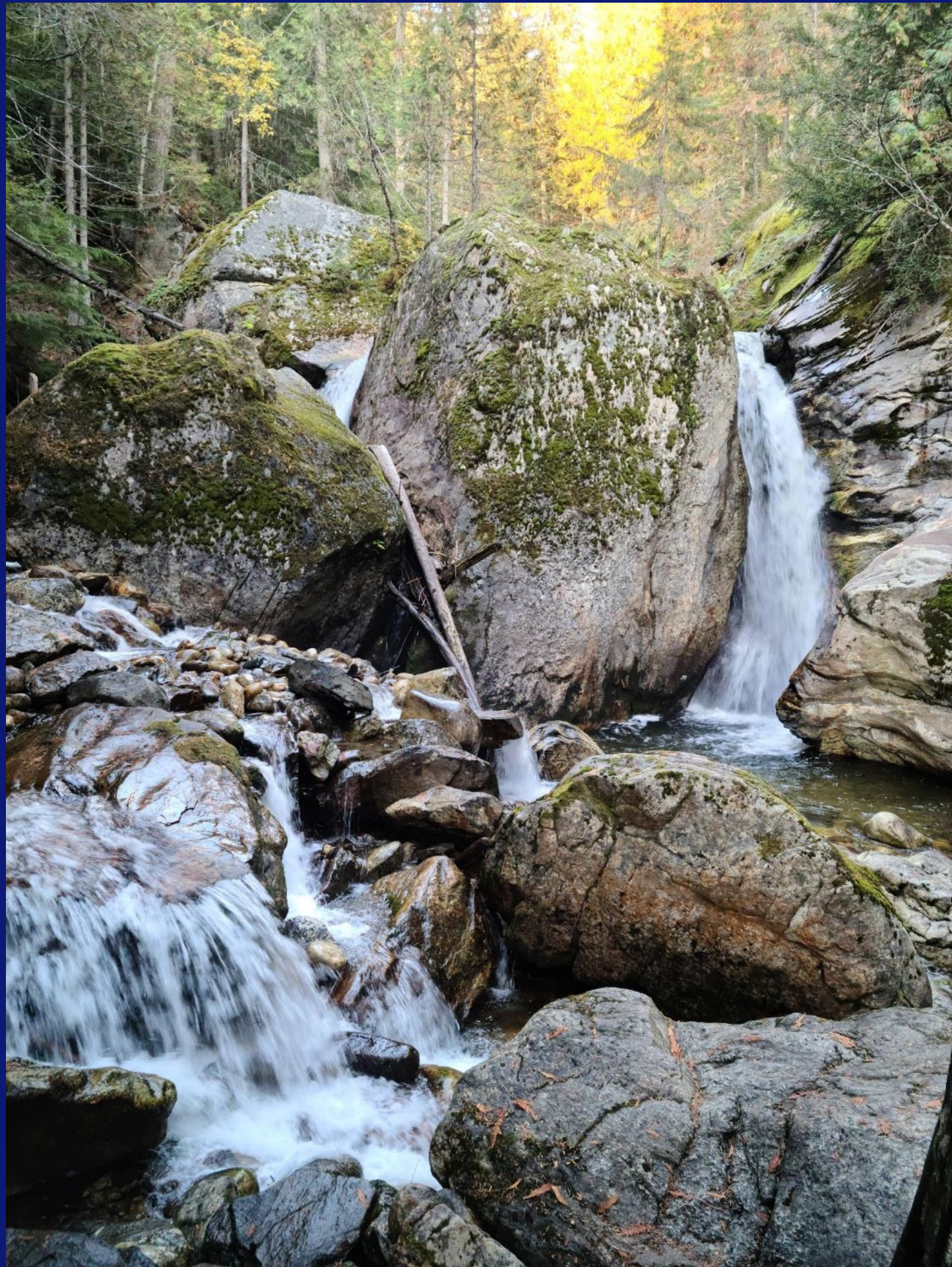


Baseline (unmitigated)



Mitigated

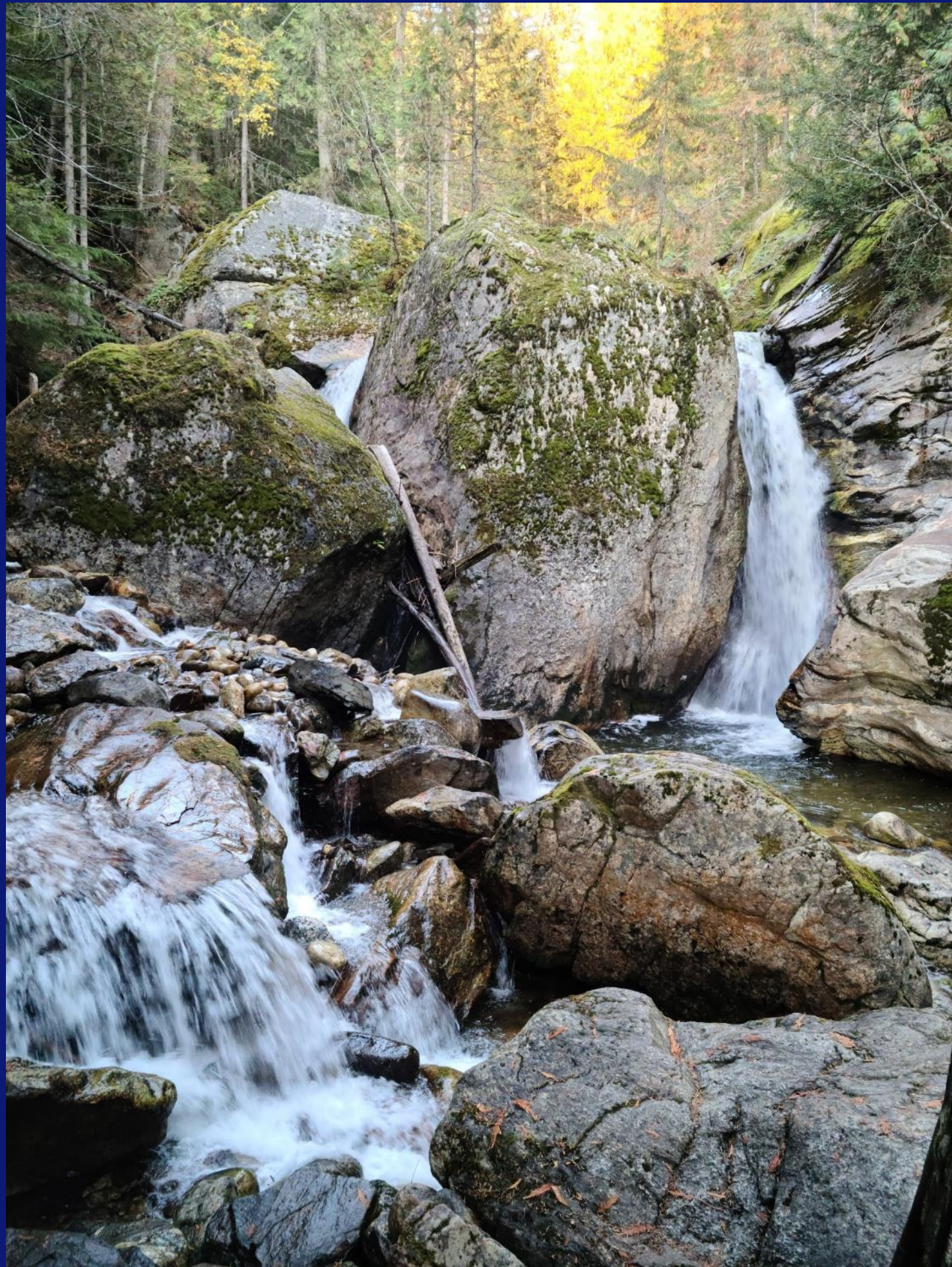
Example from Cold Spring Creek, RDEK
Risk of life-loss to individuals in buildings



RECOMMENDATIONS FOR FUTURE WORK

Recommendations for future work:

Recommendation	Rationale
Acquire detailed topographic data (lidar).	Refine understanding of site conditions. Facilitate numerical modelling and mitigation design.
Review additional, previous geotechnical reports.	Provide additional context for historic decision making and background information.
Complete site visit and detailed field analyses. May be done partially in advance of or in concert with detailed multi-hazard and risk assessment in snow-free conditions.	Address questions about hazard, risk and mitigation that can't be addressed remotely.
Complete a detailed multi-hazard and risk assessment. Detailed hazard assessment of alluvial fan and rock slope hazards from the Jason Creek watershed.	Provide the basis for risk management decisions at a level of detail that meets funding eligibility and professional practice requirements.
Develop risk evaluation criteria. May or may not be formal policy or regulation.	Provide a structured, transparent basis for risk management decisions.
Develop risk-reduction measures. Mitigation options analysis through design and implementation.	Identify preferred measures to reduce risk to people and infrastructure to an acceptable level. NOTE: The risk-reduction techniques would be intended to reduce (but not fully eliminate) certain risks.



CONCLUDING COMMENTS

Concluding comments.

- 1. Cordilleran completed emergency response work.**
The report is thorough, specific, and informed by review of previous assessments and three site visits.
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Closure

This presentation required a number of complex issues to be reduced to general concepts in a series of concise bullet points, photographs and/or diagrams. The content of this presentation is not intended for design decisions or construction. This presentation is for general informational purposes only. BGC's report(s) may contain more specific details concerning the issues identified in this presentation.

Please consult BGC for further clarification if you have any questions or concerns.

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