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HAZARD AND RISK MANAGEMENT POLICY ROADMAP RECOMMENDATIONS
Report prepared by BGC Engineering Inc. and Pinna Sustainability Inc.
Final Version – May 5, 2026

Hazard and Risk Management

Policy Roadmap Recommendations

Prepared by BGC Engineering Inc. for:

City of
NELSON

May 5, 2026

Project 2325003



May 5, 2026

Project 2325003

City of Nelson
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Nelson, BC V1L 5S4

Attention: Valerie Berthier, Planner

Hazard and Risk Management, Policy Roadmap Recommendations - Final Report

Please find the final report attached. We appreciate the opportunity to collaborate with you on this challenging and interesting project.

Should you have any questions, please do not hesitate to contact the undersigned.

Yours sincerely,

BGC Engineering Inc.
per:

A handwritten signature in black ink, appearing to read 'K. Horita', with a stylized flourish at the end.

Kathleen Horita, M.Sc., P.Eng.
Hydrotechnical Engineer

SUMMARY

The City of Nelson (“the City”) is exposed to a range of natural hazards, including flooding from Kootenay Lake and local watercourses, as well as steep-creek hazards such as debris floods and debris flows. Much of the City is already developed, and remaining development opportunities are often located in areas where these hazards may be present. In this context, clear, consistent, and defensible hazard and risk management policies are essential to protect public safety, reduce damage to property and infrastructure, and support informed land-use decision-making.

The City retained BGC Engineering Inc. (BGC) and Pinna Sustainability Inc. (Pinna) to develop a hazard and risk management policy roadmap to guide future land-use planning and permitting decisions in areas susceptible to flood and steep-creek hazards. The study area including critical facilities, lifelines, and buildings is shown in Drawing 01. This report compiles existing hazard mapping (Drawing 02) and technical studies, reviews current policies and practices used in Nelson, examines best practices from other jurisdictions in British Columbia, Western Canada, and internationally, summarizes engagement with City staff, Qualified Professionals (QPs), and other stakeholders, and provides recommendations for strengthening the City’s hazard and risk management framework.

Existing Hazard Mapping

Drawing 02 includes all compiled hazard mapping within the City. At the time of writing, there is existing hazard mapping available for floods, steep creeks, and wildfire. There is no existing hazard mapping specific to the City for drought, extreme heat, and earthquake hazards. BGC conducted a screening-level review of steep-slope hazards within the City municipal boundary. Slope gradients are displayed in Drawing 03.

Hazard and Risk Management Policy Review

BGC and Pinna reviewed risk management frameworks used in Western Canada and internationally. BC and Alberta communities prone to steep-creek hazards use a combination of policy and bylaw tools, most often including Official Community Plans (OCPs) (enacted by an OCP Bylaw), Development Permit Areas (DPAs) (also enacted as part of the OCP Bylaw), floodplain management bylaws, and QP hazard assessments to protect people and property from flood and steep-creek hazards. This layered approach means these communities rely on a combination of land-use planning, site-specific engineering, and community readiness to reduce risk.

The policy review examined two approaches for managing land-use decisions in natural hazards-prone areas:

- Hazard-based Approach:
Decisions (e.g., approvable, not approvable, approvable with conditions) are based on the development type (e.g., repairs, new building, subdivision), hazard type (e.g., floods or debris flows), and the probability of a hazard occurring and reaching a development.

Risk is often considered implicitly by using different hazard probability thresholds and decision frameworks for different hazard types to account for the variation in vulnerability of people and buildings between hazard types (e.g., buildings and people are more vulnerable to impact from a debris flow than a flood), with more damaging hazard types managed with more conservative thresholds.

- **Risk-based Approach:**

Decisions are based on a formally defined risk tolerance criteria (typically for life-safety risk) adopted by the community. Typically, a combined hazard and risk-based approach is used as the risk-based approach only provides tolerance criteria for life-safety risk and does not account for other types of risk (e.g., economic, environmental).

Lessons Learned in Implementation

The following is a summary of lessons learned in implementation of hazard- and risk-based approaches to managing land use in hazard-prone areas that BGC and Pinna have compiled over interviews and through project work.

- Communicate early and consistently with stakeholders during policy development.
- Maintain transparency throughout the policy development process.
- Integrate flexibility, where possible, through careful consideration of wording in consultation with legal counsel.
- Develop a philosophy of shared responsibility between stakeholders and the local government. Empowering homeowners through education and understanding may encourage investment in risk management strategies at the property scale while the local government seeks funding for detailed hazard and risk assessments at the hazard scale.
- Maintain a clear and simple process for updating natural hazard and risk information without requiring a full amendment of the OCPs.
- When adopting a risk tolerance policy, develop a plan in advance on how to communicate the risk and manage how risk tolerance thresholds can be met over time for existing development that may not initially meet the risk tolerance criteria thresholds.

Engagement Summary

Engagement activities included collaboration with City staff, local QPs, and First Nations, as well as outreach to neighbouring jurisdictions and agencies. The feedback received highlighted the strengths in the City's existing approach, including strong local expertise and high-quality baseline data, while also identifying gaps such as limited transparency on when a development permit is required, unclear triggers for QP studies, unclear definition on what is "safe", inconsistent interpretation of exemptions, and limited public-facing hazard information.

There was broad support for integrating hazard mapping more directly into policy to acknowledge the hazards, increase transparency to the public for development permit requirements, clarify when QP reports are needed, and provide consistent guidance on how to manage risk. Concerns were raised on how hazard information is communicated to homeowners, including the potential impacts on insurance and property values. There was

agreement that risk to life safety must be clearly defined by the City, not left to case-by-case professional judgment, and that alignment with established BC precedent on life-safety risk tolerance would improve defensibility and consistency. Participants also identified the importance of addressing creek modifications, private structures, and erosion protection explicitly in policy, improving public-facing communication and mapping tools, and planning for regular updates to hazard information to reflect changing conditions and climate impacts.

Policy Roadmap Recommendations

The recommendations provided herein are intended to protect life safety, reduce damage to property and infrastructure, and improve consistency and transparency in the development permit process. The policy recommendations require a legal review prior to implementation and the hazard mapping and policy should be reviewed by the City and updated with QP support at regular intervals or following a significant change (e.g., topographical change, construction of mitigation).

Establish a Steep-Creek Hazard DPA: A Steep-Creek Hazard DPA would formally integrate existing steep-creek hazard mapping into the City's land-use policy. The purpose of the DPA is to manage life-safety and economic risk associated with steep-creek hazards by providing clear, consistent guidance on where development may occur, when QP assessments are required, and the minimum expected mitigation measures.

The Steep-Creek Hazard DPA would generally discourage new development in areas where there is no detailed study and require a QP report and an assessment of life-safety risk to determine "safe". Similarly, in Moderate to Very High hazard zones, a QP report would be required to determine "safe". Where there is a detailed study, for example on Anderson Creek, the requirements can be lessened in Low and Very Low hazard zone because of the understanding of the hazard (BGC, March 10, 2026). In these areas no QP report would be required, but there are recommended FCL and setback requirements. An interim policy is recommended for the Cottonwood Creek fan and its channel upstream of the fan that does not require a QP report unless an owner/developer is seeking an exemption to the recommended minimum FCL. The minimum FCL aligns with guidance from the Flood Hazard Area Land Use Management Guidelines (Province of BC, 2018) and Engineers and Geoscientists BC (EGBC) professional practice guidelines (EGBC, August 28, 2018). Across all steep-creek hazard areas, BGC and Pinna recommend the DPA includes guidance on FCLs, setbacks, exemptions, and general engineering and construction best practice. Draft policy language is provided in Appendix A and hazard area mapping on Drawing 04.

Update the Flood Hazard Area and Riparian Area DPAs: The existing Flood Hazard DPA will need to be updated as Anderson, Ward, Smelter, Isaac Brook, Foster, and Cottonwood Creek will be transferred to the Steep-Creek Hazard DPA. BGC and Pinna have provided suggestions to improve the clarity of the language in the Flood Hazard DPA for development requirements and exemptions in Section 5.3.

Clarify expectations for QP studies: A Terms of Reference was requested by the City to define the minimum expectations for a QP conducting flood and steep-creek hazard and risk assessments (Appendix B).

Define “safe”: During the engagement sessions, there was general agreement from City staff and QPs that the definition of “safe” in terms of life safety must be clearly defined by the City. BGC recommends the City adopt the risk tolerance policy from the Regional District of Central Kootenay (RDCK), which is currently in development, to maintain alignment between neighbouring jurisdictions.

Improve Public Communication and Understanding of Hazards: BGC developed communication materials intended to educate homeowners and the public on flood and steep-creek hazards within the City, and to provide actionable information to reduce their exposure and vulnerability to these hazards at the parcel-scale. The communications materials are provided as digital files and will be included in Appendix C for the final report.

Address Remaining Knowledge Gaps:

- BGC recommends that the City acquire high-resolution bare-earth lidar that covers the City municipal boundary and the surrounding watersheds. New lidar would improve confidence in topographic interpretation and hazard delineation for future detailed hazard studies. BGC recommends that the City plan to acquire new lidar following a flood or steep-creek event where there is topographical change, and at regular intervals (e.g., 10 years).
- BGC recommends that the City pursue a detailed hazard and risk assessment for the remaining steep-creek fans within the municipal boundary. The studies would assess the potential for life-safety risk and create hazard maps with hazard zones that are consistent with the hazard zones delineated for the Anderson Creek fan, and provide recommendations for mitigation measures needed to allow for development that meets established life-safety risk thresholds in BC and that demonstrate a cost-benefit for economic risk. The highest priority creek for additional study is Cottonwood Creek and its tributaries, followed by Smelter Creek, Ward Creek, Isaac Brook and Foster Creek. The City may want to consider partnering with the RDCK to pursue the studies where the hazard area is within both the RDCK and the City boundary.
- BGC understands that the technical study informing DPA 5 flood hazard boundary and FCLs is unknown. The flood impact line (Drawing 02) from detailed modelling completed by BC Hydro in 2013 covers more area than the DPA 5 boundary, and it suggests that the flood hazard area delineated in Schedule E of the OCP around Kootenay Lake may not be sufficient to address Kootenay Lake flood hazards. BGC and Pinna recommend the following:
 - We recommend expanding the DPA 5 hazard boundary around Kootenay Lake (i) to match the flood impact line in Drawing 02, or (ii) redraw the boundary using the most recent lidar data available such that the flood hazard boundary matches the elevation contour of the FCL elevations in Schedule D of the OCP. BGC understands that the RDCK uses the same hazard boundary and FCLs as the

- City. BGC recommends that updating the boundary is pursued as a joint project with the RDCK to maintain consistency.
- Pursue a detailed study to update the FCLs and hazard boundary for Kootenay Lake. Given the size of Kootenay Lake and the numerous stakeholders that may be interested in this study, the City may consider pursuing this study in partnership with the RDCK, local First Nations, BC Hydro, and others.
 - Include the source (e.g., technical study and mapping) for the DPA mapping schedules to provide clarity in how the area was delineated and to show a clear record of mapping updates.
 - The desktop-level steep-slope screening (Section 2.1.3) indicates that a detailed, city-wide steep-slope hazard study is not currently warranted for the City. Unmitigated steep slopes are primarily in undeveloped areas, including municipal parks and along the existing municipal boundary. However, these areas may pose a hazard for new development proposed within these areas. Similarly, should the municipal boundary be expanded, BGC recommends that the City revisit whether steep-slope hazards should be explicitly considered within the development permitting process.
 - BGC did not review the steep slopes outside of the municipal boundary of Nelson. There are slopes with rock outcrops above the City, particularly on the north side of Kootenay Lake, that are sufficiently steep as to warrant further study to evaluate whether they pose a credible hazard to the City.

TABLE OF REVISIONS

Date	Revision	Remarks
May 5, 2026	0	Final Issue

CREDITS AND ACKNOWLEDGEMENTS

BGC and Pinna would like to thank Valerie Berthier and Natalie Andrijancic with the City of Nelson for their support and guidance throughout this project.

This report was developed through the contributions of individuals from BGC and Pinna (Table CA1-1).

Table CA-1-1 Study team. Professional designations are for practice in British Columbia.

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We acknowledge that the project is in Nelson, BC on the traditional territories of the Sinixt, Syilx, and Ktunaxa Nations.

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GLOSSARY

Term	Definition
Alluvial Fan	A fan-shaped landform of sediment deposited by a river where the gradient and/or confinement decrease, leading to decreased sediment transport capacity. This landform is more correctly called a colluvial fan or colluvial cone when formed by debris flows, but, for simplicity, the term alluvial fan is used throughout this document, irrespective of the process type (NRCan, 2025).
Annual Exceedance Probability (AEP)	The estimated probability that an event will occur exceeding a specified magnitude in any year. A flood with a 0.5% AEP has a 1 in 200 chance of being reached or exceeded in any year. AEP is increasingly replacing the term 'return period' to describe flood recurrence intervals (Fell et al., 2005).
Approving Officer	The appropriate person appointed under the <i>Land Title Act</i> (MWLAP, January 1, 2018) who has the authority to review, approve, or refuse subdivision applications within a municipality or regional district.
Avulsion	Formation of a new channel outside of the existing channel boundaries through a cutoff between meander bends, reoccupation of a previously abandoned channel on the floodplain, or incision of a new channel on the floodplain or fan surface (NRCan, 2025).
Bank Erosion	Erosion and removal of material along the banks of a river, resulting in either a shift in the river position or an increase in the river width (NRCan, 2025).
Bylaws	Legal instruments enacted by local governments under provincial legislation such as the LGA or the Community Charter. They are enforceable and binding, and typically regulate specific aspects of land use, construction, and hazard mitigation. ²
Climate Change	A change in global or regional climate patterns, particularly those observed since the mid to late 20th century. These changes are attributed primarily to increased concentrations of atmospheric greenhouse gases, especially carbon dioxide from fossil fuel use.
Consequence	Describes expected impact or outcome resulting from the occurrence of a hazardous event (Fell et al., 2005).
Covenant	A legally binding agreement registered on the title of a property that imposes specific obligations or restrictions on the use, development, or management of the land.
Debris Flow	Debris flows are rapid, channelized flows of saturated debris, including mixtures of sediment, organic debris, and water. They typically initiate in steep channels and deposit on fan landforms. Debris flows can be highly erosive in the initiation and transport reaches. They can impart greater impact forces due to their ability to transport larger boulders at higher velocities than typical of floods or debris floods.

² Examples include: Zoning Bylaws that define permitted land uses, building density, setbacks, and restrictions in hazard-prone areas; Floodplain Management Bylaws that specify development restrictions and construction levels in flood-prone zones; Building Bylaws that govern construction standards and may require hazard assessments by QPs; and Bylaws that regulate development in hazard zones, often tied to OCPs.

Term	Definition
Debris Flood	Floods involving exceptionally high rates of coarse bedload transport in steep. They are highly erosive and can transport large volumes of sediment and organic debris.
Designated Flood	A flood event with a magnitude equal to a flood having a 200-year recurrence interval, used as the basis for hazard mapping and FCL calculations.
Designated Flood Level	Observed or calculated elevation for the Designated Flood, which is used in the calculation of the Flood Construction Level.
Element at risk	The population, building or engineering works, economic activities, public services, utilities, infrastructure, and environmental features in the area potentially affected by the hazard.
Encounter Probability	The probability that a given element at risk will be reached or impacted by a hazardous event of a specified magnitude within a defined time period.
Exposure	Describes what could be impacted by a given hazard scenario, like the number of people, number of buildings, or economic value of businesses. It is derived from maps that overlay the location of assets with the extent of a hazard zone or scenario.
Flood	Inundation of normally dry land outside the natural or artificial banks of a river or lake, caused by excess discharge of clearwater in a watercourse or body of water.
Flood Construction Level (FCL)	The minimum elevation above the high water mark or ground surface required for the underside of a floor system or pad supporting habitable space, business, or storage. An FCL is the Designated Flood Level plus a Freeboard.
Flood Mitigation	Strategies, measures, and practices to reduce flood damages and impacts. It includes structural measures (such as dikes) and non-structural measures (such as floodplain zoning and floodproofing measures).
Floodplain	An area that is susceptible to flooding from a watercourse, lake, or other body of water and for administrative purposes is taken to be that area submerged by the Designated Flood plus freeboard.
Floodplain Map	A map that delineates areas susceptible to flooding; however, flooding may still occur outside of these areas. A floodplain map may include the FCL, a setback, and the design flood or design event.
Floodplain Setback	The minimum required distance from the high water mark of a watercourse, lake, or other body of water to any landfill or structural support required to elevate a floor system or pad above the flood level.
Freeboard	Vertical distance added to the designated flood level to establish the FCL. The freeboard accounts for uncertainties inherent in the estimation of the flood level including uncertainties in storm intensities, river flows, water levels, wave effects, and climate change impacts on these parameters.
Geohazard	Geological processes or conditions which can be a source of risk (Lee & Griffiths, 2024). A geohazard is typically described by the process type, the potential size or intensity of a hazard event, and the probability of that hazard event occurring.

Term	Definition
Group Risk	The probability that multiple lives will be lost during a given event. Group risk helps community and emergency planners better contemplate risk to the neighbourhood or community.
Habitable Area	Any room or space within a building or structure that is or can be used for human occupancy, commercial sales, or storage of goods, possessions or equipment (including furnaces) which would be subject to damage if flooded (Province of BC, 2018).
Hazard	Process with the potential to result in some type of undesirable outcome. Hazards are described in terms of scenarios, which are specific events with particular frequencies and magnitudes.
Hazard Assessment	The process of identifying and characterizing potential hazards that could impact an area, including the type, frequency, magnitude, extents, and intensity.
Hazard Mapping	The identification and spatial delineation of hazards and the spatial visualization of the results of hazard assessment(s) (EGBC, 2025)
High-Water Mark	The visible high watermark of any lake, river, stream, or other body of water, marking the line where vegetation starts to grow and used as a reference for setbacks.
Inactive Alluvial Fan	A fully trenched fan on which fluvial processes are limited to the present channel and its banks and avulsions on the fan surface are considered extremely unlikely (EGBC, 2018).
Individual Risk	The probability of death for an individual who lives or works in a hazard zone. Individual risk enables us to compare the risks we face in hazard zones with those in our daily lives.
Life-Loss Risk	The estimated likelihood of injury or death, often expressed as the annual probability of fatality for an individual, or probable loss of life over a period of time for groups.
Likelihood	A measure or expression of the chance a specific event will occur over a defined time period.
Official Community Plan (OCP)	An Official Community Plan is a high-level policy document adopted by a local government under the Local Government Act of British Columbia. It sets out the long-term vision, objectives, and policies for land use, development, and community growth within a municipality or regional district.
Policy	Guiding principles or strategic directions adopted by governments or organizations. Policies are not enforceable on their own but inform the creation of bylaws and other regulatory tools.
Probability	In the context of hazard assessments, probability is a measure of the chance a specific hazard event will occur over a time period based on the frequency of past events or a subjective degree of belief based on prior knowledge and evidence.
Qualified Professional (QP)	A person registered or licensed under the Engineers and Geoscientists Act, required to certify compliance or provide site-specific assessments.

Term	Definition
Resilience	Describes the ability of a system, person, community, or society to resist, respond, and recover from the consequences of a hazard. Resilience may refer to the technical capacity to withstand and recover, or the social and emotional strength needed to cope with trauma and stress. In a proactive sense, resilience may refer to policy and governance that support long-term adaptation or to community actions that reduce vulnerability, exposure, or hazard.
Return Period	An expression of the probability of occurrence, conveyed as the estimated average time interval between events of a given magnitude or greater. It represents the inverse of the annual exceedance probability, but does not predict the actual time spacing between events.
Risk	The CAN/CSA-ISO 31000 defines risk as the effect of uncertainty on objectives. In the context of this work, uncertainty refers to potential natural hazards and their impacts, while objectives relate to safe land use, occupation, and development within the City of Nelson.
Risk Assessment	A process that evaluates how likely hazards, such as landslides, debris flows, debris floods, or floods, are to occur and what consequences they could have on people, buildings, infrastructure, and the environment. It identifies the hazard present, determines who and what is exposed, assesses how vulnerable those elements are, and characterizes the overall risk by combining likelihood and consequence.
Risk Management	The process of deciding how to reduce, control, or live with the risk identified in a risk assessment. It involves selecting and implementing measures to avoid hazards where possible, minimize exposure through land-use planning, reduce vulnerability with engineering or structural mitigation, and prepare for impacts through monitoring, warning systems, and emergency planning. It is an ongoing cycle that balances safety, cost, feasibility, and community values to keep risks at tolerable levels over time.
Risk Tolerance	Refers to the level of risk that individuals, groups, or the community are willing to accept in a given context.
Safe for the Use Intended	A determination by a qualified professional that the land is considered to pose an acceptable level of risk for its proposed use, as required by Section 86 of the Land Title Act (RSBC 1996) to certify development approvals in areas subject to hazards.
Setback	Withdrawal of a building or siting of a building or landfill from the high water mark or other reference line to maintain a floodway (room for flooding to occur without damaging structures) and to allow for potential land erosion.
Steep-Creek Hazards	Natural hazards that occur on creeks and steep rivers with small watersheds (usually less than 100 km ²), such as debris floods and debris flows.
Vulnerability	Conditional probability of loss (life-loss, economic) when exposed to a hazard intensity. It reflects the sensitivity of the elements at risk to hazard impacts.
Waterbody	Ponds, lakes and reservoirs
Watercourse	Creeks, streams and rivers

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1.0 INTRODUCTION

The City of Nelson (“the City”) is working with BGC Engineering Inc. (BGC) and Pinna Sustainability (Pinna) to develop a risk management framework that will guide land-use planning and permitting decisions for areas exposed to flooding (Kootenay Lake and riverine) and steep-creek (debris flood and debris flow) hazards.

Nelson, BC is a mountain community situated on Kootenay Lake and is subject to multiple natural hazard processes. Drawing 01 shows the existing roads, railways, buildings, and critical facilities within the municipal boundary of Nelson, BC. The City is mostly developed with very little vacant land available for new development, particularly large-scale development within the municipal boundary. The land that is available for large-scale development is mostly located within steep-creek hazard areas that have not been studied yet in detail. This project is intended to identify and provide clear direction on the suite of policy tools that are best suited to enhance community resilience and support consistent land-use decision making in the City with respect to flood and steep-creek hazards. The chosen framework must be tailored for the City and the types of development that are most common and applicable within the municipality.

This report was written under the terms of Contract #2024-P-11 between the City and BGC dated March 12, 2025, and funded by a Union of British Columbia Municipalities (UBCM) grant.

1.1 Scope of Work

BGC and Pinna’s scope of work was outlined in Revision 1 of the Work Plan submitted to the City (BGC, September 24, 2025) and is summarized below.

- Hazard and Risk Management Policy Research: Review of hazard and risk management policy strategies associated with flood and steep-creek hazards in Western Canada and internationally.
- Compilation of Hazard Mapping: Compilation of existing hazard mapping and hazard studies completed for the City on flood, steep creek, wildfire, extreme heat, drought, and earthquake hazards. BGC also conducted a screening-level review of steep-slope hazards within the City’s municipal boundary.
- Facilitation and Engagement Meetings: Inclusive of informing external stakeholders, engaging with First Nations, collaborating with a working group, and presentations to City Council.
- Policy Recommendations and Reporting: This report outlining the results of the policy research, engagement, and hazard mapping, as well as BGC’s and Pinna’s recommendations on policy updates and draft policy language to manage flood and steep-creek risk within the City municipal boundary.
- Communication Materials: Accessible infographics that can be used as informational materials to the public on flood and steep-creek hazards, climate change, and risk management strategies at the landowner scale.

2.0 EXISTING FLOOD AND STEEP-CREEK HAZARD MANAGEMENT POLICY AND PROCEDURES USED IN NELSON, BC

2.1 Existing Hazard Mapping and Technical Studies

BGC compiled the most recent hazard mapping for flood hazards (Kootenay Lake), alluvial fans (steep creeks), and the wildfire interface development permit area (Drawing 02). BGC also completed screening-level steep-slope hazard mapping within the City municipal boundary. BGC is not aware of existing hazard mapping specific to Nelson for drought, extreme heat, and earthquake hazards. The City's climate action plan, Nelson Next, includes projections and planning for drought and extreme temperatures. The following subsections summarize the existing information available for each hazard type.

2.1.1 Flood Hazards

The City uses Development Permit Area (DPA) 5: Flood Hazard Area to regulate development in flood-hazard areas. Flood-hazard areas include all areas within 15 m from the high-water mark of any lake, watercourse, wetland, or where lands have been identified as flood hazard in Schedule D of the Official Community Plan (OCP). DPA 5 therefore also applies to land adjacent to all creeks within the steep-creek hazard zones discussed in Section 2.1.2 and identified in Drawing 02. Applicants applying for a development permit within DPA 5 must engage a Qualified Professional (QP) to provide site-specific recommendations and certify that the land is 'safe for the intended use'. The DPA 5 polygon from Schedule D of the OCP is shown in the data compilation in Drawing 02 for reference.

Schedule D of the OCP, includes Flood Construction Levels (FCLs) defined for Kootenay Lake. There is no reference to the technical study within the OCP that defined these FCLs. BGC knows of only one detailed study on flood hazard in Nelson and it was completed for Kootenay Lake. In 2013, BC Hydro completed detailed hydraulic modelling of Kootenay Lake and BGC received the results of that modelling from the Regional District of Central Kootenay (RDCK) on June 4, 2018 (pers. comm., Tom Dool) to support BGC's report *Kootenay Lake Flood Impact Analysis* (November 10, 2022) for the RDCK. The maximum flood scenario flood impact line from the BC Hydro modelling is included on Drawing 02 for reference. BGC understands that the "maximum flood scenario" elevation is 1.5 m above the peak reservoir levels observed in 2018 which can be considered the "flood of record". The flood impact lines BGC received do not include elevation data that can be translated to a water surface elevation or to inform an FCL. However, the flood impact line includes a larger area than the DPA 5 boundary, which suggests that the use of a 15 m offset from the high-water mark to define the flood hazard area from Kootenay Lake may not be sufficient to address Kootenay Lake flood hazards.

2.1.2 Steep-Creek Hazards

There are two technical studies on steep-creek hazards within Nelson with associated hazard mapping shown in Drawing 02.

Steep Creek Hazards Assessment (BGC, January 3, 2023), mapped steep-creek hazard boundaries for four creeks in the City (Anderson, Cottonwood including Giveout, Smelter, and Ward Creeks) and prioritized the steep-creek fans in the City in terms of potential for life-loss and economic risk. This screening-level study identified the steep-creek hazard boundaries within the City municipal boundary and the immediate surrounding area, and recommended the following:

- Detailed hazard and risk assessment of Anderson Creek which was identified as the highest priority due to its potential for high economic risk.
- Comprehensive study of Cottonwood Creek and its tributaries. Giveout Creek poses a life-safety risk and there is potential for infrastructure damage downstream on Cottonwood Creek.
- Detailed hazard and risk assessment for Smelter Creek prior to further development of the fan.
- Detailed study of Ward Creek that considers the steep-creek hazard and the City stormwater infrastructure capacity.

In May of 2023, the RDCK updated their regional flood and steep-creek assessment and updated their mapping of steep-creek fans throughout the RDCK. Foster Creek fan and Isaac Brook fan were identified during this study and provided as a digital deliverable to RDCK and uploaded to Cambio communities (BGC, May 2, 2023). The study delineated the fan boundaries, conducted a desktop-level screening of the hazard type and fan activity, and assigned a risk rating based on the fan activity and the assets exposed to the hazard. The Foster Creek fan was classified as a debris-flow fan and assigned a moderate risk rating, and the Isaac Brook fan classified as a debris-flow fan and assigned a very low risk rating. Given that the 2023 study was completed at a regional scale, BGC completed a secondary review of the fan boundaries and made updates (Drawing 02, 04).

Anderson/Fell Creek Hazard and Risk Assessment (BGC, March 10, 2026), is a detailed study for the Anderson Creek fan that mapped debris-flood hazards on Anderson/Fell Creek and estimated economic and life-safety risk on the Anderson Creek fan. The study included a climate-change adjustment to the end of century (2071 to 2100) and assumed a moderate emissions scenario (SSP2-4.5³). The study outcomes and recommendations included:

- A composite hazard map with hazard ratings from very low to high hazard. BGC recommended that the composite hazard map and the hazard ratings be used to inform the City's land-use management.
- Estimated potential future land-loss from bank erosion of up to 15 m from each bank on Anderson Creek. BGC recommended that no development or infrastructure be built

³ The SSPs are a set of different developmental pathways we humans may take in the future that influence the amount of greenhouse gases we emit. The scenario selected for a climate change assessment will have an impact on the final input values used in the hazard and risk assessment which will inform future mitigation design. SSP 5-8.5 is the worst-case scenario pathway that assumes we, as a society, will accelerate our fossil fuel consumption and do little in the way of adaptation. SSP 2-4.5 is a "middle-of-the-road" scenario. Recent research has demonstrated that globally we are tracking closest to the SSP 2-4.5 scenario (Hausfather, 2025; Gillet, 2024).

within 15 m of the high-water mark of Anderson Creek without site-specific mitigation in place designed by a QP.

- The life-safety risk, estimated as individual risk (probability of the death of an individual), was calculated to be less than 1 in 10,000 per year for existing development on the Anderson Creek fan and within levels considered tolerable for existing development in other Canadian jurisdictions that have adopted risk tolerance criteria.
- The baseline economic risk including economic losses associated with property and buildings, bridge and culvert damage, and indirect losses⁴ was estimated to be \$26.2 Million expressed in Net Present Value (NPV)⁵ assuming a 50-year service life. BGC developed a conceptual mitigation approach with a favorable return on investment. BGC recommended that additional funding is pursued to optimize the mitigation approach and advance it to preliminary design.

2.1.3 Steep-Slope Hazards

BGC conducted a desktop-level screening of steep slopes within the Nelson municipal boundary using 2 m-resolution lidar data obtained from the LIDARBC Open Data Portal (2017). The objective of this screening was to characterize the geographic distribution of potentially unstable slopes that may pose a life-safety risk to developed parcels within the City municipal boundary and to assess whether further study or policy development is warranted. Drawing 03 is a slope gradient map, as measured from the lidar, within the City municipal boundary. This map is for reference only.

BGC classified areas with slope gradients greater than 20° (>36%) and a vertical relief exceeding 10 m as 'steep slopes'. These criteria align with well-developed policy, including the District of North Vancouver (DNV) steep-slope hazard DPA, to identify areas that require further hazard review by a QP, as slope and relief alone do not indicate instability. Within Nelson, mapped steep slopes are primarily in undeveloped areas, including municipal parks and along the existing municipal boundary. Steep slopes within developed areas were few and typically small in extent. Additional effort would be needed to confirm that the screening-level steep slopes are real and pose a risk. BGC reviewed several in Google™ streetview and found most have typically been mitigated through grading or existing infrastructure (i.e., retaining walls).

Although steep terrain is a contributing factor to slope instability, the results of this screening-level assessment do not indicate a need for a detailed, city-wide steep-slope hazard study at this time because it is not a ubiquitous hazard within the developed areas of the City or where the City is zoned for development. Section 56 of the community charter could be used to invoke a site-specific assessment by a Qualified Professional, supported by engineering judgment,

⁴ Indirect losses account for additional costs from evacuation, employment disruption, administrative costs, etc. As per guidance from Natural Resources Canada and Public Safety Canada (2021), BGC assumed the indirect losses to be a percentage of the calculated direct losses, using 12.5% for residential parcels and 17.5% for commercial and industrial parcels.

⁵ NPV is the value, in dollars, of all cash flows over a set period of time. It provides a means of evaluating and comparing economic losses and capital projects where the losses/costs are spread over time using a single value in today's dollars.

where indicators of instability are observed (e.g., ground cracking, slope ravelling, rockfall, or tree fall) or where the criteria noted above is being met (slope > 20° and vertical relief > 10 m) as part of the development permit process.

Slopes located outside the current municipal boundary were not evaluated as part of this study. These areas should be subject to further assessment if future development or boundary expansion is contemplated.

2.1.4 Wildfire, Drought, Extreme Heat, and Earthquake

The City provided BGC with the existing studies on wildfire, drought, extreme heat, and earthquake.

Wildfire is the only one of these hazards with a detailed study and mitigative actions written into policy. Nelson's **Community Wildfire Resiliency Plan** (CWRP) (B.A Blackwell & Associates, July 2023) outlines 33 recommendations and action items to decrease wildfire risk within the Nelson municipal boundary. BGC understands that the recommendations and the mapping of wildfire behaviour threat class from the CWRP informed the delineation of and requirements for DPA 3 – Wildfire Interface Zone (Drawing 02) within the OCP. Within Nelson Next, and the OCP, it states that there is consideration of expanding DPA 3 to include more buildings and structures within Nelson limits; however, at the time of writing, no further details are outlined on the potential expansion of the DPA area.

At the time of writing, BGC is not aware of any detailed studies or mapping for drought, extreme heat, or earthquake hazards. The City's Nelson Next climate action plan includes climate projections and discussion on both extreme heat and drought. The City's 2019 Hazard, Risk, and Vulnerability Analysis (HRVA) followed the HRVA online toolkit from Emergency Management British Columbia (EMBC) to identify and assess risk, qualitatively, from several natural hazards (Province of BC, 2020). BC also has a **hazards insight tool** that provides regional screening-level polygons of areas potentially exposed to drought (future conditions), extreme heat (current and future conditions), and earthquake. BGC reviewed each of these resources to provide a high-level summary on each of these hazards for the City.

- Drought and Extreme Heat⁶: Drought and extreme heat were assigned a “High Risk” in Nelson Next. The number of extreme heat days, those exceeding 30°C, were estimated to increase from an average of 19.4 days per year to 24 days under RCP 4.5⁷ and 33 days under RCP 8.5 by the 2050s. The City's HRVA (2019) assigned a

⁶ BC has developed the **BC Heat Alert Response System** (BC HARS) that defines the heat alerting thresholds for BC for different regions. In southeast BC, extreme heat is defined as meeting or exceeding a maximum daily temperature of 35°C for two consecutive days with an overnight low temperature meeting or exceeding 18°C. BGC understands that BC HARS is being updated in spring 2026 to include projections that allow prioritization based on the intensity of the hazard.

⁷ RCP stands for Representative Concentration Pathway which are plausible future scenarios of anthropogenic forcing, with RCP 4.5 being an intermediate emission scenario and RCP 8.5 being a high emission scenario. SSPs have replaced RCP in the most recent updated Global Climate Models.

“Moderate/Likely⁸” likelihood and “High⁹” consequence to both drought and extreme heat hazards. The BC hazards insight tool included all of Nelson within the drought hazard zone under future (2041-2070) conditions. The BC hazards insight tool does not include Nelson within the extreme heat hazard zone under baseline (current timeframe) conditions but does under future (year 2050) conditions. The screening-level studies suggest that both drought and extreme heat hazards may pose a threat to the City in the future and should be considered in the City’s future planning and hazard management.

- Earthquake: The 2019 HRVA assigned earthquake a likelihood of “Highly Unlikely¹⁰” and a consequence of “High” and noted that an appropriate mitigation measure would be for the City to have an earthquake emergency response plan. The BC hazards insights tool suggests that there are areas along Kootenay Lake and Highway 6 that may be subject to co-seismic landslide and seismic liquefaction hazards.

The City has included mid- to long-term tactics in their “Nelson Next” climate action plan regarding drought and extreme heat which suggests that climate change and the threat of extreme heat and drought, particularly under climate change, has been acknowledged by the City and there is some long-term planning in place to address these hazards. These tactics included:

- “Develop emergency water supply plans for drinking water and Fire and Rescue Services.”
- “Explore mobile app options for offering residents extreme weather notifications and related guidance”.
- “Develop a “Cool Nelson” program to prevent the risk of heat island effect, with a focus on rooftop interventions that reduce building temperatures and energy needs/costs associated with cooling”.

2.2 Current Land-use Hazard Management Approach

The following section describes BGC and Pinna’s understanding of the process used by the City when an application for development is on land either known to be subject to hazards or where there is a reasonable basis to suspect the land is subject to natural-hazard processes. This section is not comprehensive but is instead a summary intended to confirm BGC and Pinna’s understanding of the process and supporting tools available.

The City currently manages flood and steep-creek hazards with support from the following statutory and regulatory tools:

⁸ The City’s HRVA (2019) defines a “Moderate or Likely” likelihood as having with a return period of 3 to 10 years.

⁹ The City’s HRVA (2019) defines a “High” consequence using seven categories including fatality, injury, critical facilities, lifeline, property damage, environment, and economic and social. Examples of each consequence class is provided within the HRVA for each category and the highest consequence class applicable to hazard is assigned. As an example, the “High” consequence category under “Fatality” assumes 11 to 50 fatalities, and the causal hazard example provided is a mine explosion.

¹⁰ The City’s HRVA (2019) defines a “Highly Unlikely” likelihood as having with a return period of 100 to 200 years

- The City's 2050 OCP (updated August 2025): Flood hazard DPA 5 is designated through the OCP. There is no steep-creek hazard information in the OCP. The OCP has a range of hazard-related policies across chapters.
 - DPA 5 Flood Hazard Area: See description in Section 2.1.1.
 - DPA 2 Riparian Area: applies to any development activity occurring within a Riparian Area defined as lands within 15 m of the high-water mark of lakes, watercourses, etc. A Qualified Environmental Professional (QEP) must assess the riparian area and the potential impacts of the proposed development activity. Soil removal and erosion protection works within 15 m of a watercourse would be reviewed under DPA 2.
- Development Application Procedures Bylaw No. 3526 (2022): The Approving Officer for a subdivision application may require a QP report assessing whether the proposed development(s) is 'safe for the intended use'. The Subdivision Approving Officer ensures compliance with the Land Title Act, OCP and City bylaws. The Land Title act provides the Officer the discretion to require a QP report on lands subject to hazards. Under Part 10, the Director of Development Services may also request additional study for any development permit application, temporary use permit, or zoning bylaw amendment outside of lands identified in DPA 2 or DPA 5.
- Section 56 of the Community Charter: see Section 2.3 Relevant Provincial and Federal Legislation.
- Restrictive Covenants: DPA 5 may require a restrictive covenant to be registered on title at the applicant's expense.
- Zoning Bylaw No 3199 (2013): Requirements in the DPA guidelines take precedence over requirements in the Zoning Bylaw around streams and riparian areas.
- Delegation Bylaw No. 3174 (2000): Delegates the issuance of development permits that do not require a variance to the Director of Development Services.

Additional documentation of supporting measures used by the City includes:

- Nelson Next Climate Action Plan (City, 2024): Nelson Next is a policy document to guide achieving specific climate change targets.
- Flood, Creek and Catch Basin Inspection Policy (City, June 6, 2023): The policy is specific to city-owned property and infrastructure, and it formalizes the inspections already being completed by Public Works staff throughout the year into a Council-Approved policy.
- Emergency Management and Public Awareness Initiatives: The Emergency Management program includes an Emergency Plan and emergency alert sign up. Nelson webpage includes information on preparing for emergencies, including making a **72-hour Emergency Grab and Go Kit**, and external links to **BC's public emergency preparation and recovery resources**, and the **Canadian Red Cross** web pages. Further public education about flood hazards is not evident other than through the higher-level plans such as Nelson Next and the OCP.

2.3 Relevant Provincial and Federal Legislation

The City has several provincially legislated requirements that apply to the assessment and regulation of development in areas affected by natural hazards. Specifically, the relevant acts, statutes, and guidelines include the following:

The BC Local Government Act (RSBC 2015) requires that OCPs include statements and map designations that restrict the use of land subject to hazardous conditions (Section 473). It allows for the designation of DPAs as a land-use planning tool to regulate development in hazard-prone areas. It provides zoning powers to local governments to specify land use and density (Section 458). Section 524 allows local governments to grant a bylaw exemption if it is consistent with provincial guidelines or if a report certified by a QP states that the land may be used safely for the intended use.

Section 56 of the Community Charter (SBC 2003) allows for a building inspector to require a landowner to provide a QP report that certifies that the land may be used safely for the intended use, as long as the building inspector has a reasonable basis to consider the land subject to hazardous conditions.

Under the Land Title Act (RSBC 1996), the Approving Authority has discretion to refuse subdivision or require a landowner to provide a QP report, and/or register a Covenant under Section 219 of the Land Title Act for lots created by the subdivision (s. 86(1)(c)(v)).

Under the Strata Property Act (SBC 1998), a Bare Land Strata Plan can be refused at the discretion of the Approving Authority if the land could reasonably be subject to “flooding, erosion, land slip [landslide] or [snow] avalanche”. Such plans can potentially be approved if a QP report is provided and a Covenant under Section 219 of the Land Title Act is registered.

Under the Emergency and Disaster Management Act (EDMA; SBC 2023), the Province of BC has established a risk-based, all-hazards framework for emergency management across five phases: mitigation, preparedness, response, recovery, and continuous improvement. Detailed local-authority regulation¹¹ is still pending under the Act but is expected to include requirements for preparing risk assessments, emergency management plans, and business continuity plans.

Local Governments must also consider applicable provincial standards and guidelines when developing bylaws and regulations. Those applicable to developing floodplain and alluvial fan management include the BC Flood Hazard Area Land Use Management Guidelines (FHALUMG) (2004) and the 2018 Amendment Sections 3.5 and 3.6. The guidelines state that development should be discouraged on alluvial fans. Additionally, it states that consent to develop should only be granted if no other land is available and if a QP flood assessment (including debris flows and debris floods) indicates that the development may occur “safely”.

As noted above, measures or thresholds to define “safe” are not defined unless local jurisdictions have established risk tolerance criteria or hazard acceptability thresholds

¹¹ The Province of BC indicated the regulation for local-authority emergency management is anticipated in Spring 2026, with key requirements taking effect in January 2027.

(e.g., Fraser Valley Regional District (FVRD), see Section 3.1.3.1). QPs carrying out assessments hold responsibilities under the Professional Governance Act (SBC 2018) and are subject to professional practice guidelines published by Engineers and Geoscientists of British Columbia (EGBC), as well as those of provincial or federal agencies (Section 2.4).

In addition to the above, any flood protection works or any works in and around a stream or in riparian areas are governed by the following provincial and federal legislation (EGBC, August 28, 2018):

- Provincial Riparian Areas Regulation under the Riparian Areas Protection Act
- Provincial Water Sustainability Act
- Federal Fisheries Act
- Provincial Environmental Assessment Act
- Federal Canadian Environmental Assessment Act
- Federal Navigation Protection Act (formerly the Navigable Waters Protection Act)

2.3.1.1 Designation of FCLs

The Local Government Act section 524 provides authority to a local government to, by bylaw, designate land as floodplain and specify FCLs and setbacks considering Provincial guidelines (i.e., FHALUMG). Across BC, local authorities have used various mechanisms to implement this authority. Many develop floodplain management bylaws while others include floodplain designation and specifications (FCLs and setbacks) in zoning bylaws. Several local authorities (e.g. District of Squamish, Columbia Shuswap Regional District, FVRD, City of Prince George) have natural hazard DPAs with the floodplain specifications in zoning bylaws or in standalone floodplain bylaws.

There are several examples of development permit areas that include floodplain specifications. The **District of Hope Flood and Erosion Hazard DPA** sets out floodplain specifications and requirements for QP reporting across hazard areas by hazard type. **The District of West Vancouver Foreshore DPA** outlines minimum FCLs for locations where a report by a QP is not required.

Subsection 7, the Local Government Act may exempt a person from the application of FCLs and setbacks, or the bylaw, in relation to a specific parcel of land or a use, building or other structure on the parcel of land, if the local government considers it advisable and either

1. Considers the exemption is consistent with the Provincial guidelines which clearly describe that exemption can only occur in a circumstance of physical hardship (i.e. development would be sterilized), or
2. The local government has received a report by a qualified professional certifying that the land may be used safely for the use intended.

Site-specific exemption requirements are commonly detailed in floodplain or zoning bylaws and, as in the RDCK, the Planning Procedures and Fees Bylaw. In the two examples where floodplain specifications are included in DPA guidelines, the District of Hope states that in extreme or unusual circumstances, the District of Hope may consider an application for a site-

specific exemption. The West Vancouver DPA guidelines do not mention site-specific exemptions.

2.4 Guidelines for Qualified Professionals in BC

As outlined in the preceding section, QPs conducting flood and landslide hazard assessments are required to adhere to professional practice guidelines established by EGBC, in addition to relevant guidelines issued by provincial and federal agencies. Guidelines that inform engineering practice and hazard assessment in BC include:

- *Flood Mapping in BC, Professional Practice Guidelines*, Engineers and Geoscientists BC (APEGBC, January 2017).
- *Legislated Flood Assessments in a Changing Climate in BC*, Version 2.1, Professional Practice Guidelines (EGBC, August 28, 2018).
- *Landslide Assessments in British Columbia*, Version 4.1, Professional Practice Guidelines (EGBC, March 1, 2023).
- Specifications for airborne LiDAR for the Province of British Columbia, MFLNRO GeoBC (GeoBC, 2023).
- Federal Floodplain Mapping Guidelines (NRCan, 2018).
- Guidance for Selection of Qualified Professionals and Preparation of Flood Hazard Assessment Reports, MFLNRO and Rural Development (MFLNRO, n.d.).
- Flood Hazard Area Land Use Management Guidelines (Province of BC, 2018).

3.0 HAZARD AND RISK MANAGEMENT POLICY REVIEW

This section summarizes BGC and Pinna's review of risk management approaches in jurisdictions both in Canada and internationally.

3.1 Hazard and Risk Management in Canada

3.1.1 Risk Management Approaches in Canada

Across the jurisdictions reviewed, two general approaches are used to evaluate geohazard risk; hazard-based and risk-based. Hazard-based approaches focus on the characteristics of the hazard, including hazard type, and the probability of a specific hazard scenario occurring. Risk-based approaches incorporate characteristics of the community elements exposed to the hazard (roads, buildings), their sensitivity to a hazard event, and the potential severity of the consequences.

A hazard-based approach relates land-use decisions to the hazard type (e.g., flood, debris flood, debris flow), and the probability of the hazard occurring or to the encounter probability (the probability of the hazard occurring and reaching the development). In some cases, such as the Fraser Valley Regional District (FVRD) and within EGBC guidelines for new development, the land-use decision also takes into account the development type (e.g., repairs, new building, subdivision). A hazard-based approach does not explicitly require information about the elements at risk, such as the exposure and associated consequences, as would be included in a risk assessment. Risk is often considered implicitly by using different hazard probability thresholds and decision frameworks for different hazard types to account for the variation in vulnerability of people and buildings between hazard types (e.g., buildings and people are more vulnerable to impact from a debris flow than a flood), with more damaging hazard types managed with more conservative thresholds.

Engineering standards are an example of this approach, as they often use a threshold hazard probability for design. For example, in BC, clearwater flooding is typically managed by identifying the inundation extent of the 200-year flood and restricting development within the inundated area, often enacted through local bylaws or development permit guidelines. In contrast, EGBC guidelines recommend using the 500-year or higher return period for debris flows and landslides for new development.

A risk-based approach relates land-use decisions to risk tolerance criteria defined by the local jurisdiction and it relies on risk information. Under this approach, hazard, exposure, and vulnerability are explicitly assessed to estimate the life-safety risk in hazard-prone areas. Both individual¹² and group risk¹³ can be evaluated using this approach, depending on the types and anticipated size of the hazards and the associated potential number of people exposed.

¹² Individual risk measures the likelihood of loss of life to a single representative person at a specific location. The risk unit for individual risk is Probability of Death of an Individual (PDI)

¹³ Group risk evaluates the number of people that could be killed from a hazard considering all the people exposed. Group risk is often evaluated graphically on an "F-N" curve where F = Annual frequency of N or more fatalities, and

No jurisdiction follows a purely risk-based approach but instead includes aspects of both a hazard-based and risk-based approach. Section 3.1.2 includes Table 3-1 summarizing the combination of policy tools applied within all jurisdictions reviewed by BGC and Pinna. More detail on specific hazard-based and combined hazard- and risk-based examples along with a summary of the benefits and challenges associated with each approach are summarized in Section 3.1.3 and 3.1.4.

N = number of fatalities. The F-N curve defines a reference line that can be used to inform decisions on tolerable risk levels. Typically for new development above a reference line, risk above the curve is unacceptable and below the line risk should be reduced to as low as reasonably practicable (ALARP). For existing development, the reference line provides an indication of the level of justification for risk reduction measures recognizing that it is often more challenging to reduce risk at existing development than where new development is proposed. Multiple F-N curves can be generated for the same area or project depending on scenario selection, assumptions, or modelling approaches, and no single curve uniquely represents risk. Experience with group risk assessments indicates that they are most effective for strategic, regional decision-making rather than project-level design due to their dependence on aggregated population exposure and rare high-consequence (catastrophic) events (Strouth, 2024).

3.1.2 Jurisdictional Examples in Canada

BGC and Pinna reviewed a combination of policy tools applied within jurisdictions in Western Canada (Table 3-1).

Table 3-1 Policy frameworks applied by BC and Alberta jurisdictions and their implemented tools.

Location	Applied Approach	Key Policies & Bylaw	Specific Examples / Other Tools / Notes
Fraser Valley Regional District (FVRD)	Hazard Based	- OCP hazard maps & DPA for known fans; identifies the need for further study and construction of mitigation works underway. - Floodplain Bylaw 1669, 2002 includes a section on alluvial fans applying to all those mapped in the schedule and those that have not yet been identified. All development on alluvial fans must meet FCL and setbacks determined by a site-specific geohazard assessment by a QP while taking the floodplain bylaw regulations into account. - Community-specific Hazard Acceptability Thresholds. - A standardized Geohazard Assurance Statement for geotechnical professionals to sign off on for development approvals.	Hazard Acceptability Thresholds for Development Approvals: The FVRD has had acceptability thresholds in place since 1993, outlining the type of hazard, the type of development, and the possible remedial or protective measures required for each type of application. As the probability of the hazard and the significance of the development application increase, the development approval requirements increase. A Geohazard Assurance Statement helps staff standardize QP reporting and provide greater assurance.
Regional District of Central Kootenays (RDCK)	Hazard Based	- Floodplain Management Bylaw calls out non-standard flood and erosion areas (NSFEA) where supplementary measures are needed over and above the regulations in the bylaw. For some NSFEA, complete hazard assessments by QPs are required. - Municipalities and electoral areas within the region utilize a combination of tools to address flood and debris-flow hazards, including DPAs that reference the NSFEAs, their own Floodplain Bylaws or a reference to the RDCK bylaw, and Zoning Bylaws.	RDCK is currently reviewing and updating its floodplain management bylaw following an updated detailed study of alluvial fans in the region. Anecdotally, the RDCK has had challenges consistently managing developments on NSFEAs. RDCK is also working to develop a risk tolerance policy.
City of Kelowna	Hazard Based	- Hazardous Condition Areas DPA. The DPA separates out guidelines for the development permit for each hazard type (e.g., steep slope hazards; rock fall, debris flow and landslides; ridgelines; flood hazards) - Floodplain Bylaw No. 10515 sets creek-specific FCLs. - Zoning Bylaw No. 3000 Part 5, Section 519.3 relates to building on steep slopes.	Development shall be directed away from hazard zones; QP must demonstrate risk mitigation through recommendations. Terms of Reference for Geotechnical Assessment Reports outlines the expectations for what is included within a QP report building permit applications. Mitigation measures such as debris basins have been built on major creeks. The OCP map viewer includes the DPA areas and other city planning layers.
City of Coquitlam	Hazard Based	- Hazardous Lands DPA; 15–30 m floodplain setbacks; no permit without QP; covenants required. - General section (s.519) in the Zoning Bylaw includes “Flood protection and slope control measures”.	Coquitlam offers a range of public-facing information for residents on “Living Near Steep Slopes,” which outlines the applicable policies, bulletins, and other relevant resources. While related to slope failure and landslide and not debris flow, the public information is comprehensive, linking policies together.
Cowichan Valley Regional District (CVRD)	Combined Hazard and Risk Based	- OCP Bylaw includes DPAs for floodplains and slope stability. - Development Approval Information Bylaw No. 4545 states that it may require a QP report for development on hazardous lands that may include hazard and risk assessment, and certification of “safe”. - Development Application Procedures Bylaw No. 4483 outlines delegation, exemptions, and development variance procedures. - Natural Hazard Risk Tolerance Policy.	Natural Hazard Risk Tolerance Policy: minor (renovations) and major (other applications). Minor – PDI not to exceed 1:10,000 per year, and group risk to plot in the ALARP zone. Major – PDI not to exceed 1:100,000 per year and reduced to as low as reasonably practicable. Group risk to fall within the ALARP or acceptable zones. Natural Hazards Householder: description of the natural hazard types and tips for the homeowner to reduce their exposure and vulnerability.

Location	Applied Approach	Key Policies & Bylaw	Specific Examples / Other Tools / Notes
District of North Vancouver (DNV)	Combined Hazard and Risk Based	- OCP bylaw 7900 includes a slope hazard and creek hazard DPA with guidelines outlined for each hazard area. A QP report may be required for a preliminary assessment and then a detailed assessment if necessary. - QP reports in both DPAs should reference the DNV’s Risk Tolerance Criteria and EGBC guidelines.	Risk Tolerance Criteria were developed in 2009 by DNV with a community task force. For a building permit with < 25% increase in gross floor area, 1:10,000 PDI/year + ALARP. For all other application types, it is 1:100,000 PDI/year. DNV also includes Factor of Safety (FOS) criteria in their risk tolerance criteria that applies to slope-stability assessments within the development area. DNV’s GeoWeb application includes DPAs and all natural hazard reports relevant to a property in a centralized database. DPA Brochures recommended that an applicant consult with DNV staff prior to beginning an application to understand their requirements and whether they are eligible for exemption.
Columbia Shuswap Regional District (CSRD)	Combined Hazard and Risk Based	- OCP hazard mapping for active fans. - Steep Slope & Natural Hazard DPA Bylaws based on a Geohazard Risk Prioritization study. Guidelines require a QP study to determine site-specific recommendations. - Reports to be accompanied by a CSRD Geohazard Assurance Statement Form and meet EGBC Landslide Assessment Guidelines. - Floodplain Bylaw and floodplain designations in the Zoning Bylaw. Application Guide for Floodplain Exemptions. - The Building Permit Geohazard Information Policy (P-26) refers to categories from BGC hazard ratings, along with specific requirements.	Electoral Area E OCP DPA for Geohazard: An overview study identifies the boundaries of the DPA Bylaw area and provides direction on where more detailed studies are needed. The board may refuse to issue a development permit where hazard frequency, as determined by a QP, exceeds the acceptability threshold for the proposed development, as determined by CSRD policy as it is developed and exists at the time.
District of Squamish	Combined Hazard-Risk for debris-flow hazard Hazard Based for flood and debris-flood hazard	- Natural Hazard Area DPA enacted as part of the OCP Bylaw. It includes designations for floodplains (detailed flood study), overland flow hazard areas (floods and debris-flood areas lacking detailed study), and debris-flow hazard areas (specific to the Cheekeye River fan). - OCP includes risk tolerance criteria and policies, as well as the requirements for the debris-flow hazard area zones which have an interim policy until “area-wide mitigation” is constructed. - Floodplain Management Bylaw sets guidelines for development in floodplain and overland flow hazard areas including FCLs, setbacks, erosion protection, etc. - Terms of reference for Natural Hazard and/or Risk Assessment.	New development must demonstrate safety through a QP report and mitigation. Risk tolerance policy applicable to the Cheekeye Debris-Flow Hazard Area: - Existing development: individual risk <1:10,000. - New development: individual risk <1:100,000. - Group risk shall be ‘broadly acceptable’ or ALARP. Where group risk falls in ALARP, the risk assessment must demonstrate why the cost of further reducing the risk is disproportionate to the benefit. District of Squamish Integrated Flood Hazard Management (IFHMP) Online Map: Includes all the flood DPA boundaries, FCL requirements, and velocity zones that can be used by QPs to support erosion protection design in floodplain areas. The map was informed by IFHMP study by Kerr Wood Leidal Associates Ltd. (KWL) (2017) that was completed for the District of Squamish over several years beginning in 2014. Flood Management Guide for Developers is a guide to the District of Squamish’s policies for land development applications.
Town of Canmore	Combined Hazard and Risk based	- Municipal Development Plan (MDP) includes risk tolerance thresholds for both individual risk and group risk. - Land Use Bylaw includes hazard zones and maps and references the risk tolerance criteria in the Municipal Development Plan.	The MDP includes risk tolerance for new and existing developments: - New Development - Individual Risk (PDI) ≤ 1:100,000 - Existing Development - Individual Risk (PDI) ≤1:10,000 and ALARP - Town of Canmore has Engineering and Construction Guidelines that are to be consulted wherever development is permissible.

3.1.3 Selected Hazard-Based Examples in Western Canada

3.1.3.1 Fraser Valley Regional District

In the early 1990s, the FVRD developed a series of tables with hazard probabilities by hazard type (often called “Cave Tables”) to guide land-use decisions (Cave et al., 1990; Cave, 1992). In 2020, the FVRD published the tables as **Hazard Acceptability Thresholds for Development Approvals**. The FVRD worked with QPs to develop the tables. The tables include annual hazard probability categories compared with types of development, ranging from minor repair to subdivision and rezoning (see Figure 3-1 and Figure 3-2). A companion table, with levels 1 to 5, describes the development approval conditions (Figure 3-1). Together, these tables determine whether an application for a specific type of development would be approved, along with the conditions under which it would be approved, based on the hazard probability of the site. While the FVRD framework does not explicitly evaluate risk, risk concepts are implicitly incorporated through the creation of specific frameworks for different hazard types, with more destructive hazards managed more conservatively.

1	Approval without conditions relating to hazards.
2	Approval, without siting conditions or protective works conditions but with a covenant including “save harmless” conditions.
3	Approval, but with siting requirements to avoid the hazard, or with requirements for protective works to mitigate the hazard.
4	Approval as #3 above, but with a covenant including “save harmless” conditions as well as siting conditions, protective works or both.
5	Not approvable.

Figure 3-1 Responses to guide land-use decisions (FVRD, 2020; Cave et al., 1990; Cave, 1992).

Debris Flow/Debris Torrent

Debris flows and torrents are rapid, saturated flows of coarse debris and mud, damaged trees, stumps, and smaller organic material. These flows may be contained in steep creek channels or they may spread out on debris fan surfaces. Debris flows and torrents can be life-threatening and damage or destroy property.



Table 4

	1:50	1:50- 1:200	1:200- 1:500	1:500- 1:10,000	<1:10,000
Minor Repair (<25%)	5	2	2	1	1
Major Repair (>25%)	5	4	2	1	1
Reconstruction	5	5	4	3	1
Extension	5	5	4	2	1
New Building	5	5	4	3	1
Subdivision (infill/extend)	5	5	5	4	1
Rezoning (for new community)	5	5	5	5	1

Figure 3-2 Example hazard acceptability threshold used for development approval decisions in the FVRD (2020).

Throughout the FVRD, bylaws have been used to create hazard DPAs based on the results of various overview hazard studies. Generally, the DPA guidelines describe the nature of the hazard and identify areas where further study by a QP would be required. Where required, a QP completes a site-specific hazard assessment and proposes the approval rating level from 1 to 5. In specific areas of the region where FVRD is completing more detailed hazard studies following OCP updates, hazard mitigation will be prescribed in advance, with a QP study required only if applicants disagree with the prescribed hazard mitigation measures. Where there are no DPAs, but the area is known to include hazards, the building department requires site-specific reports completed by QPs under Section 56 of the Community Charter and a covenant on title.

Guidelines in the DPA permit allow for the peer review of a QP study at the discretion of staff, with the cost covered by the applicant; however, this has been rarely applied (K. Hipwell, FVRD, personal communication, November 28, 2024). While staff at the FVRD do not assume the responsibilities of QPs, reviewing a typically high volume of reports in a given year helps FVRD staff compare the relative quality of each report they receive (K. Hipwell, FVRD, personal communication, November 28, 2024). They also rely on FVRD's Geohazard Assurance Statement for Development Approvals, which follows the EGBC's *Professional Practice Guidelines on Legislated Flood Assessments in a Changing Climate in BC* (EGBC, 2018) and *Landslide Assessments in BC* (EGBC, 2023).

3.1.3.2 Columbia Shuswap Regional District

The Columbia Shuswap Regional District (CSRD) applies a hazard-based approach for regulating development that combines regional hazard mapping, floodplain specifications, DPAs, and site-specific QP assessments. Approaches vary by Electoral Area. In some Electoral Areas OCPs include DPAs for flood hazard, steep slopes, and active alluvial fans based on earlier overview studies, including the CSRD Geohazard Risk Prioritization Study (BGC, April

16, 2020). These DPAs identify where hazards may be present and require applicants to obtain a QP assessment with site-specific recommendations before land alteration, subdivision, or construction can proceed.

CSRD's DPA guidelines require that QP reports meet the EGBC *Professional Practice Guidelines for Landslide Assessments in BC* (EGBC, 2023) and be submitted with a CSRD Geohazard Assurance Statement Form (n.d.).

For flood hazards, the CSRD manages development through a combination of flood hazard DPAs (by Electoral District), floodplain designations in the zoning bylaws (by Electoral Districts), and a policy on Floodplain Setbacks and Exemptions (P-19). These documents outline FCLs, setbacks, and conditions under which exemptions may be granted when supported by a QP. Floodplain exemptions are delegated by bylaw to the Director of Development Services. The **Application Guide for Floodplain Exemption** (n.d.) provides information and answers Frequently Asked Questions (FAQs) for applicants.

The Building Permit Geohazard Information Policy (P-26) further codifies CSRD's hazard-based approach by referencing hazard rating categories (BGC, April 16, 2020) to determine the level of geohazard information required for building permit applications. Where mapping or staff knowledge indicates a potential hazard, but the parcel falls outside a designated DPA, Policy P-26 identifies when additional QP input is needed to provide 'safe for intended use'.

3.1.3.3 Benefits and Challenges of the Hazard-Based Approach

Benefits

- **Precedent and Familiarity:** There is a strong precedent for using a hazard-based approach in BC and it is familiar to many QPs.
- **Consistency and Ease of Use:** Development decision tools such as the FVRD tables that are paired with maps of the hazard extent for the threshold encounter probability by hazard type facilitate the application review process. Once the maps are available, all developers, land-use planners, engineers, and city staff will reference the same information, supporting consistent decision-making. In contrast with a risk assessment, there are no other parameters to estimate, assume, or debate.
- **Hazard Avoidance:** Because a hazard-based approach is typically prescriptive with respect to land use, development is generally prohibited in high-hazard areas, avoiding the potential of encountering the hazard. This can be seen as either a benefit or a challenge depending on the land available within a community for development.

Challenges

- **Inflexibility:** Site-specific factors that affect the hazard, exposure, or vulnerability to the hazard (e.g., mitigation measures, variations in hazard characteristics within and between hazard types) are ignored, and there is no systematic process for incorporating these factors into decisions about variances or exemptions.

- Isolated Hazard Scenarios: Hazard-based approach does not account for multiple hazards or return periods. As a result, the cumulative effects or events that may drive the risk are not accounted for.
- Intangible Thresholds: Many hazard thresholds are based on precedent and do not have a tangible meaning. They do not explicitly consider the potential damages associated with the hazard.
- Risk is Not Known: Purely hazard-based decisions do not account for increasing the number of elements at risk exposed to life-threatening hazard. For example, the risk associated with rezoning from single family to an apartment building can be missed with the solely hazard-based approach.
- Does Not Incentivize Risk Reduction: While standardized hazard-based tools, such as FVRD's tables, help to slow population growth within the hazard zones, their use does not explicitly promote or incentivize the reduction of existing risk. Hazard avoidance is the guiding principle, and it misses opportunities to develop where the risk can be reduced to tolerable levels.
- Inability to Address Development Demands: Due to the prescriptive nature of the hazard-based approach, it does not create opportunities to manage the demands for development.

3.1.4 Selected Combined Hazard- and Risk-Based Examples in Western Canada

3.1.4.1 District of Squamish

The District of Squamish (DoS) uses various policy tools working together to address flood and steep-creek hazards. Flood and steep-creek hazards are managed through the Integrated Flood Hazard Management Plan framework shown in Figure 3-3. Floods are managed using a hazards-based approach through both the Floodplain Bylaw that specifies FCLs, setbacks, and construction specifications for a the 200-year return period and consideration of modelled dike breach scenarios. Flood and debris-flood hazards without a detailed study are integrated into the OCP as an Overland Flow Hazard Area that specifies a minimum FCL of 1 m above existing ground and erosion protection in the absence of a detailed study.

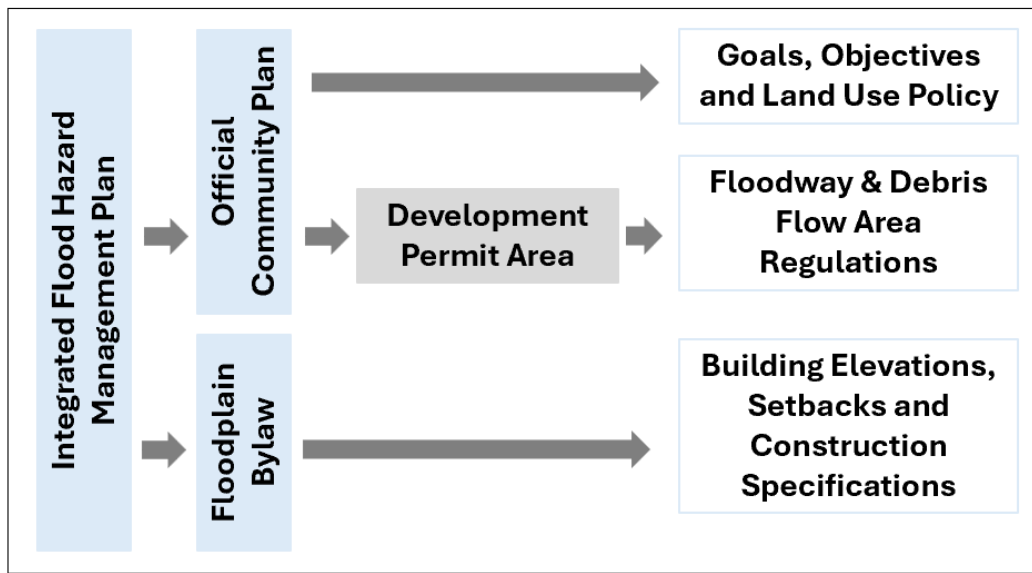


Figure 3-3 Integrated Flood Hazard Management Plan Framework (adapted from District of Squamish).

The Cheekeye fan is an area exposed to large debris flows triggered by rainfall or rock avalanches and development of this area was previously prohibited due to life-loss risk. In approximately 2014, a development partnership applied for an OCP amendment to change the land use from resource and recreational use to residential. Over the next decade, the District of Squamish undertook an expert review of the debris-flow hazard and developed hazard-related policies and bylaws to protect existing and new development, as well as to guide the construction of a mitigation structure. DoS issued interim development policies for the fan in 2014, which have been incorporated into the OCP.

The interim policy is in place to limit development on the Cheekeye fan until the completion of “Area-Wide Mitigation” on the fan. The interim policy applies to the Debris-Flow Hazard Area defined in Schedule D-1 of the OCP. The Cheekeye fan is included as a Debris-Flow Hazard Area and the Overland-Flow Hazard Area. A hazard-based approach was used to define different hazard levels on the Cheekeye fan. The mapping divides the Cheekeye Debris-Flow Hazard Area into 5 Zones (C1 to C5) using a composite of hazard intensity across all possible scenarios, and these zones, each with requirements for land-use development.

The “Area-Wide Mitigation” is a debris-flow barrier that is currently under construction. The DoS adopted risk tolerance criteria to set a clear threshold for risk-reduction that must be achieved by the “Area-Wide Mitigation” to allow new development on the Cheekeye fan.

The OCP includes a set of risk tolerance criteria similar to those used by the Town of Canmore:

- Existing development: individual risk <1:10,000.
- New development: individual risk <1:100,000.

- Group risk shall be broadly acceptable or ALARP. Where group risk falls in ALARP, the risk assessment must demonstrate why the cost of further reducing the risk is disproportionate to the benefit.

Under DPA 2 for Flood Hazard in the OCP Bylaw, applications must include a QP risk assessment aligned with DoS TOR for Natural Hazard and/or Risk Assessments and relevant EGBC guidelines, plus a completion report confirming that construction follows approved hazard-mitigation and risk-management measures.

3.1.4.2 Town of Canmore

In June 2013, extreme rainfall triggered widespread flooding in southwest Alberta, including damaging debris flows and debris floods on several creeks in Canmore. In response, the Town of Canmore invested heavily over the following decade in steep-creek hazard mapping, risk assessments, new development policies and bylaws, and major structural mitigation projects. The most significant structure is a 34 m-high, water-retaining debris-flood barrier on Cougar Creek, helping protect a developed fan with more than 4,000 residents.

Planning and development decisions in steep-creek hazard areas rely on three coordinated documents:

- Municipal Development Plan: sets policy direction and risk tolerance criteria
- Land Use Bylaw: applies risk tolerance criteria through enforceable rules and hazard maps
- Engineering Design and Construction Guidelines: define design requirements for development where it is permitted.

Canmore uses a combined hazard and risk-based approach, informed by two map types: broad “study areas” where detailed mapping is not yet available, and detailed hazard zone maps (Extreme, High, Moderate, Low, and Residual) that show maximum credible flow intensities and extents.

These hazard zones guide development outcomes much like a “no–maybe–yes” framework (Figure 3-4). Extreme and High zones prohibit new development and tightly restrict changes to existing uses. In the Moderate zone, development may proceed if a risk assessment demonstrates that risk tolerance criteria can be met. In the Low zone, development is generally allowed under the Engineering Design and Construction Guidelines (Town of Canmore, 2025). However, a risk assessment may still be required if the proposal could raise group risk or involves high potential losses.

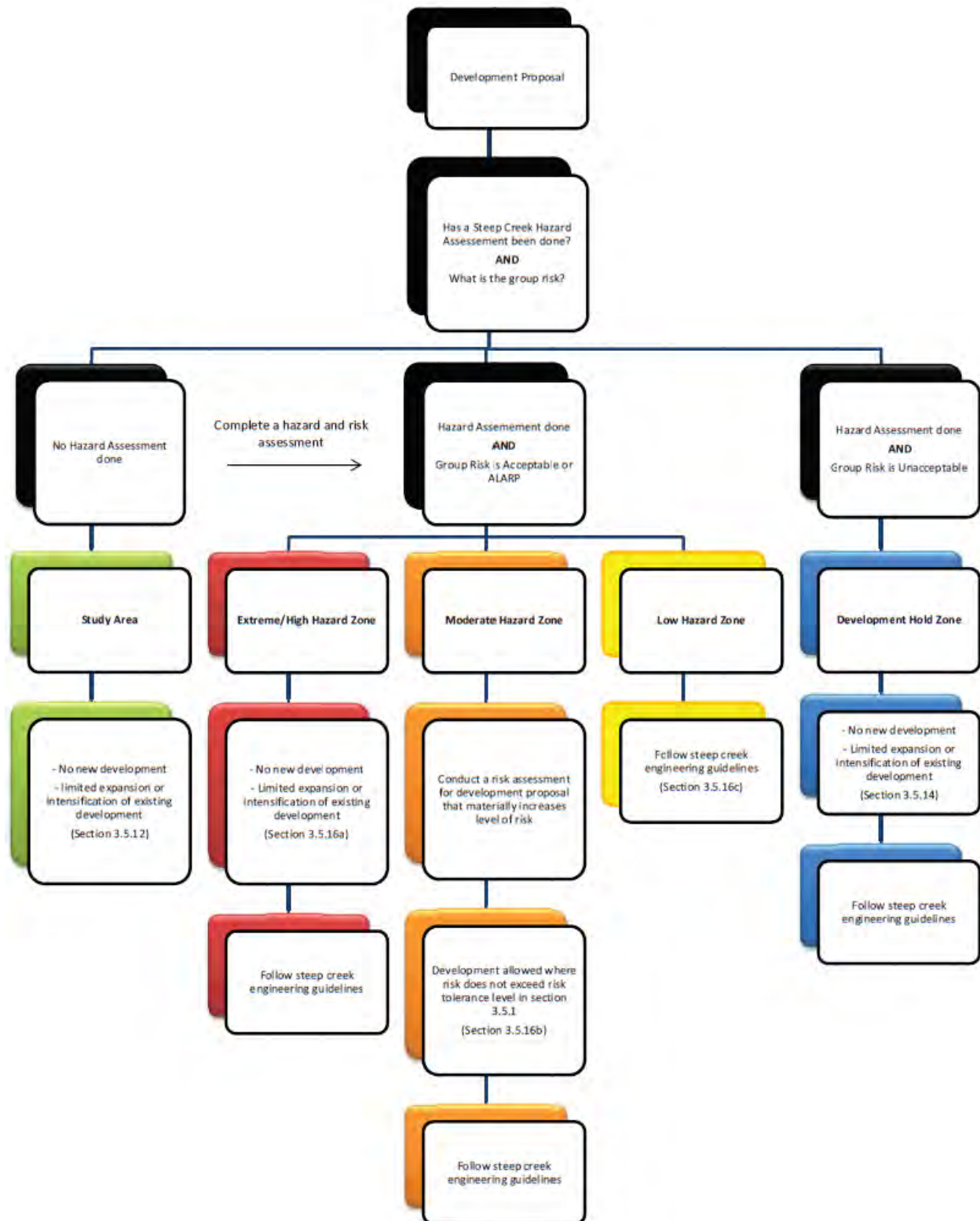


Figure 3-4 Town of Canmore steep-creek development flowchart.

Canmore's life-loss risk tolerance criteria for development impacted by steep-creek hazards are established as follows:

- Group risk is within an acceptable or ALARP range (F-N plot in Canmore's Municipal District Plan (2018))
- Individual risk (PDI) <1:10,000 for existing development
- Individual risk (PDI) <1:100,000 for new development.

The Town of Canmore uses specific language in their Municipal Development Plan that allows some flexibility on *when* the individual risk target for existing development needs to be met, stating that the Town's objective is to "reduce existing risk to within these thresholds over time".

3.1.4.3 Benefits and Challenges of Risk-Based Approaches

Benefits

- Flexibility: The risk-based approach is more flexible than the hazard-based approach, particularly where hazard avoidance is impractical. It allows development proponents to implement measures that reduce vulnerability and exposure (e.g., mitigation and non-structural measures) to meet risk tolerance thresholds and demonstrate a favourable benefit-cost ratio.
- Applicable across multiple hazard types: The approach is not limited to a predefined list of hazard types (e.g., floods and steep creeks) and can consider the total risk to development where multiple overlapping hazards exist.
- Incentive to Mitigate Risk: Adoption of risk tolerance thresholds for development approvals creates incentives to pursue risk reduction.
- Can Consider Group Risk: For larger developments and/or for assessing catastrophic events where multiple fatalities are possible, the risk-based approach can also require consideration of group risk.

Challenges

- Requires Specialists to Assess Risk: When risk-based approaches were first introduced, few registered professionals (e.g., engineers, geoscientists, or planners) in BC were experienced in risk assessment. DNV noted that this was an issue when they first implemented their risk tolerance criteria, but that it has decreased over time with more QPs becoming familiar with the process. EGBC professional practice guidelines now require Quantitative Risk Assessments (QRAs) for some QP reports depending on the class of development. The need for QPs to better understand risk assessments is evolving regardless of any individual municipalities policy requirements.
- Subjectivity in Risk Estimation: There is no consistent guidance for QPs on conducting a quantitative risk assessment which can lead to inconsistency in risk estimation. This means that there may be two adjacent parcels that receive different information from their QP reports, however, it should be noted that subjectivity is also present in the hazard assessment process and adding risk to the assessment process does not present a new challenge but can increase the challenge.

- May Be Unachievable for Existing Development: For existing development within hazard areas where the risk exceeds the threshold, minor improvements to the property may be cost prohibitive to reduce the risk to the acceptable level. One exception being if a community-level mitigation is put in by a new development that reduces risk of existing development.
- Not As Applicable for Flood Hazard: Guidelines for a hazard-based approach to flood management are well-established using requirements such as setback distance and FCLs. The research on calculating life-safety risk during floods is variable and is impacted by factors that are difficult to estimate such as timing of the flood (life-loss is more likely at nighttime when evacuation is less likely), warning and evacuation, availability of shelter, and flood type and duration.
- Limited Applicability for Life-safety Risk Criteria: A site can be “safe enough” from a life-safety perspective but may not apply to all approval decisions or other risk types (e.g., economic or environmental risks). For example, it does not account for flooding leading to extensive economic damage.

3.1.5 Common Tools Applied in Canada

Figure 3-5 summarizes the commonly used land-use management planning tools in Canada that were mentioned within the frameworks of the various jurisdictions. In summary, BC and Alberta communities prone to steep-creek hazards use a combination of policy and bylaw tools, most often including Official Community Plans (OCPs) (enacted by an OCP Bylaw), Development Permit Area (DPAs) (also enacted as part of the OCP Bylaw), floodplain management bylaws, and QP hazard assessments to protect people and property from flood and steep-creek hazards. This layered approach means these communities rely on a combination of land-use planning, site-specific engineering, and community readiness to reduce risk.



Figure 3-5 Land-use planning tools used in flood and steep-creek hazard and risk management in jurisdictions in Western Canada.

3.1.5.1 Benefits and Challenges of the various statutory tools

Of the statutory tools, an OCP through designation of DPAs, zoning bylaw and a floodplain management bylaw can all be used to designate areas, define specific building and site requirements, and can make reference to hazard acceptability thresholds or risk tolerance criteria, terms of reference, require assurance statements, etc. Table 3-2 outlines the benefits and challenges of using DPAs, zoning bylaw, or a floodplain management bylaw to designate hazard areas and enforce application permit procedures and guidelines

Table 3-2 Statutory tools commonly used in Western Canada to designate hazard areas and define requirements for development.

Statutory Tool	Benefits	Challenges
Official Community Plan (OCP) with designated Development Permit Areas (DPAs)	<u>Transparency:</u> Hazard maps and zones are publicly available. <u>Integrates broad guidance:</u> DPA guidelines can incorporate requirements for hazard management like construction techniques, drainage, vegetation management, etc. <u>Allows for further detailed study at site scale:</u> Hazard DPAs can be designated based on screening-level hazard data and later updated to include hazard zones once a detailed study is completed. This model relies on a site-specific detailed assessment by a QP.	<u>Relies on interpretation and implementation of guidelines:</u> DPA guidance is more open to interpretation than a bylaw and can be challenging to enforce consistently. <u>Cost duplication:</u> Cost duplication can occur if multiple proponents in a hazard area are required to complete similar work to demonstrate "safe for the use intended". The cost effort is lessened when there are detailed hazard maps with more defined hazard levels and detailed hazard information.
Zoning Bylaw	<u>Common planning tool:</u> Zoning bylaws are common planning tools that are well known and understood, and frequently accessed by both staff and applicants. <u>Can limit density:</u> Zoning bylaws can be used to limit land use and density in hazard areas, and can indirectly limit incremental increases in risk over time.	<u>Downzoning is difficult:</u> Rezoning in hazard areas to apply more restrictive use, or reduced density is a challenge. <u>Poor communication tool:</u> The zoning bylaw is not an easily digestible way for the public to be aware of the hazard areas and development requirements.
Floodplain Management Bylaw	<u>Clear, transparent, and enforceable:</u> Floodplain bylaws provide a clear, transparent and enforceable mechanism to regulate development within flood and steep-creek hazard areas. <u>Applicable across large areas:</u> They are efficient to apply to large, highly developed areas because they set clear requirements for regulatory compliance, and each hazard assessment references the same base mapping information. Similar to zoning bylaw, they can provide an opportunity to manage hazard at the community-scale and reduce the need for structural measures.	<u>Inflexible and difficult to change:</u> The specific requirements (e.g. FCLs) can be difficult to update to account for climate change. It may be challenging to meet for infill of existing development. If FCLs do change, it can create challenges for existing development. Often inflexible to specific site characteristics leading to site-specific exemptions which are challenging to process. <u>Hazard-based management does not account for risk-reduction measures:</u> The consequence is not accounted for in the static rules that apply to a large area. The same hazard-based standard is applied to critical facilities and a retail store that have different levels of consequence in an emergency. <u>Site-specific exemptions:</u> When site-specific exemptions are not delegated to staff, they can become challenged by political pressures.

3.2 International Perspectives on Hazard Management

At the international scale, hazard and risk management strategies vary with resources that are available to manage them. In countries with relatively abundant resources (such as New Zealand, Japan, Hong Kong, Australia, and Norway), strict zoning and land-use controls are typically combined with robust structural measures, often sustained with federal funding (Figure 3-6).

These nations make use of:

- Community-level structural mitigations, including check dams, debris nets, and engineered berms
- Detailed, large-scale hazard mapping (often at the national or regional level)
- Data-driven risk assessments that guide land-use decisions
- Risk-based zoning, setbacks, and development restrictions
- Advanced early warning systems using rainfall gauges, real-time monitoring, and public alert networks
- Strong public education, awareness campaigns, and a high level of public trust in government response
- Federal-level funding to ensure consistent evacuation corridors, policy, mapping, and mitigation works across regions.

Most major policy advances in these nations have occurred in response to a hazard event that caused catastrophic damage and/or resulted in life loss (e.g., Switzerland 1987 floods, Japan 1999 Hiroshima debris flow, New Zealand 2022 floods). Such was the case in Canada following the 2005 fatal landslide in North Vancouver, the 2012 Johnstons Landing fatal landslide, the 2013 floods in and around Canmore, Alberta, and the 2020 near-fatal Willox Creek debris flow near McBride in the Regional District of Fraser-Fort George.

In countries with significant hazards but fewer resources for management (including Nepal, the Philippines, Peru, Indonesia, and Bhutan), risk tolerance is typically higher and hazard management focuses more on community-led, non-structural measures, such as:

- Public awareness and participation as the backbone of preparedness
- Nature-based solutions like vegetation, erosion control, and drainage improvements
- Low-cost land use controls, such as basic no-build zones or simple setbacks from creeks and steep slopes
- Informal or community-managed watch and warning systems and local disaster response planning.

No single nation or region stands out internationally as having an “ideal” solution to hazard lands development policy with perfect application in BC, just as there is no local jurisdiction in BC or elsewhere in Canada with an approach that meets all needs. The regions with the strongest policy (i.e., those that produce the highest degree of risk reduction and lowest fatalities) have pooled funds together to create uniform hazard mapping and risk assessment resources for QPs. This is often in the form of national organization (e.g., Norway, Japan, New Zealand).



Figure 3-6 Review of a selection of risk-reducing policy tools used internationally.

In Canada, given the scale and variance in geography, the nearest analogue to national organization is provincial organization. Countries with low population density such as Norway, and New Zealand, are similar in size and hazard type as BC. Aspects of their approaches could be adopted, although BC implements a professional reliance model which is not applied to the same extent in Norway and New Zealand.

At the municipal level, the learnings from international settings that could be adopted by Nelson are largely on their strategies to effectively engage the public on hazard reduction. These strategies include transparency in hazard mapping and availability (e.g., **landslide and flood mapping and warning web portal in Norway**), hazard education in schools (e.g., **disaster preparedness is in the national curriculum in Japan**), public participation (e.g., **live exercises and drills in New Zealand**) and a variety of engagement platforms (e.g., **debris flow simulation video games in Switzerland**). Section 0 outlines the hazard-based approach used in Switzerland.

3.2.1 Hazard-Based Approach in Switzerland

The Swiss Federal Government has adopted a landslide hazard mapping program for land-use planning (Lateltin et al., 2005). The Swiss framework defines very low, low, moderate and high hazard based on the probability of occurrence and the intensity (destructive potential; i.e., depth and velocity, of the landslide, as might be measured by parameters such as velocity and depth; Figure 3-7). The probability ranges are defined as:

- 1 to 30 years
- 30 to 100 years
- 100 to 300 years
- Greater than 300 years (referred to as “residual dangers”).

Swiss hazard probability tolerance zones have limited regulatory enforcement unless they are approved by the local council and incorporated into local land-use management plans.

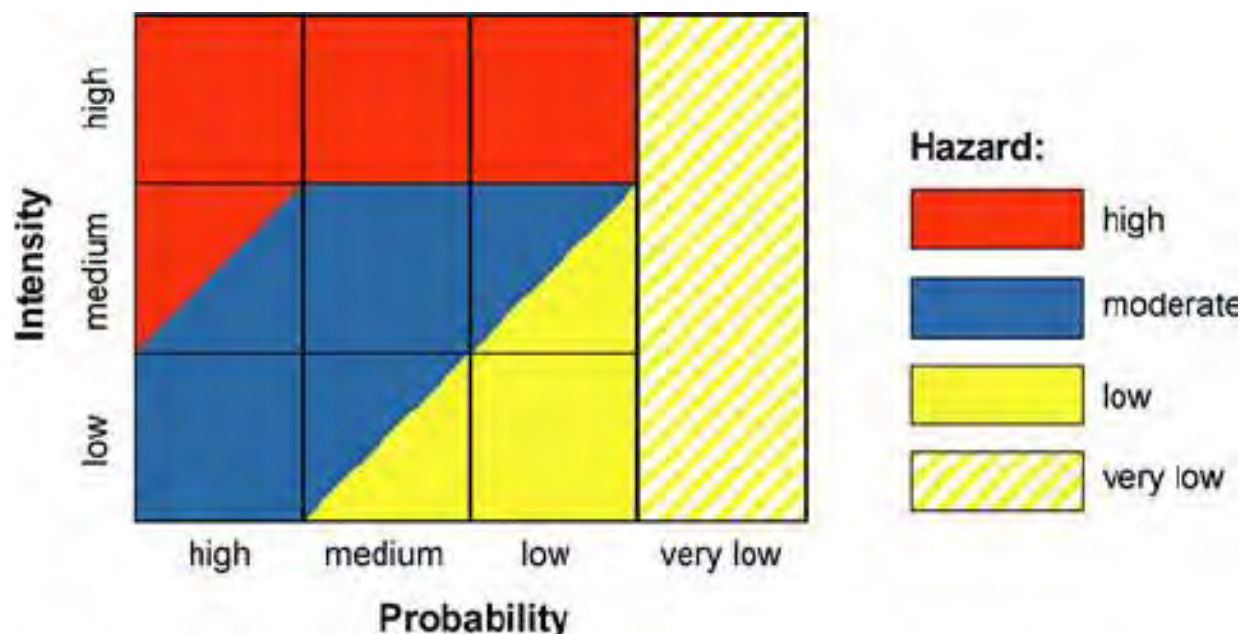


Figure 3-7 Diagram of hazard levels as a function of probability and intensity (Lateltin et al., 2005).

Generally, Switzerland's Federal Office for the Environment (FOEN) recommends the land-use zone designation and construction for each hazard zone in Table 3-3. Although Switzerland mentions risk, the land-use guideline is only based on probability and intensity of the hazard, and risk tolerance is not defined. These rules are standardized nationwide, and the local municipalities formally adopt them into their land-use plans.

Table 3-3 Hazard levels and recommended land-use zone designation and construction (FOEN, 2016).

Degree of Hazard	Description	Land-use Zone Designation & Construction
High (red or prohibited zone)	- Persons are at risk both inside and outside buildings. - The rapid destruction of buildings may be expected. - or: - The scope of the events may be lower, however, there is a higher probability of their occurrence. In this case, either persons are at risk, particularly outside buildings, buildings suffer considerable damage or are rendered uninhabitable.	- New development is not permitted - Changes in use only with risk-reduction measures.

Degree of Hazard	Description	Land-use Zone Designation & Construction
Moderate (blue or bidding zone)	- Persons are at little or no risk inside buildings but are at risk outside. - Damage to buildings may be expected, however the rapid destruction of buildings may not be expected in this area as long as certain requirements in relation to construction methods are met.	- Development is allowed only with conditions - Use restrictions for existing development - Sensitive uses (i.e., schools and hospitals) are typically not allowed.
Low (yellow or reference zone)	- Persons are at little or no risk. - Minor damage to buildings and obstructions may be expected.	- Development is generally allowed - Sensitive uses and major development are allowed with conditions.
Very Low (yellow/white or residual zone)	- Threats with a very low probability of occurrence can be indicated using yellow-white hatching. The yellow-white hatched zone is a reference area that presents a residual risk. - A restrictive approach should be adopted to the designation of reference areas. It should be carried out on a process-specific and damage-potential-oriented basis.	Similar to the Low zone

Switzerland also uses a [web-based platform](#) to show where a property falls into for these zones for multiple hazards (e.g., hail, overland flow, landslide). The web-based platform is specifically designed to help people understand whether their buildings are exposed to natural hazards and how they can reduce potential damage. The page includes an online tool that allows users to assess the natural hazards affecting a specific building location. Users can obtain an overview of relevant hazards and receive recommendations for protective measures tailored to their situation.

3.3 Lessons Learned in Implementation

The following is a summary of lessons learned in implementation of hazard- and risk-based approaches that BGC and Pinna have compiled over interviews and through project work.

- Communicate early and consistently with stakeholders during policy development. Communication is essential in developing a policy that considers a broad range of needs.
- Maintain transparency throughout the policy development process. This supported the Town of Canmore in managing cases of concerned homeowners affected by the adopted risk tolerance policy.
- Integrate flexibility, where possible, through careful consideration of wording in consultation with legal counsel. For example, the Town of Canmore expressing their objective in the Municipal Development Plan to “reduce existing risk to within these thresholds over time”.

- Developing a philosophy of shared responsibility between stakeholders and the local government can be very effective. Empowering homeowners through education and understanding may encourage investment in risk management strategies at the property scale while the local government seeks funding for detailed hazard and risk assessments at the hazard scale.
 - Tools that can assist with this include webmap applications that clearly outline hazard zones, relevant reports, and requirements (examples DNV and DoS), and guidance documents for homeowners on steps they can take to reduce hazard exposure and vulnerability (example CVRD).
- Maintain a clear and simple process for updating natural hazard and risk information without requiring a full amendment of the OCPs. DNV uses a centralized and publicly accessible tool (Geoweb) with reference reports to parcels of land has led to increased transparency in the development process.
- When adopting a risk tolerance policy, develop a plan in advance on how to communicate the risk and manage how risk tolerance thresholds can be met over time for existing development. For municipalities that have adopted a life-safety risk tolerance policy, there can be challenges within the jurisdiction when some or all of the existing development does not meet the adopted risk tolerance criteria. Planning for this may include, for example on a steep-creek fan, the hazard is likely to impact several parcels and a municipality may aim to pursue mitigation through a combination of municipal and grant funding to reduce the risk to tolerable thresholds over time (similar to Town of Canmore). Alternatively, some hazards, such as rockfall or steep slopes, may affect an individual parcel and a municipality may consider mitigation as the responsibility of the property owner to fund or may consider some combination of incentives including cost-sharing between the municipality and the homeowner and/or streamlining administrative processes to enable prompt implementation.

4.0 ENGAGEMENT

BGC and Pinna, in collaboration with City staff, undertook engagement activities to provide opportunities for interest stakeholders to contribute to our understanding of the local context and to provide input to the development of the policy roadmap recommendations. The following sections provide an overview of the engagement plan and objectives, and summarize the key themes and insights learned throughout the engagement.

Specific objectives for this engagement included:

- Collaborating with City staff and local QPs that are actively involved in hazard and risk assessment, policy, and regulatory implementation in Nelson, BC.
- Improving awareness and capacity building with respect to flood and steep-creek hazards within the Nelson community.
- Upholding DRIPA (Declaration on the Rights of Indigenous Peoples Act) and continuing to support relationship building between the City of Nelson and local First Nations.
- Ensuring that the project recommendations align with the capacity of the City of Nelson staff to implement the recommendations into policy and regulatory tools.

Engagement was guided by the International Association for Public Participation (IAP2) Spectrum for Public Participation, which outlines five levels of engagement (Figure 4-1). While the full IAP2 spectrum is presented for context, engagement activities for this project were aligned with the Inform to Involve levels, to support meaningful participation consistent with the project's mandate and engagement objectives.

INFORM	CONSULT	INVOLVE	COLLABORATE	EMPOWER
Public Participation Goal:	Public Participation Goal:	Public Participation Goal:	Public Participation Goal:	Public Participation Goal:
To provide the public with balanced and objective information to assist them in understanding the problems, alternatives, opportunities and/or solutions.	To obtain public feedback on analysis, alternatives and/or decisions.	To work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered.	To partner with the public in each aspect of the decision including the development of alternatives and the identification of the preferred solution.	To place final decision-making in the hands of the public.

Figure 4-1 IAP2 public participation spectrum (IAP2, 2015).

4.1 Engagement Plan

An engagement plan was developed and reviewed by the City of Nelson project team ahead of implementation. Table 4-1 summarizes the key groups engaged and engagement activities. Given the complex nature of the project, the engagement level for community members focused on providing information about the project outcomes and developing public communication materials.

Table 4-1 Summary of the engagement activities and general outcomes completed as part of this project.

Group Engaged	IAP2 Level of Engagement	Engagement Activities	Engagement Outcomes
Local First Nations	Inform, Consult and involve as preferred by the Nation	Ktunaxa, Syilx and Sinixt Nations invited to 1:1 project meetings Meeting and follow up with Okanagan Nation Alliance staff on February 20, 2026.	Interests discussed, shapefiles and reports shared.
Interest Holders	Inform	Project information letters sent to neighbouring jurisdictions (Castlegar, Kaslo, Salmo, Slocan, RDCK); Dehnel Planning; Ministry of Forests, Ministry of Transportation and Transit; and CPKC Rail.	Interest holders informed of the project and provided contact information for further questions
Local Qualified Professionals	Involve, Collaborate	Working Group meetings on December 9, 2025 and February 23, 2026	Substantial input to policy development
City of Nelson, Project Team	Involve, Collaborate	Regular project progress meetings	Continuous feedback and direction
City of Nelson, broader staff	Involve, Collaborate	Working Group meetings on December 9, 2025 and March 11, 2026.	Substantial input to policy development
City of Nelson Council	Inform	Presentations to Council November 18, 2025 and May 12, 2026 (planned).	Understanding, awareness and feedback
Public	Inform	Public Council meeting on May 12, 2026 (planned)	Understanding, awareness and feedback

4.2 Summary of Engagement Insights

The following section summarizes key themes identified through different engagement activities. *Note that a public Council meeting is planned but has not been completed at the time of this draft report delivery.*

4.2.1 First Nations Meetings

BGC and Pinna sent letters to the Ktunaxa, Syilx and Syilx Nation as well as a separate letter to the Yaqaan Nukiy or Lower Kootenay Band. The letters introduced the project and requested a

meeting and or correspondence to introduce the project and better understand related Nation interests and preferences for involvement in the project.

BGC, Pinna, and the City met with Syilx Okanagan Nation Alliance on February 20, 2026. The following items were discussed:

- Cultural values in the project area. BGC and Pinna have followed up with shapefiles with the spatial outlines of the steep-creek fans and requested that Syilx Okanagan Nation Alliance review and highlight if there any cultural values and resources that we need to be aware of.
- Importance of upstream management of watersheds and in taking a holistic approach to watershed management. A community watershed plan developed in partnership with stakeholders, including First Nations, was highlighted for future consideration.
- Interest in providing input on the technical reports. BGC and Pinna have provided a copy of the interim draft report for this project (BGC & Pinna, December 9, 2025) and will provide a copy of this report in draft for review.

Another meeting will be scheduled with Syilx Okanagan Nation Alliance following completion of this report to review findings.

4.2.2 Working Group Meetings

In December 2025, a working group meeting was held with local QPs and City staff. The meeting focused on the existing strengths in the local context of managing flood and steep-creek hazards and gaps and challenges with the current policy framework.

Strengths and assets in Nelson's current approach included strong local expertise and institutional knowledge across staff and local professionals. High-quality baseline data such as lidar and fan hazard mapping is in place and the small municipal footprint is an advantage for understanding hazards and coordinating mitigation. The current permitting process is generally efficient.

Some of the challenges highlighted included unclear triggers for QP reports, or reports being requested late in the application process leading to surprises at building permit stage. Staff prefer tools that are proactive and early in the process with a desire for clearer, map-based or hazard-category based triggers. Other challenges voiced included ambiguity around exemptions, the feasibility of setbacks in built-up areas and concerns about how new hazard information will affect property values, insurance and willingness to develop.

A gap was identified around rules and responsibilities with respect to private erosion protection works, private bridges and creek modifications. Mapping was generally viewed as valuable for the community for both emergency management and response thresholds, policy, and identification of areas for priority mitigation. There is interest in simple guidance for construction in hazard areas similar to the Wildfire DPA approach and improved linkages between the hazard data and asset management, culvert upgrades and emergency response planning.

In February and March 2026, separate meetings were held with QPs and City staff. Draft policy roadmap recommendations for presented at both meetings for feedback. The main themes that surfaced across both meetings are as follows.

There was broad consensus among QPs that “safe” for the use intended must be defined by the local government, not QPs and an interest in aligning with established precedence in BC on life-safety risk tolerance and alignment with EGBC professional practice guideline requirements. QPs also welcome a clear Terms of Reference from the City directing reporting. Participants expressed a recognition that risk-based hazard management requires flexibility and different approaches depending on location, land use etc. Staff and QPs support guiding high-hazard areas toward lower-occupancy, lower risk uses over time with a recognition that life-safety risk varies by occupancy and duration of use.

The dynamic nature of hazard mapping was discussed with concerns voiced about post-event changes in hazard mapping. It was identified that policy should clarify how frequently maps should be reviewed and how new information should be incorporated.

There were detailed discussions of flood construction levels, exemptions from these specifications and general exemptions from requiring a development permit. The balance between requiring a QP report where needed and reducing cost burdens on applicants was discussed. There was broad support for exemptions for minor changes and non-habitable structures and strong agreement that replacement or reconstruction should not be exempt. Exemptions on Smelter Creek without further study and detailed mapping was recognized as inappropriate.

Public hazard disclosure was discussed again with concerns about property values, developer confidence and insurance costs. Research regrading property values was provided following the meetings, and the City has received information from their insurer, the Municipal Insurance Agency of BC.

Detailed meeting minutes from each working group meeting have been provided to the City under separate cover.

5.0 POLICY ROADMAP RECOMMENDATIONS

5.1 Introduction

BGC and Pinna identified gaps in the City's existing flood and steep-creek risk management policy tools; researched hazard and risk management policy options in Western Canada and internationally and outlined lessons learned in implementation of hazard and risk management policy from other jurisdictions in Western Canada (Section 3.0); and collaborated with City staff and QPs (Section 4.2.2). These activities and the lessons learned throughout informed the recommendations provided herein.

The policy roadmap recommendations include several components detailed in the next several subsections, including:

- Section 5.2: New Steep-Creek Hazard DPA with associated mapping in Drawing 04 and draft policy language in Appendix A. This section includes steep-creek engineering and construction guidance that may be considered by the City
- Section 5.3: Recommended updates to language and mapping associated with DPA 5 Flood Hazard Area and DPA 2 Riparian Area.
- Section 5.4: Terms of Reference for Flood and Steep-Creek Hazard and Risk Assessments with draft language provided in Appendix B.
- Section 5.5: Recommended path towards defining tolerable thresholds for life-safety risk
- Section 5.6: Public communication materials
- Section 5.7: Recommended detailed hazard studies

It is important to note that the draft policy language provided herein requires review by legal counsel prior to implementation. BGC and Pinna also anticipate there to be several other steps that the City will need to take prior to implementation that may include, but is not limited to, a detailed review and update of the policy language by City staff that ensures compatibility with existing policy and bylaws, and additional engagement.

It is also important to note that hazard and risk maps need to be reviewed from time to time to confirm they still adequately reflect the hazard and reflect the most recent understanding of climate change impacts on the hazard. BGC recommends that the City plan to review hazard mapping and hazard policy at regular intervals (e.g., 10 years) with a QP, or under the following circumstances:

- A flood or steep-creek event where there is a significant amount of channel change or topographical changes to the fan.
- Mitigation or flood conveyance structure upgrades or changes that may influence the flow behaviour in the channel or on the fan.

5.1.1 Hazard and Risk Management Philosophy

The City's 2050 OCP has some language in Section 5.9.3.2 and 5.9.3.3 which state the City attempts to mitigate natural hazard risk for development through engaging QPs as necessary and that the City discourages new build projects in areas at high risk to natural hazards.

We recommend expanding on what is already within the OCP to be more specific. The guiding philosophy behind the recommendations provided herein and in the policy roadmap are to:

1. Designate flood and steep-creek hazard areas within the City and adopt guidelines to manage development to mitigate the risk to people, infrastructure, and property.
2. The risk-reduction priority is to first establish that the risk to life safety is tolerable for all new development proposals and, for where life-safety risk is intolerable for existing development, develop a plan to achieve risk reduction over time to a tolerable level. The secondary objective is to reduce economic risk to property and infrastructure.

5.2 Steep-Creek Hazard DPA

A steep-creek hazard DPA is proposed to integrate the existing steep-creek hazard mapping into the City's land-use management policy. The intended outcome is to reduce life-safety and economic risk within these areas by providing consistent guidance on (i) where development can occur within these areas and under what conditions, (ii) when life-safety risk needs to be included within a QP report, and (iii) to increase transparency for applicants on when a development permit and/or a QP report may be needed. A DPA was specifically chosen as the implementation mechanism because it fits into the City's existing policy framework, it is flexible and can be updated regularly, it includes mapping within the OCP schedules, and it can integrate engineering and construction guidance within the DPA.

The recommended approach for each steep-creek hazard area is provided in Table 5-1, including recommended FCLs and setbacks based on BC's Flood Hazard Area Land Use Management Guidelines (FHALUMG), EGBC Professional Practice Guidelines, and previous studies on these creeks. The rationale for each area is provided in the table footnote. More discussion on the designation on FCLs is provided below.

BGC and Pinna have included exemptions from a development permit and exemptions from FCL requirements in the draft policy language based on examples used by other jurisdictions.

BGC and Pinna have outlined minimum FCL and setback requirements within the Steep-Creek Hazard DPA (Table 5-1), following the example set by the District of Hope and the District of West Vancouver. A legal review is recommended to better understand the implications of incorporating floodplain specifications (FCLs and setbacks) in a development permit area and how best to incorporate the option for a site-specific exemption in alignment with the Local Government Act (see Section 2.3.1.1).

Table 5-1 Recommended approach for each steep-creek hazard area within the Steep-Creek Hazard DPA (Appendix A, Drawing 04).

Steep-Creek Hazard Area	Available Mapping (Drawing 04)	Hazard Zone	Recommended Approach	Recommended Minimum FCL (above adjacent ground ⁽¹⁾)	Recommended Minimum Setback (distance from high-water mark of creek)
Anderson Creek fan	Detailed Hazard Zones	High and Very High	A QP report is required that specifically concludes whether the site is “safe for the intended use” and to propose mitigation measures as needed. Life-safety risk must be evaluated through a Quantitative Risk Assessment (QRA) for all development applications.	1 m ⁽²⁾	15 m ⁽⁵⁾
		Moderate	A QP report is required that specifically concludes whether the site is “safe for the intended use” and to propose mitigation measures as needed. “Safe” may be determined through a standards or risk-based approach in alignment with EGBC professional practice guidelines.	1 m ⁽²⁾	15 m ⁽⁵⁾
		Low	No QP report required unless seeking a site-specific exemption from the minimum FCL and/or setback requirements.	0.6 m ⁽³⁾	15 m ⁽⁵⁾
		Very Low		0.3 m for all windows and doors ⁽⁴⁾	15 m ⁽⁵⁾
Smelter Creek fan	Fan Boundary Only	N/A	New development is strongly discouraged until a detailed hazard and risk assessment of the entire fan is completed that delineates the hazard zones and a QRA is completed. Development applications require a QP report that specifically concludes whether the site is “safe for the intended use” and to propose mitigation measures as needed. “Safe” may be determined through a standards or risk-based approach in alignment with EGBC professional practice guidelines.	1 m ⁽²⁾	30 m ⁽⁶⁾
Ward Creek Fan				1 m ⁽²⁾	15 m ⁽⁷⁾
Isaac Brook Fan				1 m ⁽²⁾	30 m ⁽⁶⁾
Foster Creek Fan				1 m ⁽²⁾	30 m ⁽⁶⁾
Cottonwood Creek Fan and Channel	Fan Boundary and 30 m from the Channel High-water Mark Upstream of the Fan		New development is strongly discouraged until a detailed hazard and risk assessment of the entire fan is completed that delineates the hazard zones and a QRA is completed. An interim policy ⁽⁸⁾ is recommended that does not require a QP report unless seeking a site-specific exemption from the minimum FCL and/or setback requirements.	1 m ⁽²⁾	30 m ⁽⁶⁾

Notes:

- “Above adjacent ground” was recommended wording from the working group meetings in February and March 2026. The fans in Nelson are steep, and the use of “above surrounding grade” would make the downslope FCL much higher than needed to achieve the desired intent which is to maintain floodways away from proposed development and prevent overland flow from entering the development.
- BC’s Flood Hazard Area Land Use Management Guidelines (FHALUMG) (2018) and EGBC (August 28, 2018) recommend an FCL minimum of 1 above the surrounding grade on fans.
- EGBC (August 28, 2018) states that the FCL on protected (i.e., mitigated) fans may be 0.6 to 1.0 m above surrounding finished grade. There is precedence on fans in BC (e.g., Resort Municipality of Whistler Fitzsimmons Creek and Whistler Creek fans) for using 0.6 m on fans where there is protective mitigation in place. Detailed modelling on the Anderson Creek fan (BGC, March 10, 2026) suggests the expected range in flood depths within a Low hazard zone during a 500-year debris flood is 0.3 to 0.5 m where 0.5 m is generally in low-lying areas. An FCL of 0.6 m follows precedent and allows for 0.1 m of freeboard on top of the maximum modelled flood depth for the Low hazard zone.
- The Very Low hazard zone is an area of the fan that is still considered part of the active fan, but the detailed modelling (BGC, March 10, 2026) did not show any overland flow reaching this area. BGC (March 10, 2026) estimated that overland flow depths could be 0.1 to 0.3 m within the Very Low hazard area in a 500-year debris-flood event. The recommended FCL is intended to remove obvious access points for overland flow to enter a development.
- BGC recommends a reduced setback of 15 m from the high-water mark of the creek for Anderson Creek based on detailed bank-erosion modelling completed in BGC (March 10, 2026).
- BC’s Flood Hazard Area Land Use Management Guidelines (FHALUMG) (2018) recommend a minimum setback of 30 m from the high-water mark of the channel on fans.
- BGC recommends a reduced setback of 15 m from the high-water mark of the creek for Ward Creek. The purpose of the setback is to maintain a riparian zone and to protect development from bank erosion and channel avulsion. Ward Creek is 10 to 15 m wide as measured from top of banks, it is well-incised, and its dominant-process type is most likely to be floods and debris floods with low sediment availability (BGC, January 3, 2023).
- An interim policy is recommended for Cottonwood Creek based on feedback during the working group meetings that a (i) study was completed on the Cottonwood Creek fan that demonstrated the dominant hazard to be overland flooding and (ii) BGC understands that the City is actively pursuing funding for detailed hazard and risk assessment for Cottonwood Creek and its tributaries (e.g., Giveout Creek).

Steep-Creek Engineering and Construction Guidance

BGC has provided engineering and construction guidance for steep-creek hazard areas within the draft policy language in Appendix A. The guidance provided is general and is limited by the budget and scope of this project. **Town of Canmore Engineering and Design Construction Guidelines** and the District of Squamish OCP and Floodplain Bylaw have more prescriptive guidance based on the development type and hazard. If in practice, the City finds that more prescriptive guidance is useful, further work could be pursued under a separate scope of work.

Below are key principles for development on steep-creek fans that BGC has compiled from research (Section 3.0) and from learnings in advising the Town of Canmore in the development of their guidelines that have been incorporated into the Draft language in Appendix A.

Hazard Type: Each hazard type has different implications for mitigation design; therefore, designers of steep-creek mitigation need to identify which hazard type or types (e.g., flood, debris flood, and/or debris flow) could affect the development.

Building Siting: Place buildings in the lowest hazard zone, particularly any habitable space. Higher hazard zones should be used for low occupancy activities such as parking or green space.

Flood Construction Level (FCL): FCLs are established to ensure that the habitable space and electrical components of a development are higher than modelled flood levels. Infrastructure and buildings should generally be at or above the natural fan topography. Typical guidance in BC's Flood Hazard Land Use Management Guidelines is that the Flood Construction Levels (FCLs) on alluvial fans should be 1 m above the existing ground. Protect fills and building foundations from erosion and undermining.

Site Grading: Floodways should be incorporated into the site grading plans such that overland flow is conveyed through designated areas and away from buildings and infrastructure. In particular, access and egress points (i.e., windows and doors) should be raised to the FCL, and site grading, including driveways, should slope away from access and egress locations.

Channel Erosion Protection: Channel erosion protection should be designed by a QP and should be designed with an understanding of the hazard type (e.g., flood, debris flood, and/or debris flow) and in a manner that the cross-sectional area maintains the capacity to convey the full design flow event with freeboard.

Basements and Secondary Suites

In the working group meetings, a concern was raised that FCLs do not allow for habitable space below the FCL and that basement suites would not be permitted. Bill 44, referred to as the "Small Scale, Multi-Unit Housing" legislation increased the maximum permitted residential density of low-density residential neighbourhoods. The City and BC local authorities have updated zoning to align with the legislation and allow for more dwelling units on low-density residential lots, including increasing the allowance of secondary suites. Limiting basement

suites through the Steep-Creek Hazard DPA may conflict with other priorities that the City may have in regard to housing.

BGC and Pinna have not included specific language on secondary suites in the draft language in Appendix A. There is opportunity for a QP to support an FCL exemption for a property in the language, however, there is limited precedence for reduced FCLs on steep-creek fans in BC. The Town of Canmore Engineering Design and Construction Guidance Section 9.3.3.7 and the District of Squamish Floodplain Bylaw No. 3184 Section 8.4 both have language around secondary suites that the City may consider. Examples of the language and engineering guidance around the use of secondary suites that the City may consider includes:

- Windows and doors are raised 0.3 m above the adjacent ground in accordance with minimum FCL requirements.
- The City require a QP report that evaluates if the life-safety risk for habitable space below ground is within acceptable thresholds and specifically concludes that the site is “safe for the intended use”.
- Walk-out basements are preferred and the walk-out should be on the non-flow exposed side of the property. Walk-outs ideally are built into a hill or on a lot with a high slope gradient to avoid having a sunken basement entrance or dug-in stairs that will allow for overland flow to enter the basement.
- In general, encourage flood resiliency, in particular on the flow-exposed side of the property, that limits the ability for overland flow to infiltrate into a basement.

The District of Squamish Floodplain Bylaw No. 3184 Section 8.4 also specifies “*The owner/developer be required to register a covenant on the land title that includes the QP report and indemnifies the City against all claims*”. BGC recommends that the City engage legal counsel on how best to approach allowance of secondary suites including consideration of whether a covenant is applicable.

In the interim, BGC recommends that secondary suites are allowed within the Very Low Hazard Area of the Anderson Creek fan only.

5.3 Recommended Updates to DPA 5 and DPA 2 Flood Hazard Development Permit Area

BGC and Pinna recommend that the City review the proposed updates and changes to language for the existing DPA 2: Riparian Area and DPA 5: Flood Hazard Area with the support of legal counsel and evaluate whether the proposed changes are compatible with other existing City policies and bylaws. The existing Flood Hazard DPA will need to be updated as Anderson, Ward, Smelter, Isaac Brook, Foster, and Cottonwood Creek will be transferred to the Steep-Creek Hazard DPA.

DPA 5: Flood Hazard Area

- Update the area where the DPA 5 Flood Hazard Area guidelines apply to include all lands within 15 metres of the high-water mark of any lake, watercourse or wetland with the exception of Cottonwood Creek, Anderson Creek, Ward Creek, Smelter Creek, and

Foster Creek which will be covered by the Steep-Creek Hazard DPA. The DPA 5 area will also include any areas identified as Flood Hazard Area in the Schedule D mapping.

- Update Schedule D and Schedule E mapping. In both Schedule D and E, the Steep-Creek Hazard Areas shown in Drawing 04 will need to be added, and the Flood Hazard Area will need to be updated to include only the Kootenay Lake Area (see recommendation in Section 5.7 on updates to the Flood Hazard Area delineation around Kootenay Lake).
- Reword guideline #1 to say that “development is discouraged on hazard lands where current and future risk cannot be mitigated.”
- Clarify the language in guidelines #3, #4, and #5 on when a geotechnical report is required. Guideline #3 relates to all “new developments and applications for new buildings and subdivisions”, guideline #4 relates to “every new building or part of a building” and guideline #5 relates to renovations to any permanent structures, yet the geotechnical report requirement is only mentioned for point #3. Adding clarity to what “part of a building” includes within point #4 is also recommended.
- We recommend reviewing the language provided in the Steep-Creek Hazard DPA in Appendix A and using some of the general requirements provided there to strengthen the guidance for the geotechnical report requirements in guideline #3.
- We recommend reviewing guideline #5, applicable to renovations, and moving these general guidelines to be applicable to development and new buildings as well, and included within the geotechnical reporting requirements.

DPA 2: Riparian Area

We recommend that the City update language to make it clear that a development permit is needed for soil removal or modifications to the channel and structures lower than the building bylaw threshold of 1.2 m for structures within the channel, and that a Professional Engineer is required for the design of erosion protection. Currently, in DPA 2, the language in guideline #7(c) requires that a QEP is engaged and that the QEP follows the Kootenay Lake Shoreline Guidance Document. The Shoreline Guidance Document does require a Professional Engineer to sign off on any erosion protection, but this is not clearly stated in DPA 2. The following language was included within the Steep-Creek Hazard DPA in Appendix A to capture channel modifications with the potential to alter the hazard risk profile and require design of erosion protection by a Professional Engineer. This language may fit better within DPA 2 as it focuses on the riparian area: *“A Professional Engineer must specify design of any works that involve channel modification, including but not limited to erosion protection; bridge structures, paving and modifications to creek banks, and certify that they do not increase risk or hazard to other properties or structures.”*

5.4 Terms of Reference for Flood and Steep-Creek Hazard and Risk Assessments

BGC and Pinna have drafted a draft Terms of Reference for Flood and Steep-Creek Hazard and Risk Assessments that is included as Appendix B. The purpose of the Terms of Reference is to define the minimum expectations for QPs to include within these assessments and their

reporting. BGC recommends the Terms of Reference is reviewed by the City alongside the Steep-Creek Hazard DPA language prior to adoption with the support of legal counsel.

5.5 Defining “Safe” in Terms of Life-Safety Risk

In the working group meetings, it was highlighted by both QPs and by City Staff that EGBC professional practice guidelines encourage local governments to define what is “safe” and that it is not the responsibility of the QP to provide that definition.

The following are options that the City may pursue in future work to develop a risk tolerance policy that defines the minimum “safe” in terms of life-safety risk.

1. The City may require, through a Terms of Reference, that QPs refer to existing precedence on life-safety risk tolerance in BC (e.g., District of Squamish, District of North Vancouver, Cowichan Valley Regional District) to support their declaration of “safe for the use intended” for the purposes of their assessment. BGC and Pinna note that tolerable life safety risk is defined similarly across BC for both individual risk and group risk.
2. The RDCK is currently working on developing a life safety risk tolerance policy. The City could choose to adopt the RDCK’s risk tolerance policy and require its use by QPs.
3. Finally, the City of Nelson can pursue developing their own life safety risk tolerance policy under a future scope of work.

BGC recommends the second option of adopting the RDCK’s risk tolerance policy as the most efficient path that is defensible and aligns with the neighbouring jurisdiction. An adopted risk tolerance policy would need to be referenced in any relevant bylaws, DPAs, and Terms of Reference, and would require legal review prior to implementation.

5.6 Public Communication Materials

The purpose of the communication materials is to educate homeowners on flood and steep-creek hazards, and to provide actionable information to reduce their exposure and vulnerability to these hazards at the parcel-scale. The materials also provide guidance to City staff and QPs regarding the potential impact of climate change on these hazards in the future. The communication materials have been developed for digital use and are intended to be hosted on the City’s website as a public resource. They are formatted such that they can be linked as a resource on the City’s website. They are provided as digital files and will be included in Appendix C for the final report.

The following educational materials are recommended for education to the public on flood and steep-creek hazards:

- A dedicated webpage for flood and steep-creek hazards on the City’s website
- A “how-to” guide for the development permit process, similar to the following reference examples:
 - DNV [steep slope hazard DPA](#)
 - City of Coquitlam [How Development Happens](#) resource
- An interactive webmap, including:

- DPA polygons for each hazard type
- Links to publicly available technical reports associated with each hazard area
- Follows precedents such as the [DNV GEOweb Property Viewer](#)

5.7 Recommended Detailed Studies

Further detailed hazard assessments would benefit from the acquisition of high resolution, bare-earth lidar. The currently available dataset (2017) has a resolution of 2 m and appears to exhibit surface noise, which may limit its reliability for detailed terrain analysis. While a comprehensive evaluation of data quality was not undertaken, these characteristics suggest that an updated lidar survey would improve confidence in topographic interpretation and hazard delineation and would benefit future detailed hazard studies. BGC recommends that the City plan to acquire new lidar at regular intervals (e.g., 10 years) and, particular, following a flood or steep-creek event where there is topographical change that may impact existing knowledge of flood and steep-creek hazards.

Steep-Creek Detailed Studies

BGC recommends that the City pursue to complete detailed hazard and risk assessment for the remaining steep-creek fans within the municipal boundary. The studies would assess the potential for life-safety risk and create hazard maps with hazard zones that are consistent with the hazard zones delineated for the Anderson Creek fan, and provide recommendations for mitigation measures needed to allow for development that meets established life-safety risk thresholds in BC and that demonstrates a favourable cost-benefit for economic risk.

The benefit of completing these detailed hazard studies is that it allows for the delineation of Low and Very Low Hazard Areas where the development permit requirements can be lessened, and it reduces the level of effort for each QP asked to provide a QP report.

The priority for detailed study and the rationale is listed below:

1. Cottonwood Creek fan and channel including an evaluation of the risk posed from Giveout Creek (a tributary of Cottonwood Creek): Cottonwood Creek is highly-developed on the fan and adjacent to the channel and there is potentially a high economic risk from Cottonwood Creek. Giveout Creek may pose a life-safety risk that is intolerable and it is unknown whether the life-safety risk may extend to the Cottonwood Creek channel within the municipal boundary. Giveout Creek is within the RDCK and it may be advantageous to pursue a detailed study of both creeks in partnership with the RDCK.
2. Smelter Creek fan: The Smelter Creek fan is likely to produce debris flows which are commonly associated with intolerable life-safety risk (BGC, January 3, 2023). Most of the fan is currently low occupancy land use (i.e., golf course). A detailed hazard and risk assessment should be completed in advance of future development.
3. Ward Creek fan: The Ward Creek fan is highly developed and most of the channel on the fan is subsurface. Similar creeks exist in the DNV and have frequently plugged culverts and have led to extensive overland flooding and economic damage. BGC

recommends a detailed study is pursued to better understand the risk to residents and whether they City's infrastructure is appropriately sized to handle the steep-creek hazard from Ward Creek.

4. Foster Creek fan and Isaac Brook fan: Foster Creek fan and Isaac Brook fan were identified in a study completed for the RDCK in 2023 (BGC, May 2, 2023). BGC recommends a detailed hazard and risk assessment is completed in partnership with the RDCK in advance of future development for both fans.

Lake Flooding

BGC understands that the technical study informing DPA 5 flood hazard boundary in Schedule E and the FCLs in Schedule D is unknown. The flood impact line (Drawing 02) from detailed modelling completed by BC Hydro in 2013 covers more area than the DPA 5 boundary, and it suggests that the flood hazard area delineated in Schedule E of the OCP around Kootenay Lake may not be sufficient to address Kootenay Lake flood hazards. BGC and Pinna recommend the following:

- We recommend expanding the DPA 5 hazard boundary around Kootenay Lake (i) to match the flood impact line in Drawing 02, or (ii) redraw the boundary using the most recent lidar data such that the flood hazard boundary matches the elevation contour of the FCL elevations in Schedule D of the OCP. BGC understands that the RDCK uses the same hazard boundary and FCLs as the City. We recommend that updating the boundary is pursued as a joint project with the RDCK to maintain consistency.
- Pursue a detailed study to update the FCLs and hazard boundary for Kootenay Lake. Given the size of Kootenay Lake and the numerous stakeholders that may be interested in this study, the City may consider pursuing this study in partnership with the RDCK, local First Nations, BC Hydro, and others.
- Include the source (e.g., technical study and mapping) for the DPA mapping schedules to provide clarity in how the area was delineated and to show a clear record of mapping updates.

Steep Slopes

The desktop-level steep-slope screening (Section 2.1.3) indicates that a detailed, city-wide steep-slope hazard study is not currently warranted for the City. Unmitigated steep slopes are primarily in undeveloped areas, including municipal parks and along the existing municipal boundary. However, these areas may pose a hazard if new development is proposed. Similarly, should the municipal boundary be expanded, BGC recommends that the City revisit whether steep-slope hazards should be explicitly considered within the development permitting process.

If the City elects to formally incorporate steep slopes into the OCP, the **DPA framework implemented by the DNV** provides a relevant precedent for managing development in steep slopes in an urban context. For land-use planning purposes, the DNV identifies "steep slopes" as areas with slope angles greater than 20° and a vertical height exceeding 10 metres. These criteria are used to delineate areas where development is subject to additional review to

manage potential slope-related hazards. Site-specific assessment and professional judgment are required to determine slope stability; slope angle and vertical rise alone are insufficient.

BGC did not review the steep slopes outside of the municipal boundary of Nelson. There are slopes with rock outcrops above the City, particularly on the north side of Kootenay Lake, that are steep (shadow angle $> 27^\circ$, Evans & Hungr, 1993) and may warrant further study to evaluate whether they pose a credible hazard to the City.

Although steep terrain is a contributing factor to slope instability, the results of this screening-level assessment do not indicate a need for a detailed, city-wide steep-slope hazard study at this time because it is not a ubiquitous hazard within the developed areas of the City or where the City is zoned for development. Section 56 of the community charter could be used to invoke a site-specific assessment by a Qualified Professional, supported by engineering judgment, where indicators of instability are observed (e.g., ground cracking, slope ravelling, rockfall, or tree fall) or where the criteria noted above is being met (slope $> 20^\circ$ and vertical relief > 10 m) as part of the development permit process.

6.0 CLOSURE

We trust the above satisfies your requirements. Should you have any questions or comments, please do not hesitate to contact us.

Yours sincerely,

BGC Engineering Inc.
per:



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EGBC Permit to Practice, BGC Engineering Inc. 1000944

KRH/LCH/mjp/js

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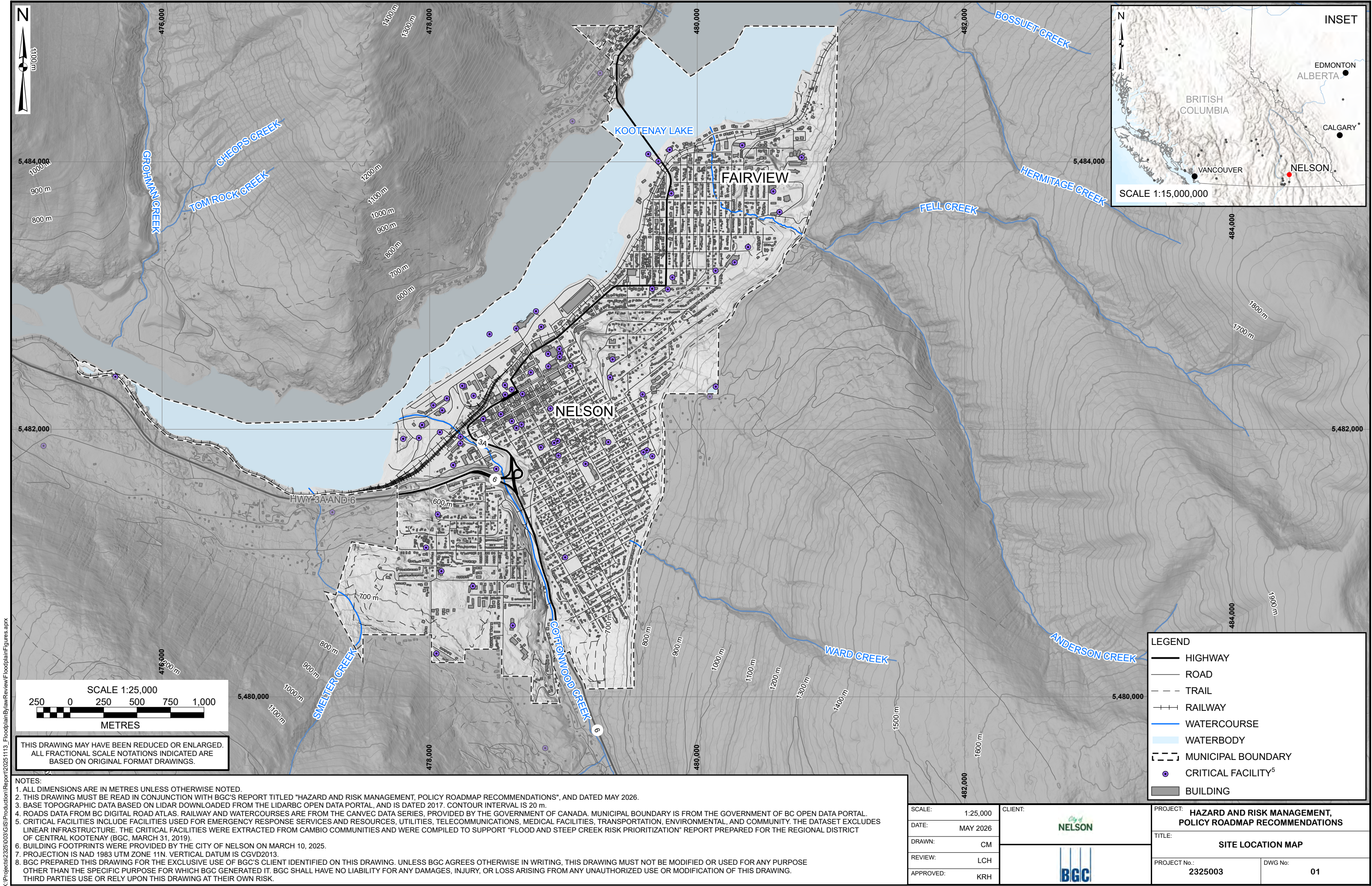
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DRAWINGS





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 6. BUILDING FOOTPRINTS WERE PROVIDED BY THE CITY OF NELSON ON MARCH 10, 2025.
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REVIEW:	LCH
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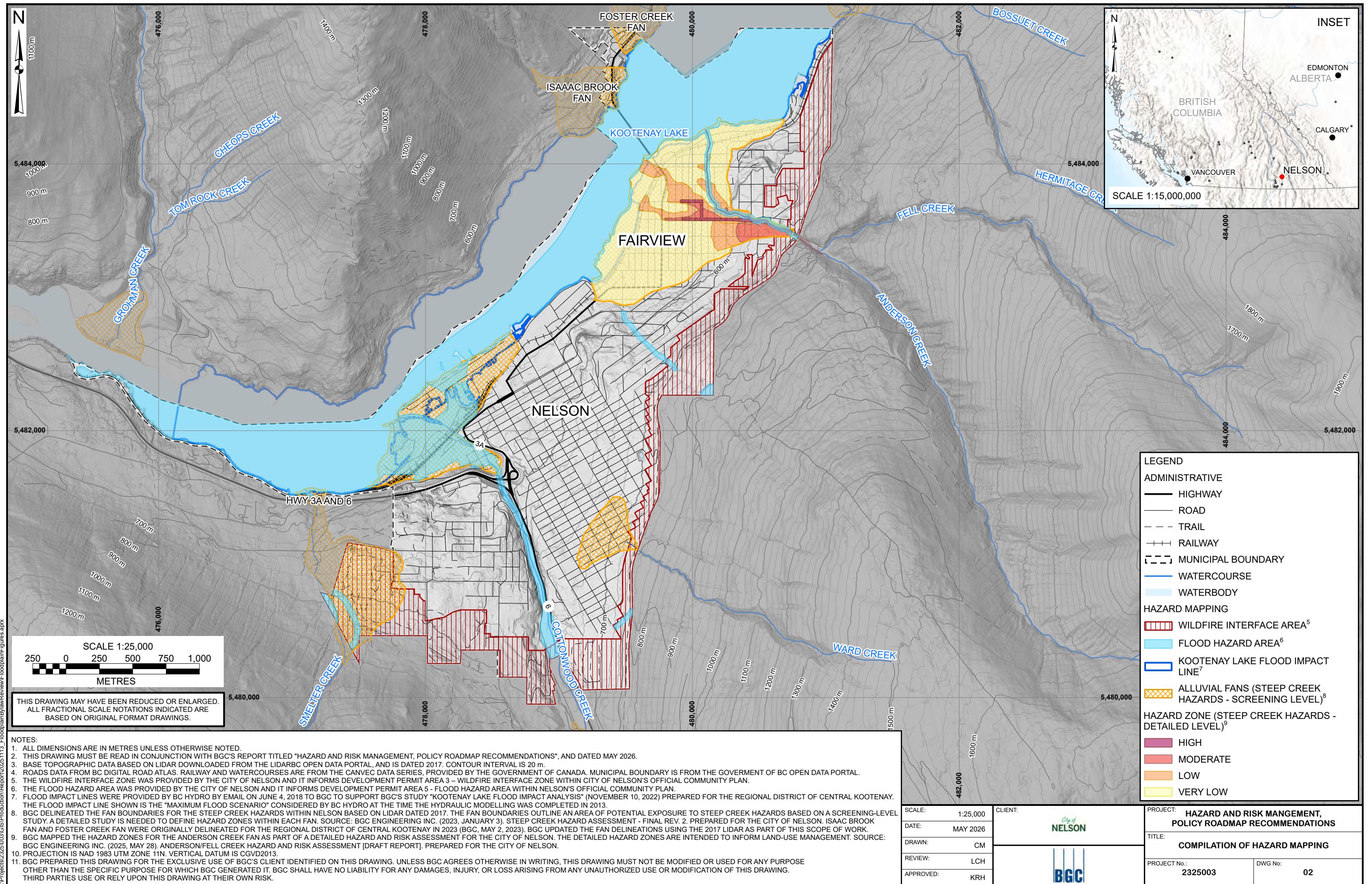
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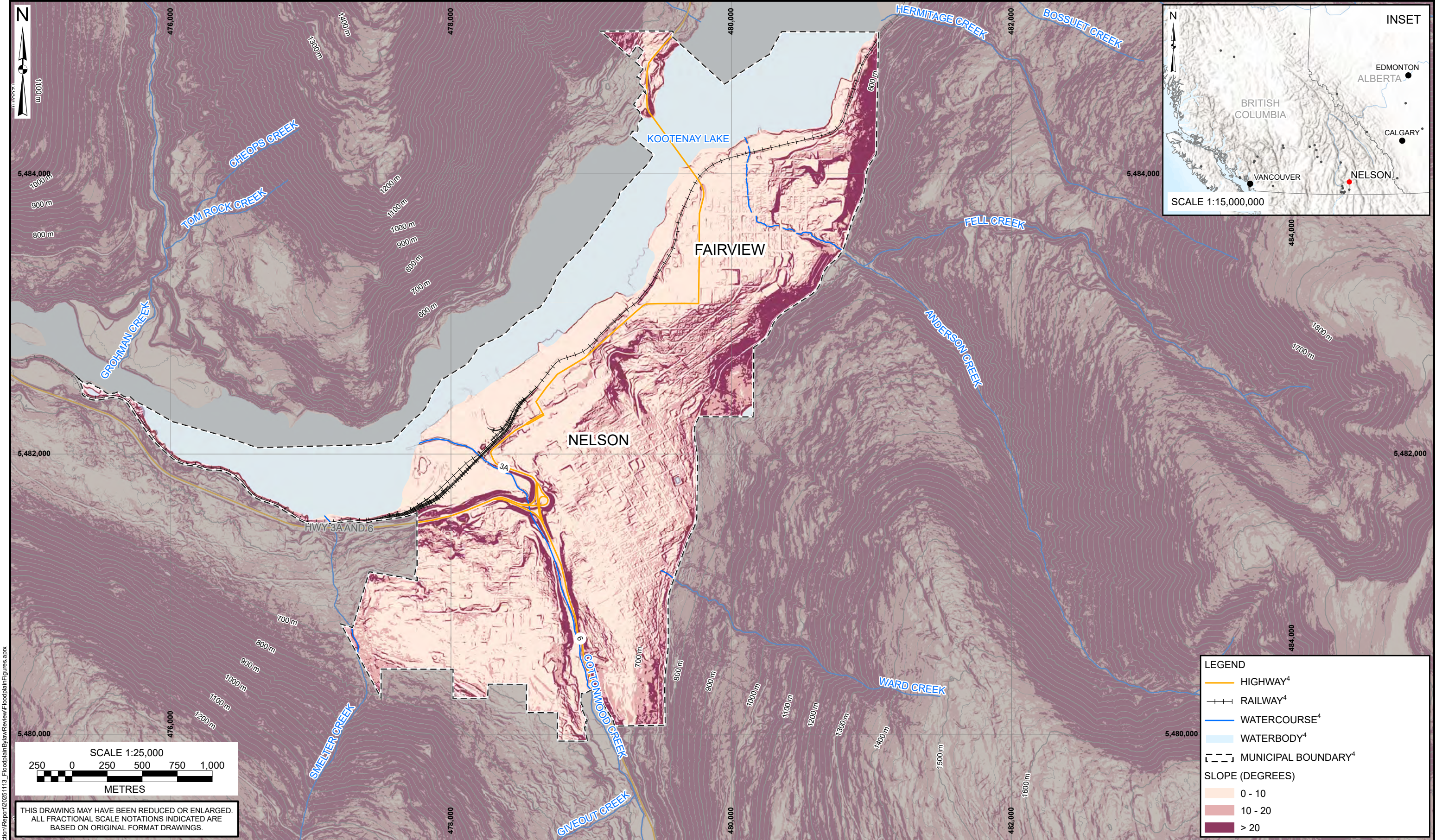
PROJECT: **HAZARD AND RISK MANAGEMENT,
POLICY ROADMAP RECOMMENDATIONS**

TITLE: **SITE LOCATION MAP**

PROJECT No.:
2325003

DWG No.:
01





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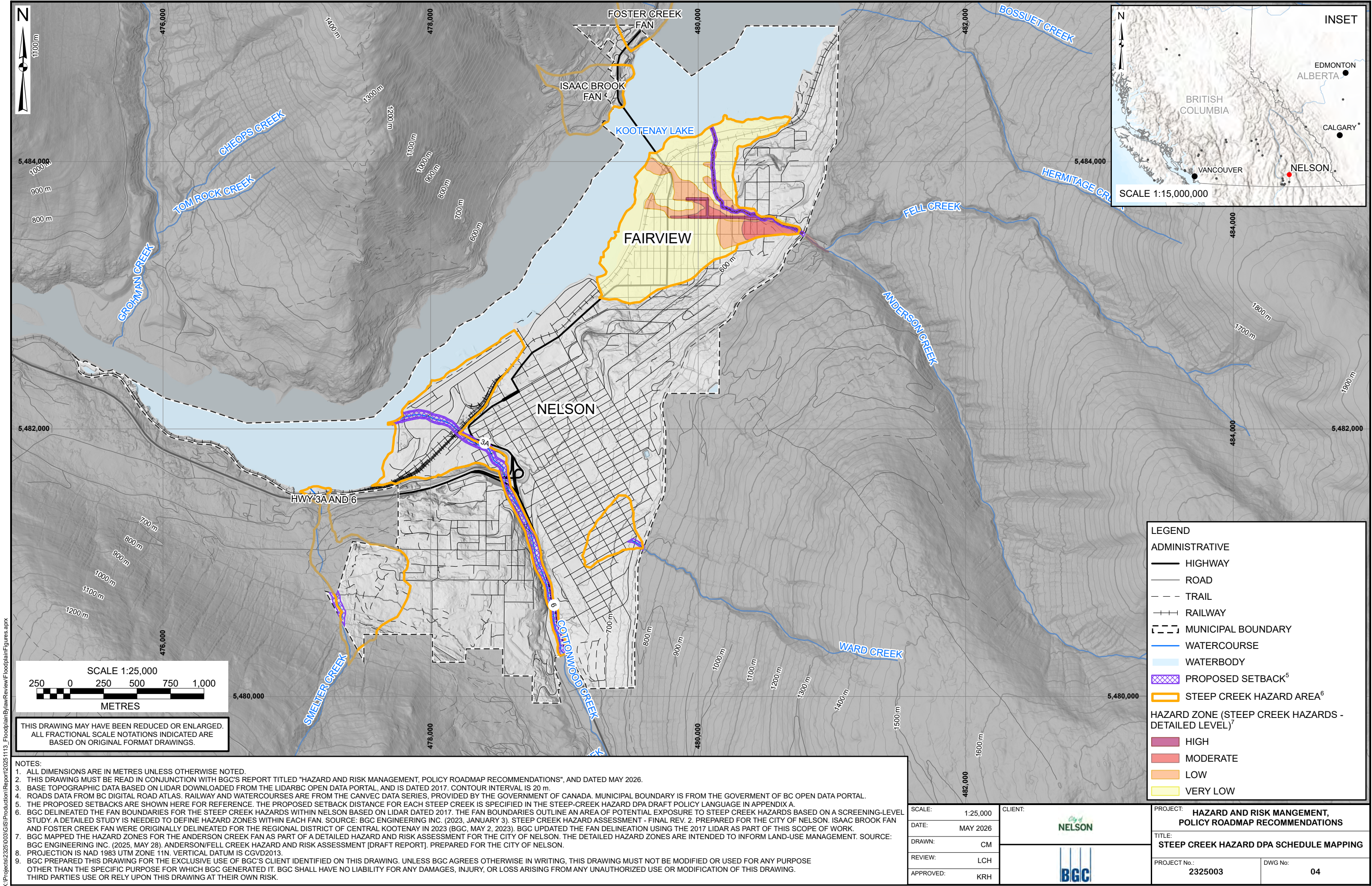
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APPROVED:	KH

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PROJECT: HAZARD AND RISK MANAGEMENT, POLICY ROADMAP RECOMMENDATIONS	
TITLE: SLOPE GRADIENT MAPPING	
PROJECT No.: 2325003	DWG No.: 03



APPENDIX A

STEEP-CREEK HAZARD DPA DRAFT POLICY LANGUAGE



Date May 5, 2026

Project 2325003

To City of Nelson

From BGC Engineering Inc. & Pinna Sustainability Inc.

Draft Policy Language Recommendations: Steep-Creek Hazard Development Permit Area 6

LEGEND

Black text is recommended language

Grey text is language directly from, or slightly modified from, the City of Nelson's 2050 Official Community Plan

Blue text is language directly from other jurisdictions' geohazard-related development permit areas (DPAs)

Italics are notes to City of Nelson staff for consideration

JUSTIFICATION AND PURPOSE

The justification of Development Permit Area 6, for the purpose of section 488(2)(b) of the Local Government Act, is for the protection of development from hazardous conditions. The purpose is to minimize risk to people, property, and the environment from hazards originating from mountain creeks which includes a continuum between these hazard types: flood, debris flood, and debris flow ("steep-creek hazards"). New development must consider and mitigate these hazards to reduce the exposure of people and property, improving public safety and community resilience to natural hazards.

AREA

The Steep-Creek Development Permit Area Guidelines apply where lands have been identified as Steep-Creek Hazard Areas on Schedule X. *(Shapefiles to be provided by BGC. Steep-Creek Hazard Areas are in Drawing 04.)*

Mapped Steep-Creek Hazard Areas include:

- Within 30 metres of the high-water mark of Cottonwood Creek upstream of the fan; and
- The steep-creek fans of Cottonwood Creek, Smelter Creek, Ward Creek, Isaac Brook, Foster Creek, and Anderson Creek.

Anderson Creek has detailed steep-creek hazard mapping categorized into the areas identified in Table 1.

Note that the areas could be named here in the DPA but the descriptions (table) may fit better within section 5.9 Natural Environment, Wildfire Protection and Community Safety of the OCP

Table 1. Description of Steep-Creek Hazard Areas.

Hazard Area	Description
High	An area characterized by fast flowing and deep water with debris which has a moderate likelihood of causing structural damage to buildings and a high likelihood of causing sediment and water damage to property and roads. It is potentially unsafe to people on the first floor or in basements, and for people outside of buildings.
Moderate	An area characterized by fast flowing but mostly shallow water with debris which a low likelihood for structural damage, and a high likelihood of sedimentation and water damage. It is potentially unsafe to more vulnerable individuals (i.e. older adults and children) on the first floor or in basements of buildings and any person outside of buildings in areas of deeper water.
Low	An area with a very low likelihood of structural damage, and a moderate likelihood of sedimentation and water damage. It is potentially unsafe for more vulnerable individuals outside of buildings in areas of deeper water.
Very Low	An area with low likelihood of water damage and it is generally safe for people.

DEVELOPMENT REQUIRING A PERMIT

A development permit is required prior to any development within DPA 6 as follows:

- Subdivision of land where the number of parcels is increased.
- Construction of, addition to or alteration of a building or other structure.
- Renovations for the purposes of adding a secondary suite.
- Alteration of land, including the removal, deposit or moving of soil greater than 30 cubic metres.
- Channel modifications including, but not limited to, structural works within, crossing, or on the banks of the channel, erosion protection works, impervious paving, or any works where the cross-sectional area of the channel is modified. *(This may also be moved to the existing DPA 2 with an amendment to the guidelines that a professional engineer sign off on any channel modifications).*

EXEMPTIONS FROM THE REQUIREMENT OF A DEVELOPMENT PERMIT

In Development Permit Area 6, a development permit is not required for:

- Internal alterations of a building only.
- Boundary adjustments between two lots when no additional properties are created.

- Construction, renovation or repair of a permanent structure if the structure remains on its existing foundation with no increase in the floor area unless it is for the addition of a secondary suite
- Property owned by the Corporation of Nelson.
- Routine maintenance of existing landscapes.
- Installation of fencing that allows for the passage of water, deck or patios, all that do not require the removal of trees, except where they are reviewed as part of a larger Steep-Creek Hazard DPA 6 application. This does not apply to fencing placed within the channel.
- Emergency response or works required by the Corporation of Nelson to prevent or control emergencies.
- Structures with a floor area less than 10 square metres.
- Planting or removal of trees or vegetation in accordance with City Bylaws.

GENERAL EXEMPTIONS FROM THE REQUIREMENT TO MEET THE FLOOD CONSTRUCTION LEVEL (FCL)

The following are exempt from meeting the minimum FCL requirements within these guidelines.

- Accessory buildings such as storage buildings and domestic greenhouses that are not habitable space, provided that all electrical and mechanical equipment is installed above the FCL. *Note that some jurisdictions specify 10 m² for exempt accessory building*
- Construction of a portion of a building or structure that is used as a porch, carport or garage.
- On-loading and off-loading facilities associated with water-oriented industry and portable sawmills, provided the main electrical switchgear is located above the FCL.
- That portion of a building with a ceiling height not exceeding 1.5 m (crawl space) provided that no goods damageable by floodwater are stored within the crawl space.
- Recreation shelters, stands, washrooms and other outdoor facilities designed to withstand periodic flooding.
- *Note that exempting commercial space came up during the Working Group meetings. There are a few examples of this, including the West Vancouver Foreshore DPA. If you wanted to go this direction, we recommend the following language: Commercial space is exempt from FCLs only where no electrical or mechanical equipment is installed below the FCL and where no habitable space is located below the FCL.*

GENERAL GUIDELINES

1. The City will require the registration of a Section 219 restrictive covenant for lands that have been identified as hazardous, prepared at the applicant's expense and to the satisfaction of the City. *(Consider whether the City wants to require the Section 219 covenant for all development permits or only when a QP is required (QP reports are required in Moderate and High Hazard Areas, within the fan boundaries of Smelter,*

Ward, Isaac Brook, and Foster Creek, and for applicants seeking an exemption from the minimum FCL requirements listed in Table 2).

2. Development should:
 - a. Be constructed in a location and manner that will maximize the safety of people, the natural environment and property;
 - b. Not increase the risk or hazard to, or vulnerability of, other properties and structures;
 - c. Be located in the least hazardous part of the subject parcel;
 - d. **Not include the installation of any mechanical equipment or electric wiring below the FCL except in accordance with the recommendations made by a Qualified Professional and in compliance with these guidelines;**
 - e. **Not include habitable space below the FCL specified by the Qualified Professional except in accordance with the recommendations made by a Qualified Professional and in compliance with these guidelines;**
 - f. With respect to renovations to any existing permanent structure, where reasonable, reduce steep-creek hazard by raising the habitable area to the FCL;
 - g. Consider additional structural and/or non-structural flood protection measures to mitigate the impacts of flooding within areas already developed;
 - h. Maintain and/or restore vegetation along all creek banks and within floodplain setback areas to minimize erosion and protect slope stability;
 - i. Develop the site so as to allow normal natural processes and anticipated flooding to occur. Where appropriate, this should include actions, such as grading of the site, to deflect flood water, and to allow for floodways or pooling of floodwater.
 - j. **Design the building so that egress/ingress to buildings, such as windows and doorways, are located above the FCL.**
 - k. For any development activity occurring within a Riparian Area (15 m from the high-water mark) a development permit adhering to the guidelines in Development Permit Area 2 will be required.
 - l. A Professional Engineer must specify design of any works that involve channel modification, including but not limited to erosion protection; bridge structures, paving and modifications to creek banks, and certify that they do not increase risk or hazard to other properties or structures.
3. A drainage plan is required for new construction and subdivisions. The drainage plan should aim to minimize to the fullest extent the impact the development may have on riparian areas, if applicable, while developing and when built. The drainage plan must include recommendations that address the following factors:
 - i. Water quality;
 - ii. Water quantity;
 - iii. On-site detention;
 - iv. Erosion and Sediment control;
 - v. Impact on fish and wildlife habitat; and
 - vi. Physical riparian functions.
4. For the purposes of these guidelines, unless an FCL and setback is established by a Qualified Professional in accordance with these guidelines, the floodplain specifications (minimum FCL and setback) are set out in Table 2. *See the notes in the main report about legal review and existing examples of including FCLs in DPAs instead of in bylaws.*

- a. All structural support or compacted fill or combination thereof supporting a building or structure shall be designed to withstand forces imposed by overland flow and debris. Minimum requirements are outlined in Table 3.

Table 2. Floodplain specifications – Minimum FCLs and setbacks.

Area	FCL	Setback
Cottonwood Creek Fan and Channel	1 m above adjacent ground.	30 m from high-water mark of the creek and any side channels.
Smelter Creek Fan	1 m above adjacent ground.	30 m from high-water mark of the creek and any side channels.
Ward Creek Fan	1 m above adjacent ground.	15 m from the high-water mark where the creek daylights
Foster Creek Fan	1 m above adjacent ground.	30 m from high-water mark of the creek and any side channels.
Anderson Creek Very High and High Hazard Areas	1 m above adjacent ground.	15 m from high-water mark of the creek
Anderson Creek Moderate Hazard Area	1 m above adjacent ground.	15 m from high-water mark of the creek
Anderson Creek Low Hazard Area	0.6 m above adjacent ground.	15 m from high-water mark of the creek
Anderson Creek Very Low Hazard Area	No FCL applied but all access and egress to be at minimum 0.3m above adjacent ground.	15 m from high-water mark of the creek

Table 3. Minimum design standard for fill slope or structural foundation erosion protection.

Flow Condition and Hazard Area	Minimum Design Standard
Velocity < 1 m/s <u>and</u> in Very Low or Low Hazard Areas	No bare earth (i.e., fill slopes must be revegetated.
All other conditions	Erosion and scour protection shall be designed by a Professional Engineer.

AREA-SPECIFIC GUIDELINES

Anderson Creek Fan Hazard Areas

1. Development or alteration of land within the Very High, High, and Moderate Hazard Areas on Anderson Creek identified on Schedule X, shall require a geotechnical report completed by a Qualified Professional and prepared in accordance with the City's Terms of Reference for Flood and Steep-Creek Hazard and Risk Assessments stating that the proposed development is safe for the use intended. The report must address the following minimum requirements:

- a. In the High and Very High Hazard Areas, life-safety risk must be assessed quantitatively and compared to existing thresholds;
 - b. Certify that no alternative development location is available outside the hazard area on the lot;
 - c. Specify mitigation requirements with respect to the proposed location, form, elevation, and orientation of development to reduce hazard exposure; and
 - d. Specify design of foundations, floodproofing fill, and protective works to ensure that structures are oriented and anchored to minimize the potential impact of flood, debris and erosion damage (Table 3).
 - e. Demonstrate that the proposed development integrates resilient design and that reasonably practicable measures to reduce risk have been identified and integrated as appropriate.
2. Development or alteration of land within the Low or Very Low Hazard Areas does not require a geotechnical report completed by a Qualified Professional unless the FCL and/or setback within these guidelines (Table 2) is to be varied. A person may make an application to the City of Nelson to exempt a specific parcel of land or a use, building or other structure on that parcel of land from the flood specifications (Table 2) where:
 - a. The City of Nelson Director of Development Services (*given the Delegation Bylaw*) considers the exemption advisable; and
 - b. The property owner has provided a report prepared by a Qualified Professional in accordance with the City's Terms of Reference for Flood and Steep-Creek Hazard and Risk Assessments certifying that:
 - i. The land may be used safely for the use intended,
 - ii. A valid hardship exists and no other reasonable option is available,
 - iii. The proposed FCL and Floodplain Setback represent the minimum practicable variation from the requirements of these guidelines given the location, configuration, and intended use of the land, specifically without regard to the economic circumstances or siting preferences of the Owner,
 - iv. The exemption will not result in a transfer of flood hazard to other lands, and
 - v. That life-safety risk is within tolerable thresholds and that other proposed mitigation measures can achieve the same or greater risk reduction.

Smelter Creek Fan, Ward Creek Fan, and Foster Creek Fan Hazard Areas

1. New development is generally discouraged in these hazard areas until a detailed hazard and risk assessment, and delineation of hazard areas is completed for the entire fan.
2. Development or alteration of land within the Steep-Creek Hazard Areas on Ward and Smelter Creek as identified in Schedule X, shall provide a geotechnical report completed by a Qualified Professional and prepared in accordance with the City's Terms of Reference for Flood and Steep-Creek Hazard and Risk Assessments stating that the proposed development is safe for the use intended. The report must address the following minimum requirements:
 - a. Life-safety risk must be assessed qualitatively or quantitatively in accordance with EGBC professional practice guidelines and compared to existing tolerance thresholds;
 - b. Certify that no alternative development location is available outside the hazard area on the lot;

- c. Specify mitigation requirements with respect to the proposed location, form, elevation, and orientation of development to reduce hazard exposure; and
- d. Specify design of foundations, floodproofing fill, and protective works to ensure that structures are oriented and anchored to minimize the potential impact of flood, debris and erosion damage (Table 3).
- e. Demonstrate that the proposed development integrates resilient design and that reasonably practicable measures to reduce risk have been identified and integrated as appropriate.

Cottonwood Creek Fan and Channel Hazard Area

Until such time as detailed steep-creek hazard mapping for Cottonwood Creek is available, the following guidelines shall apply.

1. A geotechnical report completed by a Qualified Professional is not required in the Cottonwood Creek Steep-creek Hazard Area identified on Schedule X unless the FCL and/or setback presented in these guidelines in Table 2 is/are proposed to be varied.
2. In cases where a geotechnical report completed by a Qualified Professional is required, it will be prepared in accordance with the City's Terms of Reference for Flood and Steep-Creek Hazard and Risk Assessments and will address the following minimum requirements:
 - a. Certify that the proposed development is safe for the use intended;
 - b. Certify that no alternative development location is available outside the hazard area on the lot;
 - c. Specify mitigation requirements with respect to the proposed location, form, elevation, and orientation of development to reduce hazard exposure; and
 - d. Specify design of foundations, floodproofing fill, and protective works to ensure that structures are oriented and anchored to minimize the potential impact of flood, debris and erosion damage (Table 3).
 - e. Demonstrate that the proposed development integrates resilient design and that reasonably practicable measures to reduce risk have been identified and integrated as appropriate.

APPENDIX B

DRAFT TERMS OF REFERENCE FOR FLOOD AND STEEP-CREEK HAZARD AND RISK ASSESSMENTS



Date May 5, 2026

Project 2325003

To Qualified Professionals, Land Owners, and Developers

From City of Nelson Development Services

Draft Terms of Reference for Flood and Steep-Creek Hazard and Risk Assessments

LEGEND

Black text is recommended language

Grey text is language directly from, or slightly modified from, the City of Nelson's Terms of Reference for the Submission of Geotechnical Assessment Reports for Subdivision Applications (July 2024)

Italics are notes to City of Nelson staff for consideration

JUSTIFICATION AND PURPOSE

The City of Nelson's (City) Official Community Plan (OCP) designates certain parts of Nelson, BC as Flood and Steep-creek Hazard Areas. Development Permit Areas (DPAs) in the OCP state that a report prepared by a Qualified Professional (QP) will be required for most development proposals (i.e., building permit, subdivision, development permit, rezoning) on land located within an identified Flood or Steep-Creek Hazard Area. The report shall establish the suitability of the land for development and any required mitigation measures.

Further, under the provisions of Section 86 of the *Land Title Act*, the Approving Officer – when approving a subdivision which may be subject to flooding, erosion, landslip or avalanche – may require an engineering report certifying that the land may be used safely for the intended purpose and/or require the subdivider to enter into a covenant to establish mitigation requirements. Similar provisions are available under the Bare Land Strata Regulations.

Under the provisions of Section 56 of the Community Charter, a building inspector can request a report prepared by a Qualified Professional where it is considered that construction would be on land subject to hazards whether specifically identified on a map or not.

Each lot is unique and carries unique requirements, which require the judgment of the QP completing the assessment. The following is intended to provide general terms of reference for typical requirements when completing flood and steep-creek hazard and risk assessment reports in the City of Nelson.

1.0 GENERAL

- The QP must be registered and in good standing with Engineers and Geoscientists of British Columbia (EGBC). It is the responsibility of the QP to determine whether he/she has the appropriate level of education, training, and experience to conduct and accept responsibility for hazard and/or risk assessments for proposed developments.
- Flood and steep-creek hazard and risk assessments must be conducted in accordance with the procedures and guidelines in the most recent version of EGBC professional practice guidelines "*Legislated Flood Assessments in a Changing Climate in BC*" and "*Landslide Assessments in British Columbia*", as amended from time to time clearly documenting any areas of the report that diverge from the guidelines.
- The professional must consider the most recent version of the *Flood Hazard Area Land Use Management Guidelines* and other Provincial guidelines for flood hazard assessment and mitigation, as amended from time to time, clearly documenting any areas of the report that diverge from the guidelines.

2.0 INSURANCE

The QP shall provide the City with evidence of professional liability insurance coverage in the amount of at least \$2,000,000 as provided to their client.

3.0 REPORT CONTENT

A report supporting a subdivision application or land development application must include the information below. While the structure of the report is flexible, all listed items must be addressed.

General

- The report shall reference the appropriate EGBC professional practice guidelines and the level of assessment being conducted. The hazard and risk assessment shall follow the typical hazard and risk assessment methods outlined in EGBC guidelines for the proposed class of development and document any deviations from the guidelines.
- The report shall reference this Terms of Reference document.
- The report shall include either or both, as applicable, completed by the QP:
 - Flood Assurance Statement from EGBC's guidelines for *Legislated Flood Assessments in a Changing Climate in BC*.
 - Landslide Assessment Assurance Statement from EGBC's guidelines for *Landslide Assessments in British Columbia*.
- Any existing covenants related to land use or natural hazards shall be identified and attached to the report, with relevant zoning or geotechnical setbacks or easements marked on the plan, where applicable.
- The report shall identify and assess any hazards or site conditions which may affect the development and use of the property. The report must clearly state the specific types of hazards assessed (e.g., clearwater flood, debris flood, debris flow, groundwater flows,

erosion, subsidence, landslide, avalanche, earthquake), as well as any hazards that may affect the subject area but were excluded from the scope of the assessment.

Proposed Development

- The report must contain the legal description and civic address of the subject property as well as a plan showing the location of the property.
- The report shall include a plan drawing(s) showing the proposed development, including the number, type and zoning of lots and/or units, construction type, and use, and any associated vegetation removal or soil disturbance.

Field Investigation

- The QP shall complete all necessary surface and subsurface investigations in order to complete the hazard and/or risk assessment.
- The field review may include but is not limited to:
 - Topography and features such as bedrock outcrops, cliffs and slope transitions, seasonal and permanent wet areas, seasonal and permanent watercourses, top of bank, etc. When applicable, the topographic survey will include current and proposed roads, site grading and post development contours.
 - Physical properties of soil and rock
 - Identification of any potential avulsion channels and evidence of bank erosion.
 - Observations of surface water and groundwater drainage such as channels, gullies, seepage points, and ponding.
 - Observations for evidence of slope movement, such as scarps, tension cracks, uneven ground, depressions or sinkholes, bulging slopes, tilted trees, debris.
 - Description of any existing mitigation structures (e.g., berms, erosion protection, basins) and flood conveyance structures and their erosion protection on or near the property.
 - Photographs from the field visit.

Note: Some Terms of Reference are very prescriptive on the level of assessment required for each development type and provide a checklist for what is needed in desktop assessment, hazard characterization, field investigation, hazard assessment, risk assessment, risk-reduction and mitigation measures. That is outside of this scope of work to provide that level of detail for each development type, however, these details could be added at a later date. Any prescriptive checklist should align with guidance within EGBC Professional Practice Guidelines.

Quantitative Risk Assessments (QRA) (as applicable when assessing life-safety risk and/or group risk)

- The QP must describe the risk assessment methods, variables, and assumptions.
- The risk assessment results must be compared against risk tolerance thresholds used in BC to justify the determination of “safe”.
- Where density is being increased, the QP shall refer to EGBC professional practice guidelines to evaluate whether calculation of group (societal) risk is required.

Reporting and Recommendations

- The QP must specifically conclude on whether the site is ‘safe for the intended use’.
 - The QP may use a standards-based or risk-based approach to determine “safe” depending on the level of assessment as described in EGBC professional practice guidelines. See additional reporting requirements above for when a QRA is required.
 - For any development in High and Very High Steep-Creek Hazard Areas, the QP is required to assess life-safety risk via a QRA in addition to the requirements for the level of assessment outlined in EGBC guidelines. The QP must demonstrate that the proposed development does not increase the exposure or vulnerability of the inhabitants to the steep-creek hazard.
- The report must specify all mitigation measures required to allow the QP to conclude the site is ‘safe for the intended use’. Typical hazard mitigation measures include (but are not limited to) specification of Flood Construction Level(s), setbacks, erosion/scour protection requirements for floodproofing fill and building foundations, construction/upgrade of Protective Works (e.g., basin, berms), establishing flood ways/site coverage requirements, and establishing Statutory Right of Ways for Protective Works.
- The QP must certify that the development and any mitigation does not result in a transfer of risk to other lands or negative impacts on floodway conveyance.
- The QP must consider access/egress for lands where road(s) may be impacted by a hazard.
- The report shall state that the Approving Officer may rely upon the report when making a decision on the subdivision application.
- Describe limitations and uncertainties of the hazard and/or risk assessment.
- The hazard and risk assessment must undergo a documented checking and review process before being finalized and delivered to the City.

4.0 COVENANT

Under Section 219 of the Land Title Act, the owner/developer may be required by the City to register a covenant against the property title at the Land Titles Office as a notification to future land owners. The covenant will incorporate provisions included in the QP report(s) and indemnify the City against all claims. It must be in a form as required by the City, granted to the City in priority of all liens, charges and encumbrances and executed in registrable form by the person who owns the land. During the construction phase, enforcement of the covenant provisions are the responsibility of the owner/developer and the QP.

5.0 PEER REVIEW

The City may require an independent peer review for conformance to good engineering practice and adherence to these guidelines on a case-by-case basis. The peer review shall be completed by a QP *with the City selecting from a list of consultants proposed by the applicant*. Any costs incurred by the City to conduct a peer review shall be borne by the owner/developer.

The QP engaged by the City shall notify the QP responsible for the hazard/risk assessment in writing of the peer review. The peer review may identify deficiencies in field investigations, analysis and/or reporting. All deficiencies will need to be resolved prior to development approval.

APPENDIX C

PUBLIC COMMUNICATION MATERIALS



STEEP-CREEK HAZARDS IN NELSON

WHAT ARE STEEP-CREEK HAZARDS?



Mountainside creeks can be hazardous because their steep grade means that they have lots of energy to make water flow quickly. When triggered, they can quickly turn from a quiet stream to a rumbling torrent, and can carry mud, large rocks, and even entire trees into our neighbourhoods.

WHAT ARE THEY CAUSED BY?



Steep-creek hazards are typically triggered by heavy rain or rain falling onto melting snow in the springtime and are more common after wildfires.

HOW WILL CLIMATE CHANGE AFFECT STEEP-CREEK HAZARDS?



Climate change is expected to increase the intensity and number of rainstorms, and will extend the rainfall season into fall and winter. This will lead to more frequent and potentially larger steep-creek hazard events that can occur any time of year.



LET'S GET TECHNICAL!

Steep-creek hazards include different types of flooding, such as floods, debris floods, and debris flows, which are grouped based on how much mud and debris are mixed in with the water. Floods are mostly water, debris flows are more than half debris by volume, and debris floods fall in between. These events can happen quickly or last for several days. Debris floods and debris flows often arrive in one or several pulses. Homes closest to steep creeks are at the highest risk, but even small creeks can grow rapidly or overflow their banks during these events, potentially impacting homes farther away.

HISTORY OF STEEP-CREEK HAZARD EVENTS IN NELSON



WHAT MAKES THESE CREEKS HAZARDOUS? WHAT CAN HAPPEN DURING AN EVENT?

Plugs culverts or bridges



Erodes banks



Road washouts



Overland flooding and debris



Damage/destroy homes. Potential life-safety risk.



Cottonwood Creek flood on Ymir Road (1954).

LAKE FLOODING HAZARDS IN NELSON



WHAT IS LAKE FLOODING?

Lake flooding happens when a lake's water levels rise because water is coming in faster than it can drain away. Lake flooding can last days or weeks and spreads out over low-lying land near the shore. Groundwater levels can rise and flood basements of homes near the lakeshore.



WHAT TRIGGERS FLOODING IN KOOTENAY LAKE?

Long rainstorms and spring snowmelt. Flooding on Kootenay Lake usually occurs in the spring (March to June) following a winter with a high snowpack.



WHO AND WHAT CONTROLS WATER LEVELS ON KOOTENAY LAKE?

Water levels in Kootenay Lake are controlled by dams operated by BC Hydro and the U.S. Army Corps of Engineers. These dams are managed to balance several needs, including electricity generation, fish health, and flood risk. In addition to the dams, there is a naturally narrow section of the river about 3 km downstream of Nelson called Grohman Narrows. When water levels rise, this narrow point slows how quickly water can flow out of the lake into the Kootenay River, which results in higher water levels in Nelson. This effect is most noticeable in the spring, from March to June, when snowmelt increases water levels.



HOW WILL CLIMATE CHANGE AFFECT LAKE FLOODING?

Nelson is expected to become warmer over time, and snowfall could either increase or decrease depending on how warm and dry conditions become. Overall, climate change is not expected to have a noticeable impact on Kootenay Lake flooding in Nelson outside of normal variability.



Kayaking in Lakeside Park during the flood of 2012.



High water in Lakeside Park in 1933.

HISTORY OF HIGH WATER

In July of 2012, Kootenay Lake levels peaked at their highest recorded since 1974.



Flooding on Front Street in 1974.



Kootenay Lake flood 1894.

Historical images are courtesy of the Nelson museum.

Google Earth

HOW CAN THE COMMUNITY BE PREPARED FOR FLOODING AND STEEP-CREEK EVENTS?

Practical ways you can help to build help build a resilient community and reduce your risk.

DO NOT MODIFY THE CREEKS:

1. Support healthy creeks by **leaving them in their natural state** and seeking professional advice before building near the banks.
2. Refrain from moving rocks, soil, or plants, or blocking the flow.



UNDERSTAND HOW WATER FLOWS AROUND YOUR HOME:

1. Shape your yard and driveway so water **flows away** from your home and towards the city stormwater collection system.
2. **Maintain drainage infrastructure** – Keep gutters clean and make sure downspouts carry water **away** from your home.
3. Be aware that changes to your property can increase risk for your neighbours.
4. Keep your yard natural – trees, grass, plants, and soil all help store water in a flood event, reducing the severity.



BE PREPARED FOR FLOOD AND STEEP-CREEK HAZARDS:

1. Store valuables **above the bottom floor level** to prevent water damage.
2. **Pack an emergency kit** with your household to keep you safe in your home during an event



WHAT SHOULD WE DO DURING A HAZARD EVENT?

SHELTER



Take shelter away from creeks and avoid basements. The downslope side of your home and higher ground is safest. Evacuate if directed to do so.

BUILD SANDBAG DIKES



Sandbag dikes can prevent or reduce damage when built before overland flooding.

AVOID BANKS



Steep-creek hazards can quickly erode and undermine banks. Near the bank, you are at risk of falling and being swept away.

AVOID BRIDGES



Steep-creek hazards can erode bridge piers and cause bridges to collapse. Avoid potentially damaged bridges.

AVOID FLOOD WATERS



Moving water as little as 30cm deep can quickly sweep you away. Do not attempt to drive or walk through water or debris.

WHAT IS THE CITY OF NELSON DOING TO PROTECT OUR COMMUNITY?



Conducting hazard and risk studies to understand these changing hazards.



Updating development guidance and policy to build a safe community in a changing climate.



Educating the public about hazards in our community.