



TECHNICAL MEMORANDUM

Date July 30, 2025

Project 1572010

To Kara Zandbergen, Project Supervisor, Flood Mitigation and Water Resources
Regional District of East Kootenay

From Beatrice Collier-Pandya, P.Eng.

Cold Spring Creek Residual Hazard Map

1.0 INTRODUCTION

A debris flow barrier and basin were recently constructed near the fan apex of Cold Spring Creek to reduce the life safety risk on the Cold Spring Creek fan (BGC, April 29, 2025). The as-built conditions of the barrier and basin are described and shown in the record drawings and reporting (McElhanney Ltd. [McElhanney], in progress). As part of the implementation of an operations and maintenance (O&M) manual for the constructed mitigation (Regional District of East Kootenay (RDEK), in progress), BGC Engineering Inc. (BGC) has produced the attached updated residual hazard map to incorporate the as-built conditions of the debris flow barrier and basin. This mapping is consistent with the hazard map recently produced for the adjacent Fairmont Creek fan (BGC, July 4, 2025). The purpose of this letter is to reference the methods that were used to complete the residual hazard mapping.

BGC is performing its services for McElhanney under terms and conditions of the subconsultant agreement signed by BGC and McElhanney dated April 27, 2021. McElhanney has a master agreement with the RDEK, which is identified as CDL# 0593 and dated August 30, 2021.

2.0 BACKGROUND

The details of the constructed mitigation can be found in the design report and O&M manual. Table 2-1 summarizes the sediment volume and peak discharge for unmitigated and mitigated conditions at Cold Spring Creek.

Table 2-1 Cold Spring Creek debris flow volumes and peak discharges for unmitigated and mitigation conditions.

Return Period (years)	Unmitigated		Mitigated ¹	
	Sediment Volume (m ³)	Peak Discharge (m ³ /s)	Sediment Volume (m ³)	Peak Discharge (m ³ /s)
100 to 300	63,500	210	0	— ²
300 to 1000	76,000	260	0	— ²
1000 to 3000	96,000	320	12,000	107

Note:

1. Results shown are for discharges over the spillway with an assumed basin storage of 84,000 m³.
2. Peak discharges were not calculated for return periods less than 1000 years. While the basin is expected to contain a majority of the sediment for lower return period debris flows, clearwater flows would still discharge through the barrier. BGC has not calculated these clearwater flows as the residual hazard is dictated by the 1000 to 3000-year debris flow.

The design hydrograph (for the numerical modelling and preparation of the residual hazard map) assumes that the discharge over the spillway occurs after a best estimate basin storage of 84,000 m³ is exceeded during the 1,000 to 3,000-year debris-flow event (Figure 2-1). Debris flows are sometimes associated with multiple surges; however, it was assumed to be a single surge in design because it is generally the worst-case scenario for impact loads and an actual multi-surge event is difficult to predict and therefore model. This results in approximately 12,000 m³ of material overtopping the barrier in the modelling with a peak of discharge of 107 m³/s. A higher-than-normal flow could be expected after the debris-flow event, but it is assumed to be a clearwater flow and was not included in the assessment.

Sediment volumes associated with lower return period debris flows are expected to be fully contained within the debris flow basin.

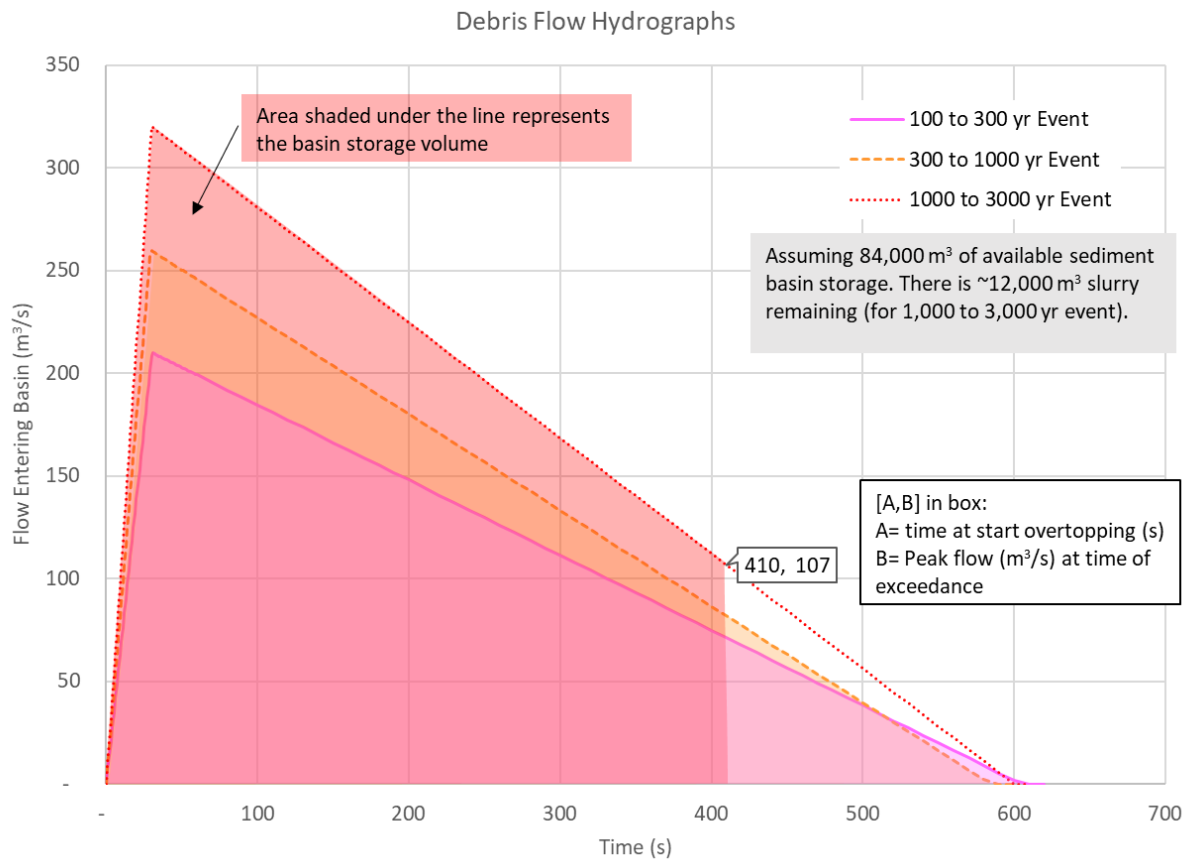


Figure 2-1 Debris-flow event hydrographs with barrier and sediment basin mitigation in place.

3.0 HAZARD MAPPING

The hazard mapping relies on numerical modelling results. The numerical modelling followed the methods outlined in BGC's hazard and risk assessment report (September 25, 2020; March 12, 2021) and the topography was updated to include the current conditions of the barrier and downstream regrading, as of June 2025. The regrading downstream of the barrier includes a small (less than 0.5 m deep) swale at its downstream extent that redirects flow back towards Cold Spring Creek. The current modelling was completed with an updated version of FLO-2D (version 23.10.25). The modelling did not include the potential for entrainment of sediment downstream of the barrier. The model results were then processed to calculate a risk index as outlined in BGC (July 4, 2025), that was then interpreted to the attached hazard map (Drawing 01). Table 3-1 summarizes the proposed hazard zones used for the Fairmont Hot Springs community (i.e., both Cold Spring and Fairmont creeks).

Table 3-1 Hazard zones.

Hazard Zone	Risk Index¹ (PDI)	Other Jurisdictions' Risk Tolerance Criteria²	Comparable Annual Risk of Fatality (PDI)
Very High	>1:1,000	Existing and proposed development unacceptable without mitigation works.	40th year of life in USA from all causes (1:500)
High	1:10,000 to 1:1,000	Existing and proposed development unacceptable without mitigation works	- Covid-19 in 2020 (1:1,000) - Car accident (1:10,000)
Moderate	1:100,000 to 1:10,000	- Existing development acceptable - Proposed development unacceptable unless <25% increase to gross floor area or mitigation works implemented.	- Gun violence in USA (1:25,000) - General anesthesia per instance (1:100,000)
Low	<1:100,000	Existing and proposed development acceptable	Drowning in bathtub (1:1,000,000)

Note:

1. Risk level assumes fully occupied, detached, wood-frame building and does not account for site-specific building characteristics or mitigation.
2. Other jurisdictions such as Town of Canmore (2016), District of North Vancouver (2018), District of Squamish (2018), and Cowichan Valley Regional District (2019).

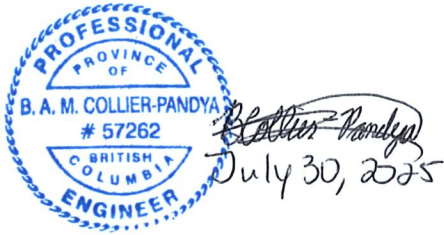
The hazard upstream of the barrier to the fan apex is considered 'very high'. The hazard map illustrates this zone, however, further qualified professional assessment should occur prior to consideration of any increased foot traffic (e.g., popular hiking trails) near Cold Spring Creek between the barrier and apex of the fan. Risk reduction such as signage, at a minimum, are recommended if hiking trails are considered within that area.

4.0 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:



Beatrice Collier-Pandya, M.A.Sc., P.Eng.
Geological Engineer

Reviewed by:

Hamish Weatherly, M.Sc., P.Geo.
Principal Hydrologist

EGBC Permit to Practice, BGC Engineering Inc. 1000944

PN/HW/ab/cfd

Attachment(s): Limitations
References
Drawing

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¹ References in these Limitations to the “document” include the document to which these Limitations are attached, any content contained in this document, and any content referenced in this document but located in one of BGC’s proprietary software applications (e.g., Cambio).

REFERENCES

BGC Engineering Inc. (2020, September 25). *Cold Spring Creek Hazard Assessment* [Report]. Prepared for Regional District of East Kootenay.

BGC Engineering Inc. (2021, March 12). *Cold Spring Creek Fan Debris-Flow Quantitative Risk Assessment* [Report]. Prepared for Regional District of East Kootenay.

BGC Engineering Inc. (2025, April 25). *Cold Spring Creek Fan Debris-Flow Mitigation: Geohazard and Geotechnical Design Report* [Report]. Prepared for Regional District of East Kootenay.

BGC Engineering Inc. (2025, July 4). *Fairmont Creek Updated Hazard and Risk Assessment – Interim Draft* [Report]. Prepared for Regional District of East Kootenay.

Cowichan Valley Regional District. (2019). *Natural Hazard Risk Tolerance Policy*. Duncan, BC.

District of North Vancouver. (2018). *Our Official Community Plan for a Sustainable Future* (Bylaw 7900). North Vancouver, BC.

District of Squamish. (2018). *Official Community Plan* (Bylaw 2500, 2017). Squamish, BC.

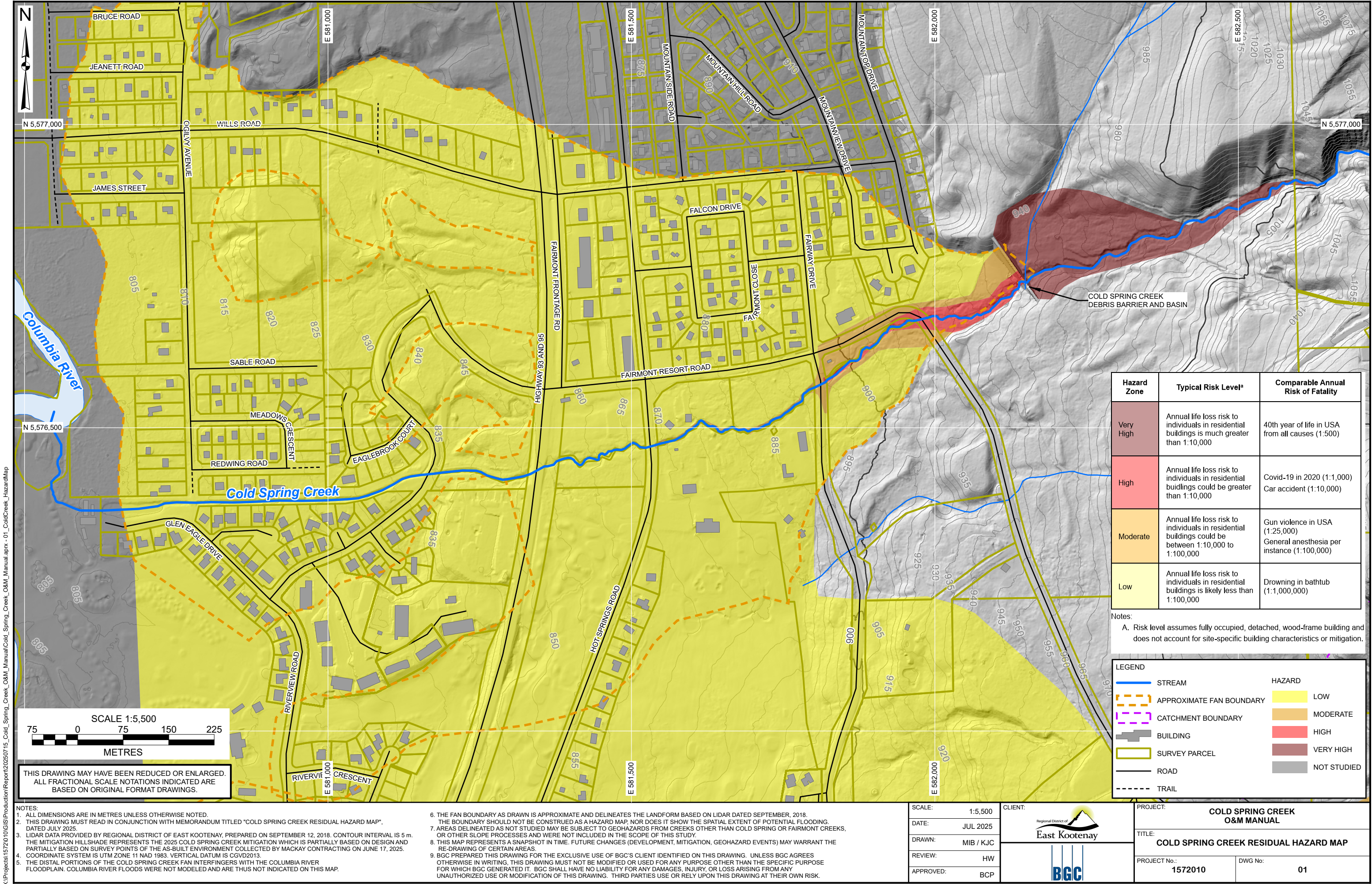
McElhanney Ltd. (In Progress). *Cold Spring Creek Debris-Flow Mitigation - Construction Completion Report*.

Regional District of East Kootenay. (In Progress). *Cold Spring Creek Debris-Flow Mitigation – Operations and Maintenance Manual*.

Town of Canmore. (2016). *Canmore Municipal Development Plan* (Bylaw 2016-03). Canmore, Alberta.

DRAWING





Hazard Zone	Typical Risk Level ^a	Comparable Annual Risk of Fatality
Very High	Annual life loss risk to individuals in residential buildings is much greater than 1:10,000	40th year of life in USA from all causes (1:500)
High	Annual life loss risk to individuals in residential buildings could be greater than 1:10,000	Covid-19 in 2020 (1:1,000) Car accident (1:10,000)
Moderate	Annual life loss risk to individuals in residential buildings could be between 1:10,000 to 1:100,000	Gun violence in USA (1:25,000) General anesthesia per instance (1:100,000)
Low	Annual life loss risk to individuals in residential buildings is likely less than 1:100,000	Drowning in bathtub (1:1,000,000)

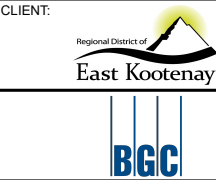
Notes:
A. Risk level assumes fully occupied, detached, wood-frame building and does not account for site-specific building characteristics or mitigation.

THIS DRAWING MAY HAVE BEEN REDUCED OR ENLARGED.
ALL FRACTIONAL SCALE NOTATIONS INDICATED ARE
BASED ON ORIGINAL FORMAT DRAWINGS.

- NOTES:
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
 2. THIS DRAWING MUST READ IN CONJUNCTION WITH MEMORANDUM TITLED "COLD SPRING CREEK RESIDUAL HAZARD MAP", DATED JULY 2025.
 3. LIDAR DATA PROVIDED BY REGIONAL DISTRICT OF EAST KOOTENAY, PREPARED ON SEPTEMBER 12, 2018. CONTOUR INTERVAL IS 5 m. THE MITIGATION HILL SHADE REPRESENTS THE 2025 COLD SPRING CREEK MITIGATION WHICH IS PARTIALLY BASED ON DESIGN AND PARTIALLY BASED ON SURVEY POINTS OF THE AS-BUILT ENVIRONMENT COLLECTED BY MACKAY CONTRACTING ON JUNE 17, 2025.
 4. COORDINATE SYSTEM IS UTM ZONE 11 NAD 1983. VERTICAL DATUM IS CGVD2013.
 5. THE DISTAL PORTIONS OF THE COLD SPRING CREEK FAN INTERFINGERS WITH THE COLUMBIA RIVER FLOODPLAIN. COLUMBIA RIVER FLOODS WERE NOT MODELED AND ARE THUS NOT INDICATED ON THIS MAP.

6. THE FAN BOUNDARY AS DRAWN IS APPROXIMATE AND DELINEATES THE LANDFORM BASED ON LIDAR DATED SEPTEMBER, 2018. THE BOUNDARY SHOULD NOT BE CONSTRUED AS A HAZARD MAP, NOR DOES IT SHOW THE SPATIAL EXTENT OF POTENTIAL FLOODING.
7. AREAS DELINEATED AS NOT STUDIED MAY BE SUBJECT TO GEOHAZARDS FROM CREEKS OTHER THAN COLD SPRING OR FAIRMONT CREEKS, OR OTHER SLOPE PROCESSES AND WERE NOT INCLUDED IN THE SCOPE OF THIS STUDY.
8. THIS MAP REPRESENTS A SNAPSHOT IN TIME. FUTURE CHANGES (DEVELOPMENT, MITIGATION, GEOHAZARD EVENTS) MAY WARRANT THE RE-DRAWING OF CERTAIN AREAS.
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SCALE: 1:5,500
DATE: JUL 2025
DRAWN: MIB / KJC
REVIEW: HW
APPROVED: BCP



PROJECT: **COLD SPRING CREEK O&M MANUAL**

TITLE: **COLD SPRING CREEK RESIDUAL HAZARD MAP**

PROJECT No.: **1572010** DWG No.: **01**