

BRITISH COLUMBIA TIMBER SALES, CHINOOK BUSINESS AREA

PHASE 3 REVIEW OF TSL TA0521
BLOCKS G03B4P2 & G043B4P8
MT ELPHINSTONE SOUTH

Polar File: 740202
BCTS Contract: 10005-40/PD21TBF001
FINAL REPORT
JUNE 2023

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CITATION

Polar Geoscience Ltd. (Polar). 2023. Phase 3 Review of TSL TA0521, Blocks G03B4P2 & G043B4P8, Mt Elphinstone South. Prepared for BC Timber Sales, Chinook Business Area. Polar File No. 740202, BCTS Contract 10005-40/PD21TBF001.



June 20, 2023

Polar File: 740202

BCTS Contract: 10005-40/PD21TBF001

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Re: Phase 3 Review of TSL TA0521, Blocks G03B4P2 & G043B4P8, Mt Elphinstone South

BACKGROUND & OBJECTIVES

Polar Geoscience Ltd. (Polar) is pleased to submit this final report on our field review of Timber Sale Licence (TSL) TA0521 located within the catchments of (from north to south): Clough Creek, Joe Smith Creek, Molyneux Creek, Slater Creek, and Higgs Brook¹ (FIGURE 1). The scope of this Phase 3 review is to evaluate the site-level hydrologic hazards and risks associated with the two laid out and field-flagged blocks [G03B4P2 - 4 openings (arbitrarily labelled A, B, C, D from north to south), G043B4P8 - 1 opening] and associated new roads (FIGURE 2 & FIGURE 3).

¹ A portion of Block G043B4P8 falls within the Leek Creek drainage area (FIGURE 1), which was not identified as a principal assessment stream although is associated with several surface water intakes.

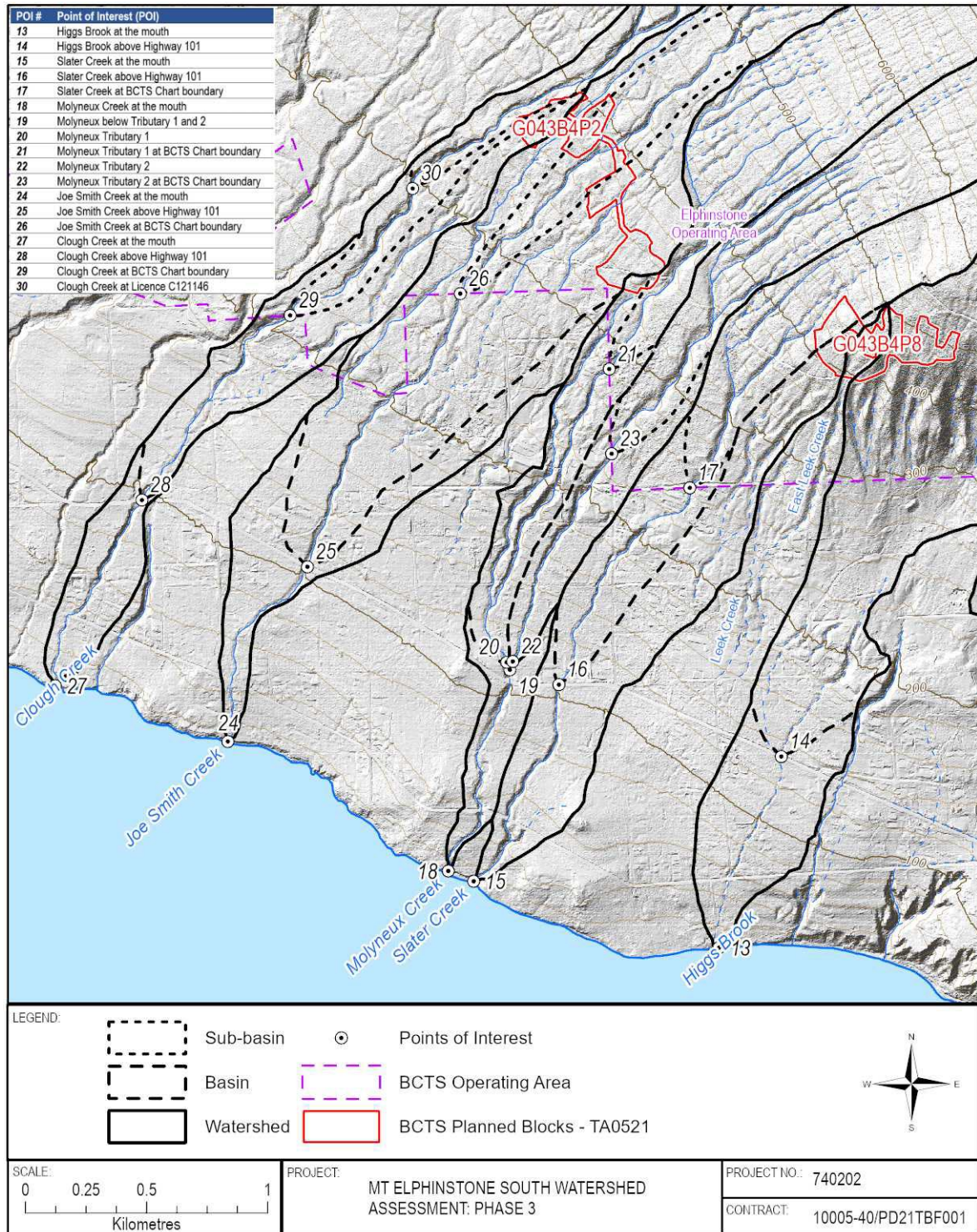


FIGURE 1 The assessment watersheds and locations of planned blocks G03B4P2 and G03B4P8 of TSL TA0521. The block shapes presented are those of the preliminary harvest plans.

Document Name: ArcPro Map Elphinstone South Report Figs Rev3

This review follows a watershed-level assessment of the Mt Elphinstone South area, including the catchments noted above. Phase 1 (2020-2021) involved an overview of the planned development area to identify: 1) the principal streams and watersheds for review; 2) the conditions of the watersheds; 3) watershed values downslope of development; and 4) preliminary hydrogeomorphic hazards and risks. Phase 2 (2021-2023) involved field-review, consultation with owners of properties near the creeks (including those with registered water licences), confirmation of watershed values downstream of planned development, and review of stream channel conditions. Prior to finalizing the Phase 2 report, a presentation summarizing the report was delivered through a series of meetings in late-March 2023 to the Sechelt Community Forest, Town of Gibsons, Sunshine Coast Regional District Committee of the Whole, Sunshine Coast Regional District Staff, and the Squamish Nation. A virtual presentation open to the public was delivered in early-April, 2023. The purpose of these meetings was to inform stakeholders of the findings from Phase 1 and 2, and to receive comments and concerns relevant to the report and assessment area. Comments within the scope of the assessment were subsequently addressed and integrated into the Phase 1 and 2 report.

METHODS

TSL TA0521, Block G03B4P2 was field reviewed on August 8, 2022 by Lars Uunila, PGeo (Senior Hydrologist & Geoscientist of Record) and Robbie Johnson, GIT (Project Hydrologist) of Polar. Accompanying Lars and Robbie were Pierre Aubin, RPF and Gino Amato, RFT of BC Timber Sales, Chinook Business Area (Powell River). Block G043B4P8 was subsequently field reviewed on August 9, 2022 by Robbie Johnson of Polar and Pierre Aubin of BCTS.

The weather on both days was sunny with temperatures near 30°C. Ground conditions were dry and perennial streams were flowing near seasonal lows. Block boundaries and planned road alignments were field-flagged prior to our review. The review began in opening D of G043B4P2 by driving along Sechelt Roberts FSR 7575 Br16² to the southwestern extent of the opening, then walking northeastward along the western extent of the planned block until reaching the planned road alignment. Openings A, B and C of block G043B4P2 were reviewed by walking northwest along the planned road alignment. Planned block G043B4P8 was reviewed by walking east to west along the northern (i.e., upper) planned road alignment, then southwestward along the eastern extent of the block and finally walking west along the lower road alignment back to Sechelt Roberts FSR 7575 Br16.

Following the Phase 1 and 2 meetings and Phase 3 field review, a preliminary draft of the Phase 3 report was prepared and submitted to BCTS on June 9, 2023. This draft evaluated how BCTS' harvest plans aligned with the Phase 1 and 2 recommendations outlined in Polar (2023). Subsequently, BCTS amended its harvest plans associated with TSL TA0521. For transparency, both our conclusions and recommendations regarding the preliminary harvest plans and those of the amended harvest plans are presented herein.

² Also referred to as "NK Main".

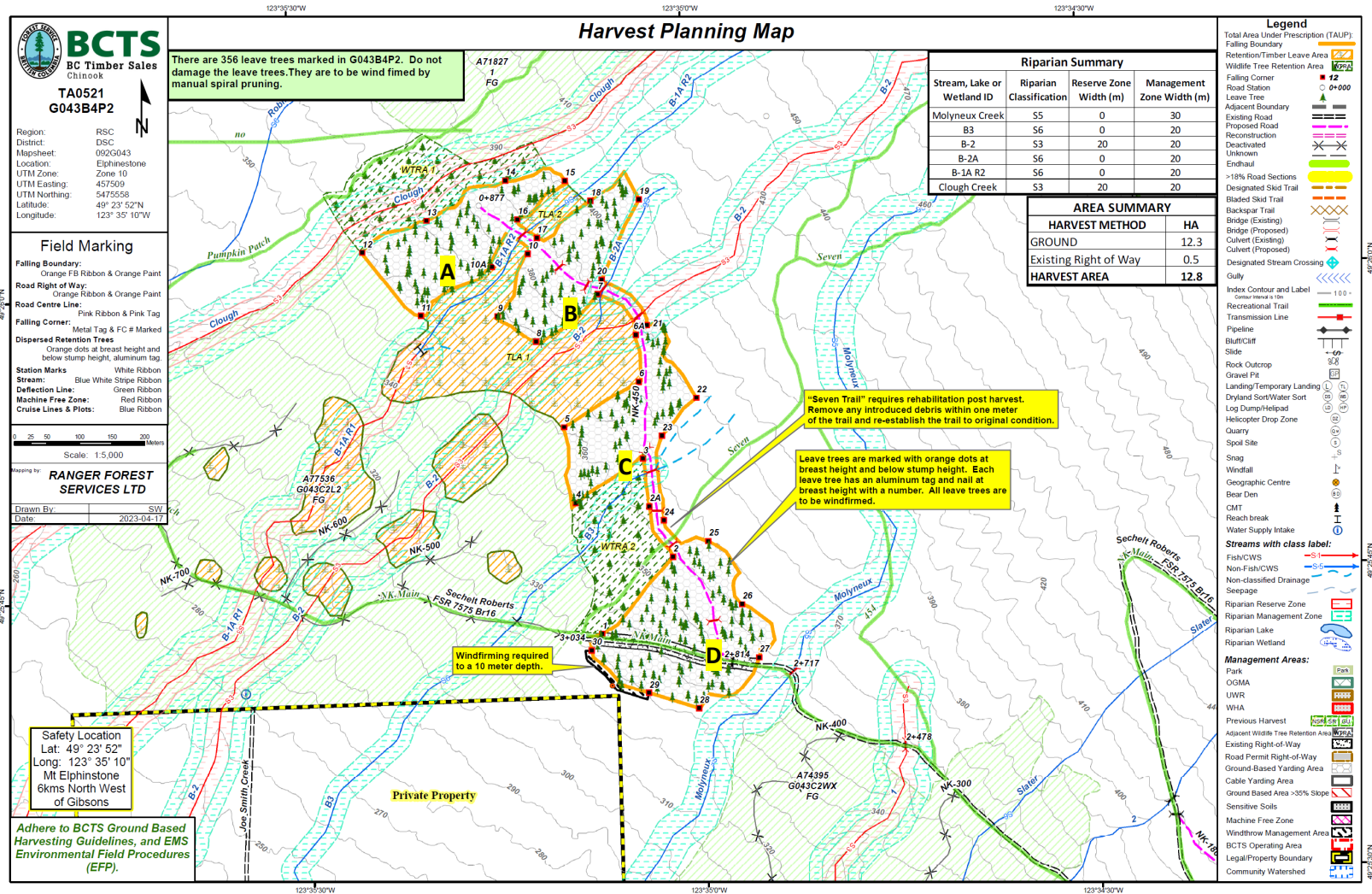


FIGURE 2 Preliminary harvest planning map of TSL TA0521, Block G043B4P2 (from BC Timber Sales, 18 April, 2023). For the purposes of this report, we have labelled the openings A-D from north to south. Note that these plans were subsequently revised by BCTS based on the findings in Phase 3. Refer to FIGURE 6 for the revised plans.

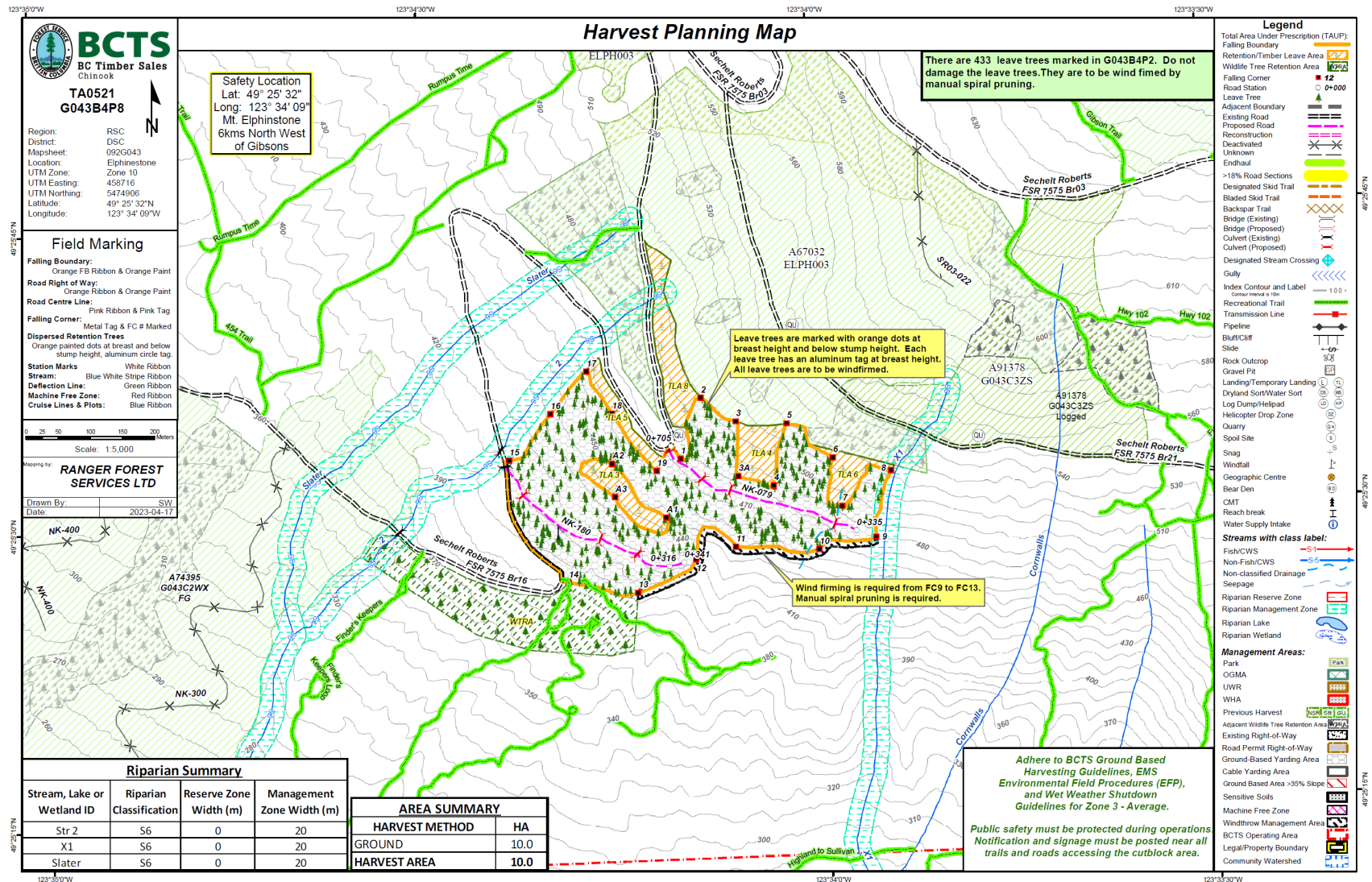


FIGURE 3 Preliminary harvest planning map of TSL TA0521, Block G043B4P8 (from BC Timber Sales 18 April, 2023). Note that these plans were subsequently revised by BCTS based on the findings in Phase 3. Refer to FIGURE 7 for the revised plans.

FIELD OBSERVATIONS

The harvested area and basal area retention of the planned blocks is presented in TABLE 1. Our main observations based on the field review are provided below, organized by block. Note that these observations were made with reference to the preliminary harvest plans identified in FIGURE 2 and FIGURE 3.

TABLE 1 Preliminary harvested area and basal area retention³ for planned blocks G043B4P2 and G043B4P8 above the POIs in the assessment area.

Watershed	POI #	POI	Drainage Area (ha)	G043B4P2		G043B4P8	
				Area (m ²)	Area (ha)	Area (m ²)	Area (ha)
Higgs Brook	13	Higgs Brook at the mouth	145			44,215.1	4.4
	14	Higgs Brook above Hwy 101	111.2			44,215.1	4.4
	Basal area retention:					94.1	0.0094
Leek Creek ⁴	-	Leek Creek above BCTS Chart Bdry	10.6			23,694.9	2.4
	Basal area retention:					39.0	0.0039
Slater Creek	15	Slater Creek at the mouth	142.4			33,372.8	3.3
	16	Slater Creek above Hwy 101	80.6			17,341.1	1.7
	17	Slater Creek at BCTS Chart Bdry	54.1			17,341.1	1.7
	Basal area retention:					69.0	0.0069
Molyneux Creek	18	Molyneux Creek at the mouth	264.8	7,865.5	0.8		
	19	Molyneux below Tributary 1 and 2	249.1	7,865.5	0.8		
	20	Molyneux Tributary 1	137.2	7,865.5	0.8		
	21	Molyneux Tributary 1 at BCTS Chart Bdry	107.5	1,791.4	0.2		
	Basal area retention:				10.7	0.0011	
Joe Smith Creek	24	Joe Smith Creek at the mouth	228.6	92,659.4	9.3		
	25	Joe Smith Creek above Hwy 101	190.8	92,659.4	9.3		
	26	Joe Smith Creek at BCTS Chart Bdry	64.6	24,197.8	2.4		
	Basal area retention:				139.9	0.0140	
Clough Creek	27	Clough Creek at the mouth	154.1	27,146.2	2.7		
	28	Clough Creek above Hwy 101	134.9	27,146.2	2.7		
	29	Clough Creek at BCTS Chart Bdry	93.2	8,002.8	0.8		
	30	Clough Creek at Licence C121146	79.3	2,206.2	0.2		
Basal area retention:				43.5	0.0044		
Total basal area retention:				194.1	0.019	202.1	0.0
Total harvested area:				127,477.0	12.8	101,080.7	10.1

³ The retention we identify is within the openings only and does not include the retention captured by the Timber Leave Areas or Wildlife Tree Retention Areas.

⁴ Leek Creek was not identified as a principal assessment stream, although was evaluated given identified values downstream.

Block G043B4P2

- Opening A is located within the Clough Creek Watershed, opening B, C, and the majority of D are located within the Joe Smith Creek Watershed. The southeastern portion of opening D is located within the Molyneux Creek Watershed (FIGURE 2).
- The block is located on gentle ground (~18% slope) with low drainage density.
- The western boundary of opening A is set down in a gully but separated from Clough Creek by a berm.
- The surface of soils were dry on the date of the field review.
- The mapped channel at the location of the road alignment between opening A and B (mapped as B-1A on FIGURE 2) is 0.5 m wide and was dry during the time of the field visit. The channel has a cobble streambed with some gravel deposits and some incision was noted. Abundant in-stream and suspended wood were present.
- Between opening B and C, the planned road alignment crosses mapped channels B-2A and B-2⁵, which join roughly 30 m below the road. Channel B-2A is 0.5 m wide with no surface flow noted during the time of the field review. Some gravel deposits were noted and abundant in-stream wood was present. Joe Smith Creek is 2.0-2.5 m wide at the road crossing and minor surface flow was present during the time of the field review. The channel has a bed comprised of small boulder and cobble (FIGURE 4) and incision of up to 0.5 m was noted. Abundant in-stream wood and debris were present. Active sediment transport is likely to occur in response to fall and winter rainstorms.

Block G043B4P8

- The western portion of the block is located within the Slater Creek Watershed and eastern portion is within the Higgs Brook Watershed. The center of the block is located within the drainage area of Leek Creek.
- Hillslope gradients range from 30% in the southwest portion of the block (FIGURE 5) to 45% in the northeast portion. The hillslopes below the northeastern portion of the block steepen to roughly 60%⁶.
- Localized blowdown was noted in the southeast portion of the planned block.
- One mapped NCD is located in the northeast portion of the block. At the planned road crossing, the NCD is 0.5 m wide. Some fluvial deposits and exposed boulders were noted where the channel is incised, indicating periodic surface flow. Less evidence of surface flow was noted downstream along the southern block boundary.
- It appears that for the most part, water within the block travels subsurface and appears on the surface on the steeper slopes below, where gullies are present.
- A potential issue to be aware of is the steeper areas in the east portion of the block, where roads are planned and cut banks will likely be required. This is due to the increased potential

⁵ Joe Smith Creek.

⁶ We understand that a terrain stability assessment has been conducted on this block by Onsite (2023).

for interception of near-surface groundwater along cut-banks, which can increase flow along ditches resulting in surface erosion.



FIGURE 4 View upstream of Joe Smith Creek at the planned road crossing. Active small boulder lined stream and evidence of incision noted. Photo: IMG_5792, August 11, 2022.



FIGURE 5 View south-southwest of lower portion of planned block G043B4P8. Roughly 30% gradient. Photo: IMG_5833, August 11, 2022.

PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

ECAs in Phase 1 and 2 Watershed Assessment (Polar, 2023) were calculated for the drainage areas above several points-of-interest (POIs) in each watershed. ECA recommendations were presented with the goal of limiting incremental increases in peak flow hazard at POIs downstream of BCTS Chart, while maintaining ECAs below 20% (i.e., a low peak flow hazard) for the portion of each watershed within BCTS' chart area. Maximum additional ECA consistent with the ECA

recommendations of Polar (2023) are presented in TABLE 2 for each of the watersheds. The POIs referred to in TABLE 2 are presented on FIGURE 6.2 and FIGURE 6.3 of Polar (2023). The Phase 1 and 2 report also recommended considering alternative silvicultural⁷ approaches to minimize the incremental increases to current peak flow hazards. This includes small openings⁸, strip cuts or individual tree selection.

TABLE 2 *Maximum additional ECA to avoid incremental increase in peak flow hazard.*

Assessment Watershed	Recommended maximum additional ECA within BCTS Chart to avoid an incremental increase in peak flow hazard
Higgs Brook	≤ 6.5 ha overall
Leek Creek	≤ 1.6 ha within BCTS Chart area
Slater Creek	≤ 3.7 ha overall and ≤ 1.8 ha above POI 16 (Slater Creek above Highway 101)
Molyneux Creek	≤ 14.7 ha overall and ≤ 8.8 ha above POI 20 (Molyneux Tributary 1) ≤ 6.4 ha above POI 22 (Molyneux Tributary 2)
Joe Smith Creek	≤ 3.9 ha overall
Clough Creek	≤ 6.3 ha overall

In consideration of summer low flows, maintaining net opening size to less than 8 ha⁹ and implementing partial harvest silviculture systems (i.e., thinning) is recommended. Additionally, for S4, S5, and S6 streams, a management zone is recommended within gullies or draws, and these areas should be prioritized for relatively high retention levels in order to minimize changes in riparian water demands via evapotranspiration.

Based on our preliminary Phase 3 review, BC Timber Sales has largely incorporated our Phase 1 and 2 recommendations into its site-level planning. This includes a reduction in gross block area for TSL TA0521 and incorporation of basal area retention to reduce the incremental increase in ECA. It also includes minimizing new road alignments, and where possible, locating such roads on gentle slopes to minimize road cuts and the potential for shallow groundwater interception. The primary exception where management recommendations were not fully reflected in the preliminary harvest plans included the total harvested area within the Joe Smith Creek Watershed and total harvested area within the Leek Creek¹⁰ drainage area.

⁷ The ECA recommendations assume a clearcut silviculture system. If a selective harvest silviculture system is used, ECAs are scaled based on the values in TABLE 6.1 of Polar (2023).

⁸ If more than one opening is associated with a single cutblock, the space between openings should be large enough such that the adjacent opening is sufficiently buffered from wind and solar radiation.

⁹ If more than one opening is associated with a single cutblock, the space between openings should be large enough such that the adjacent opening is sufficiently buffered from wind and solar radiation.

¹⁰ Although Leek Creek was not identified as a principal assessment stream, ECA for the Leek Creek drainage area within BCTS Chart area was evaluated given the values downstream.

Given the preliminary area of planned blocks G043B4P2 and G043B4P8 presented in TABLE 1, the recommended ECA threshold was projected to be exceeded in the Joe Smith Creek Watershed and Leek Creek drainage area within BCTS Chart. To maintain the current peak flow hazard rating in Joe Smith Creek, ECAs should not be increased by more than 3.9 ha overall currently (TABLE 1). Roughly 9.3 ha of block G043B4P2 was planned in the Joe Smith Creek Watershed under the preliminary harvest plan, exceeding the recommended threshold by 5.4 ha. To meet the management recommendations put forth, the portion of the planned block within the Joe Smith Creek Watershed would have to either be reduced in size or basal area retention increased. Alternatively, the planned block could be deferred until 5.4 ha of hydrologic recovery has occurred, which is projected in roughly 15-20 years or by the year 2036 – 2041 (TABLE E.1 in Polar, 2023).

To maintain a low peak flow hazard within the portion of Leek Creek above BCTS Chart boundary, ECAs should not be increased by more than 1.6 ha (TABLE 1). Approximately 2.4 ha of block G043B4P8 was planned within BCTS Chart in the Leek Creek drainage area. As such, it was recommended that the portion of block G043B4P8 within BCTS Chart be reduced by 0.8 ha, either by reducing block size or increasing basal area retention.

With reference to the conservation of summer low flows, BCTS has incorporated our Phase 1 and 2 recommendations by prioritizing high retention within management zones of S4, S5, and S6 streams. In upland areas, BCTS has implemented small openings with retention of mature veteran trees. Moreover, net opening sizes¹¹ are less than 8 ha for each planned block within the assessment watersheds. For planned block G043BP2, the preliminary openings range from roughly 2 ha to 4 ha. For planned block G043B4P8, the portion within the Higgs Brook Watershed is 4.4 ha and the portion within the Slater Creek Watershed is 3.3 ha (TABLE 1). As per the Phase 1 and 2 assessment, the space between openings should be large enough such that the adjacent opening is sufficiently buffered from wind and solar radiation. The shortest distance between the openings in planned block G043BP2 is roughly 40 m, which is considered large enough to buffer wind and solar radiation. Moreover, these two openings are in different watersheds. The distance between the remaining openings of planned block G043BP2 are greater than 120 m. Planned block G043B4P8 consists of a single 10.1 ha opening; however, it spans three drainages. As such, the adjacency requirements are considered to be met.

Based on our preliminary review, the site-level hydrologic risks were low; however, the following recommendations were identified to protect stream and riparian features and minimize downstream risks:

1. Establish machine free zones (MFZs) 5 m wide on each side of S6 streams within the blocks and minimize, where practical, crossings of S6 streams by heavy equipment. Based on FIGURE 2 and FIGURE 3, there are three S6 streams that pass through planned block G043B4P2 and one S6 stream near the eastern border of planned block G043B4P8.

¹¹ This excludes road rights-of-way.

2. One NCD is crossed by the upper road alignment in planned block G043B4P8. Excessive soil disturbance of NCDs followed by high runoff can result in erosion, downslope sedimentation, and in some cases, conversion of NCDs to S6 channels. In effect, groundwater flow becomes more rapidly flowing surface flow. To minimize the risk of this occurring, equipment operators should be instructed to minimizing trafficking along or across such areas where practical.
3. Given the steeper slopes in the northeast portion of planned block G043B4P8, we recommend out sloping the road to distribute runoff to the slopes below and minimize slope instability.

HARVEST PLANNING AMENDMENTS

Polar's preliminary conclusions and recommendations summarized above were submitted to BCTS on June 9, 2023. Upon receipt of the preliminary report, BCTS has accepted all recommendations and revised harvest plans accordingly. Amendments to harvest plans include a reduction in the total harvested area of planned blocks G043B4P2 and G043B4P8. The updated harvest planning maps are presented in FIGURE 6 and FIGURE 7. Current and projected ECAs in the affected watersheds are presented in TABLE 3.

As per the recommendations put forth herein, planned block G043B4P2 has been reduced in size by 8.5 ha by removing openings A, B, and C. As such, 3.7 ha of the block is located within the Joe Smith Creek Watershed and 0.8 ha of the block is located in the Molyneux Creek Watershed. Given the projected ECAs in TABLE 3, the peak flow hazard in Molyneux Creek and Joe Smith Creek is expected to remain low within BCTS Chart and is not projected to increase at the POIs downstream of BCTS Chart following development of planned block G043B4P2.

Similarly, the timber leave area for planned block G043B4P8 has been increased, reducing the opening size of the block by 0.8 ha. Following the amended planned development, ECAs within the BCTS portion of the Leek Creek drainage area are projected to increase by 1.5 ha. As such, peak flow hazard in the Leek Creek drainage area is expected to remain low within BCTS Chart and is not projected to increase downstream of BCTS Chart.

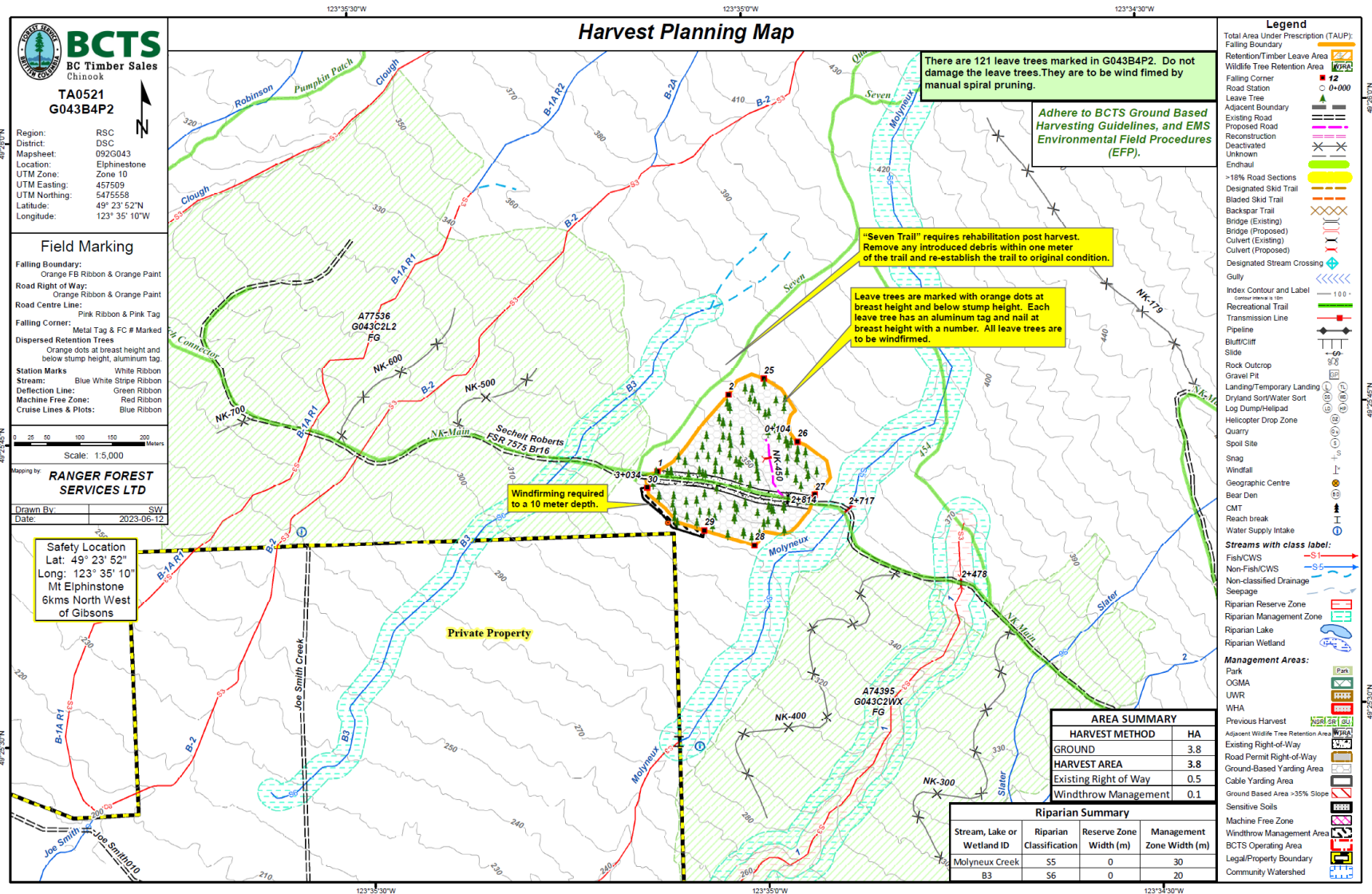


FIGURE 6 Amended harvest planning map of TSL TA0521, Block G043B4P2 based on recommendations for the preliminary Phase 3 draft report (from BC Timber Sales June 13, 2023).

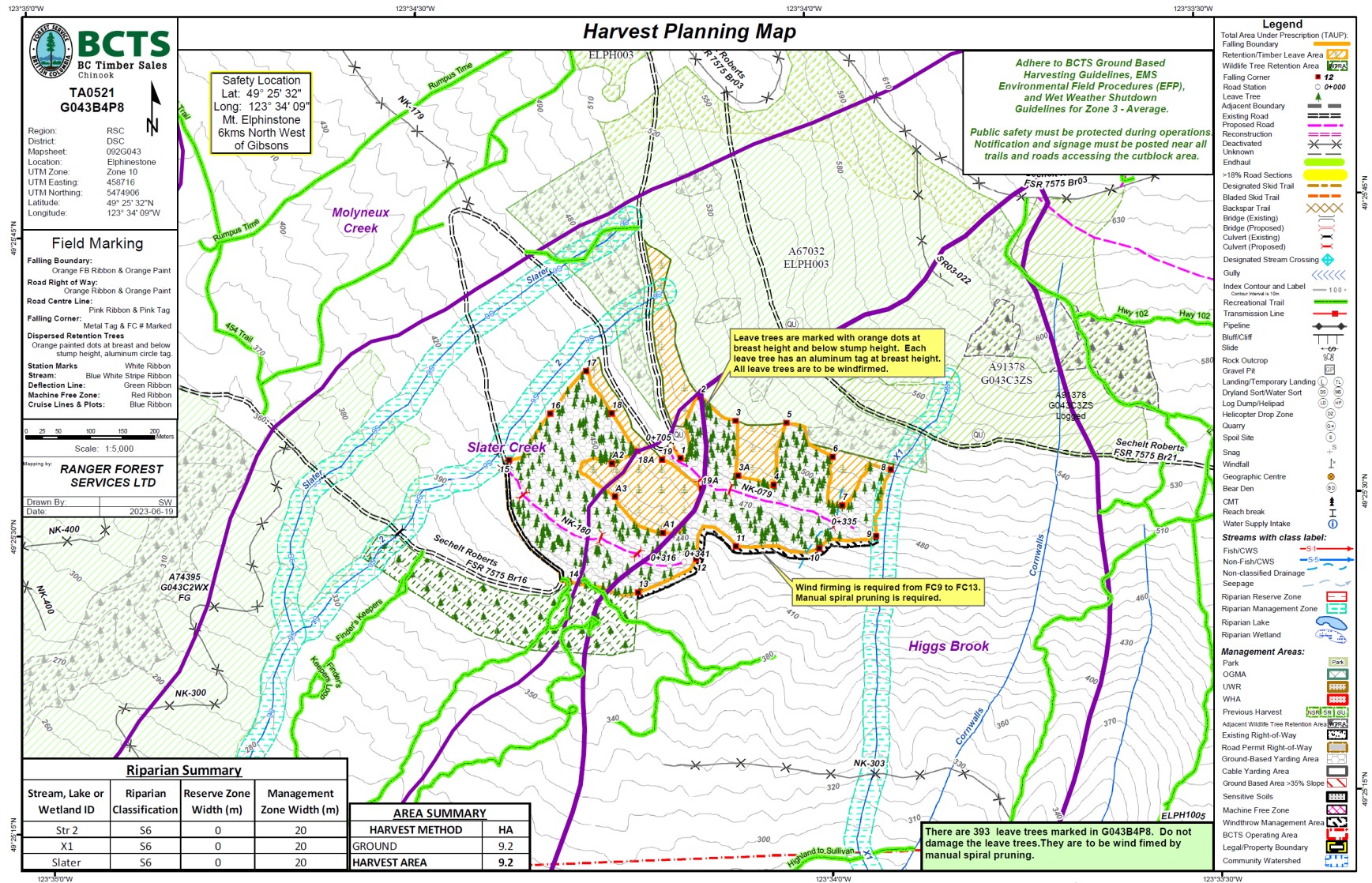


FIGURE 7 Amended harvest planning map of TSL TA0521, Block G043B4P8 based on recommendations for the preliminary Phase 3 draft report (from BC Timber Sales June 19, 2023).

TABLE 3 Current and projected ECAs in the affected watershed units¹².

Watershed	POI #	POI	Drainage Area (ha)	Current ECA (ha)	Current ECA (%)	Projected ECA (ha)	Projected ECA (%)
Higgs Brook	13	Higgs Brook at the mouth	145	53.7	37.0%	58.1	40.1%
	14	Higgs Brook above Hwy 101	111.2	33.9	30.5%	38.3	34.4%
Leek Creek	-	Leek Creek above BCTS Chart Bdry	10.6	0.5	4.5%	2.0	19.3%
Slater Creek	15	Slater Creek at the mouth	142.4	37.2	26.1%	40.5	28.4%
	16	Slater Creek above Hwy 101	80.6	19.9	24.7%	21.6	26.8%
	17	Slater Creek at BCTS Chart Bdry	54.1	8.6	15.9%	10.3	19.0%
Molyneux Creek	18	Molyneux Creek at the mouth	264.8	38.2	14.4%	39.0	14.7%
	19	Molyneux below Tributary 1 and 2	249.1	34.6	13.9%	35.4	14.2%
	20	Molyneux Tributary 1	137.2	18.6	13.6%	19.4	14.1%
	21	Molyneux Tributary 1 at BCTS Chart Bdry	107.5	8.6	8.0%	8.8	8.2%
Joe Smith Creek	24	Joe Smith Creek at the mouth	228.6	57.6	25.2%	66.9	29.3%
	25	Joe Smith Creek above Hwy 101	190.8	34.2	17.9%	43.5	22.8%
	26	Joe Smith Creek at BCTS Chart Bdry	64.6	6.1	9.4%	8.5	13.2%
Clough Creek	27	Clough Creek at the mouth	154.1	31.8	20.6%	34.5	22.4%
	28	Clough Creek above Hwy 101	134.9	20.7	15.3%	23.4	17.3%
	29	Clough Creek at BCTS Chart Bdry	93.2	6.2	6.7%	7.0	7.5%
	30	Clough Creek at Licence C121146	79.3	4.8	6.1%	5.0	6.3%

¹² Refer to Polar (2023) for discussion of the peak flow hazards associated with the ECAs.

CLOSURE

We trust that this report meets your requirements at this time. If you have any questions or require clarification, please do not hesitate to contact the undersigned.

Yours truly,

Polar Geoscience Ltd.

A handwritten signature in black ink, appearing to be 'Robbie Johnson', written over a horizontal line.

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Project Hydrologist

Lars Uunila, M.Sc., P.Geo., P.Geol., P.H., CPESC, CAN-CISEC, BC-CESCL
Senior Hydrologist & Geoscientist

REFERENCES

- Amato, G. 2022. Personal communication with L. Uunila of Polar Geoscience on August 8, 2022. Operational Technologist, BC Timber Sales, Chinook Business Area, Powell River, BC.
- Onsite Engineering Ltd. 2023. Terrain Stability Assessment Cutblocks G043B4P8 (TA0521) Elphinstone Mountain. Prepared for: BC Timber Sales Chinook Business Area. March 7, 2023.
- Polar Geoscience Ltd. (Polar). 2023. Mt. Elphinstone South Watershed Assessment: Phases 1 & 2. Prepared for BC Timber Sales, Chinook Business Area. Polar File No. 740102.