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PASULKO LAKE AREA

DETAILED TERRAIN MAPPING WITH EVALUATIONS FOR SLOPE STABILITY AND EROSION POTENTIAL

Prepared by
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For
B.C. Ministry of Forests
Lillooet Forest District

November 1995 c

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CONTENTS

(1) INTRODUCTION

The objective of this project was to prepare terrain, slope stability and erosion potential maps as a basis for long term environmental planning, including forest management, in the following three areas: Yalakom River (Retaskit-Peridotite Creeks), Murray Creek, and Pasulko Lake. A brief report for each study area (Tsang, 1995a,b) accompanies the terrain and interpretive maps. The Pasulko Lake area, which is the subject of this report, encompasses about 575 ha (Figure 1).

Terrain mapping and interpretations for slope stability and erosion potential were carried out according to provincial standards (Section 3). Terrain mapping was done on 1:15 000 scale colour air photos by air photo interpretation, followed by field checking. This mapping supersedes air photo interpretation that accompanied a preliminary report on terrain conditions for proposed cut blocks and road alignments prepared for Bruce Hupman (MoF) in Spring 1995. Terrain, slope stability and erosion potential information are presented on 1:5000 scale maps.

This report augments the information that is shown on the maps. It provides a general overview of the physiography of the study area (Section 2), descriptions of terrain mapping methodology and mapping reliability (Section 3). Additional information about surficial materials and processes (Sections 4 and 5), and criteria applied to slope stability and erosion potential interpretations (Section 6) are also included. Implications and recommendations for forest land management that arise out of this terrain work are discussed in Section 7.

(2) PHYSIOGRAPHY

The study area is located north of the confluence of the Fraser and Thompson Rivers, within the Clear Range of the Interior Plateau physiographic region (Holland, 1964). It occupies a gently rolling ridge top between the basins of Murray and Laluwissin Creeks. Local relief in the study area is about 410 meters, with elevations ranging from 1495 m a.s.l. (meters above sea level) at Laluwissin Creek to 1905 m on the ridge at the southeast corner of the study area.

Bedrock geology of the study area has been mapped at a scale of 1:250 000 (Duffell and McTaggart, 1952; Monger and McMillan, 1989), and surficial geology at 1:125 000 (Ryder, 1981). The area is underlain by volcanic and sedimentary rocks of the Spences Bridge Group (Figure 2). The regional-scale surficial geology map of the study area identifies drift deposits (mostly till), colluvium and outcrops of bedrock.

In the study area, bedrock is mostly buried by basal till that ranges in thickness from less than a metre to a few metres (see Section 4). The basal till was deposited during the last major glaciation (Fraser Glaciation). During the glacial maximum, about 15 000 years BP (before present), a broad southerly and southeasterly flowing ice stream occupied the Fraser and Thompson plateaus and overrode the Cascade Mountains. The surface of the ice sheet stood at about 2400 m (Duffell and McTaggart, 1952) over the study area. Rounded peaks and

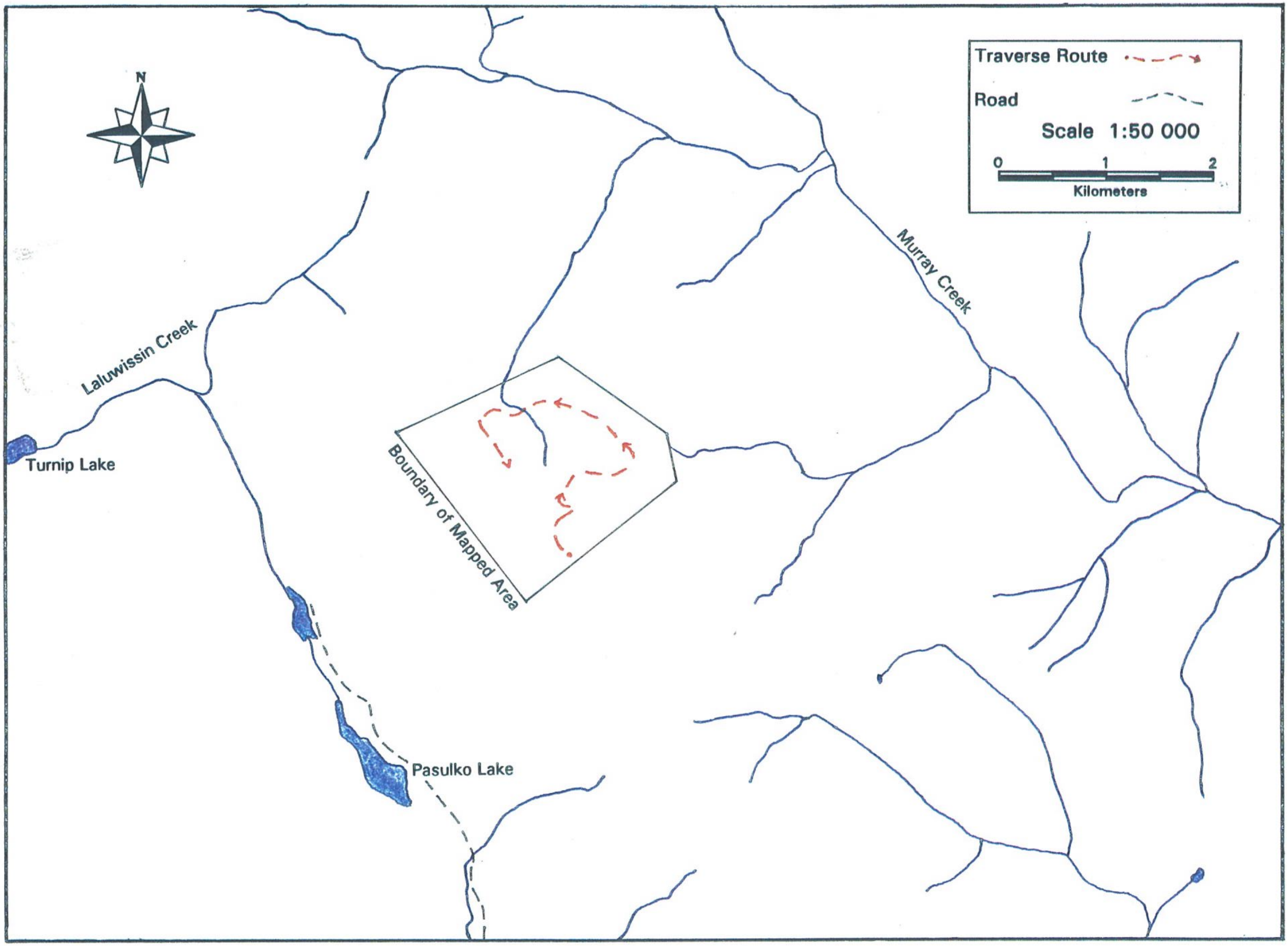
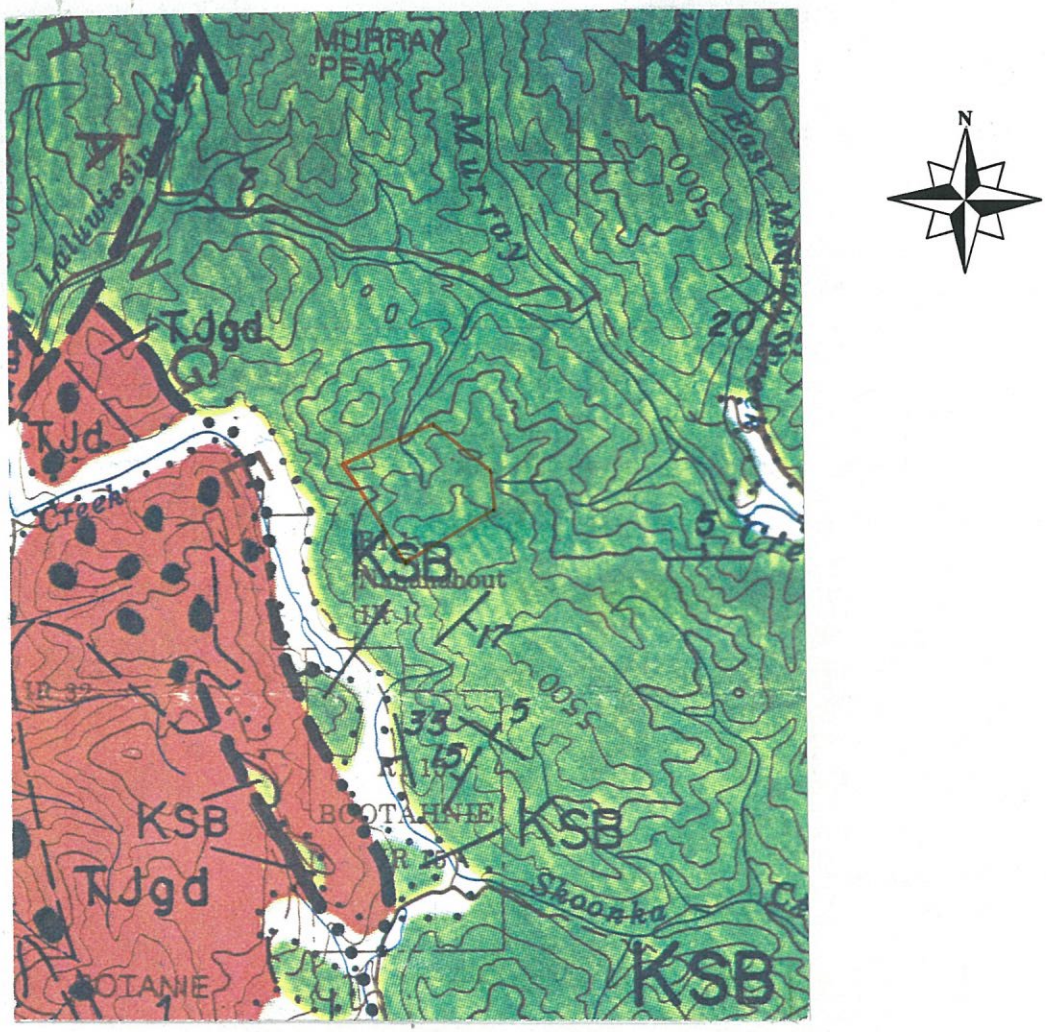


Figure 1. Location map for Pasulko Lake study area.



Scale 1:125 000

0 2.5 5
Kilometers

LEGEND

KSB — **MIDDLE AND LATE CRETACEOUS**
SPENCES BRIDGE GROUP-Intermediate, locally felsic and mafic flows and pyroclastics; sandstone, shale, conglomerate

TJgd,qm — **TRIASSIC AND/OR JURASSIC**
Granodiorite, quartz monzonite (GUICHON CREEK, PENNASK, WILD HORSE CREEK BATHOLITHS; DOUGLAS LAKE STOCK; granodiorite of MOUNT LYTTON COMPLEX)

TJd — Diorite and amphibolite of MOUNT LYTTON COMPLEX; small dioritic intrusions in NICOLA GROUP

Area of outcrop

Geological boundary (defined, approximate, assumed)

Bedding (inclined)

Fault (defined, approximate, assumed)

Normal fault (bar indicates downthrow side)

Figure 2 : Bedrock geology of the Pasulko Lake area (from Monger, J.W.H. and McMillan, W.J. GSC Map 42-1989).

ridge crests are the result of ice erosion on the uplands. During deglaciation, about 12 000 to 11 000 years BP, ice thinned and stagnated, exposing the uplands while ice remained in deep valleys.

During post-glacial time, the processes of weathering and erosion have modified the landscape. Landslides and colluvial blankets have developed on both bedrock and Quaternary deposits.

(3) METHODS

(3.1) Terrain Mapping

Terrain mapping followed the standard British Columbia terrain classification (Howes and Kenk, 1988) and mapping methodology (Ryder, 1994).

Preliminary terrain mapping was done by interpretation of 1:15 000 scale colour air photos (30BCC 674: 198-200; 30BCC 682: 119-121). A day of field work with a crew of three was carried out on July 4th, 1995. Field work involved traversing representative polygons of different surficial materials and slopes, with attention focused on relatively steep slopes likely to be designated as stability classes IV or V. As well, all proposed cut blocks were visited in order to verify interpretations for slope stability and erosion potential. The study area was traversed on foot from the helicopter drop-off at the southeast corner (Figure 1). All field observation sites are shown on the terrain map. Formal site description forms completed for 17 sites are presented in Appendix 3. Soil pits were dug where natural exposures such as slide scars or tree-throw hollows were not available for examination.

Back in the office, terrain mapping on air photos was corrected in light of field observations. Soil drainage and slope classes were added, the latter based partly on field measurements and partly on 1:5000 scale topographic maps (10 m contour interval). Comparison with field measurements suggests that the topographic map is reliable, although some small, locally steep or gently sloping areas are not clearly represented by contours. Interpretations for slope stability and potential erosion were made according to criteria that are discussed in Section 6. Terrain polygon boundary lines were transferred to the 1:5000 scale map by hand, using topography as indicated by contour lines, creeks, forest openings and roads as a guide. On-site symbols relevant to slope stability interpretation (e.g., landslide scarps) were also added.

Overlays and maps in digital format containing the terrain, slope stability and erosion potential information were produced by Hugh Hamilton Ltd., according to MoF specifications. These should be used in conjunction with 1:5000 scale topographic maps.

(3.2) Mapping Reliability

Air photo interpretation and field checking for this project were carried out at a level of detail and reliability that is appropriate for 1:20 000 scale terrain mapping. Approximately 50% of polygons within operability limits were checked (ground check sites and visually inspected sites), conforming to the standard for TSIL B (Terrain Survey Intensity Level B). Maps are presented at a scale of 1:5000, however, to be compatible with the large scale maps used for planning purposes. For this reason, terrain polygons appear to be relatively large and the information that they portray is generalized when compared to the topographic details that are shown by the base map. Map users should be aware that many small areas (less than about 5 ha) of different materials, slope steepness and drainage conditions are unmapped.

The information and analyses contained in this report are based on observations of land-surface conditions and current understanding of slope processes. However, because slope stability is strongly influenced by subsurface conditions that are not apparent from surface observations or air photo interpretation (e.g., characteristics of subsurface materials, subsurface hydrologic conditions), by events whose time of occurrence cannot be predicted (e.g., extreme storms, earthquakes), and by land management practices, the results and recommendations provided in this report cannot guarantee that no landslides will occur in areas affected by forestry activities. Appropriate use of terrain information and implementation of recommendations will, however, reduce the risk of landslides and erosion.

(4) SURFICIAL MATERIALS AND ASSOCIATED LANDFORMS

The following descriptions are based on observations of materials exposed in road cuts, tree-throw hollows, and soil pits ranging in depth from 0.25 to 1.20 metres. Material characteristics were recorded at specific sites, general observations were made continuously during traverses (see Appendix 3 for site forms and the terrain map for site locations), and samples were collected for laboratory analysis to confirm hand texturing in the field.

(4.1) Till (M)

Till is material deposited directly by glacier ice. It typically consists of a fine-grained matrix (particles <2 mm) surrounding and supporting clasts (particles >2 mm) of a variety of sizes, shapes and rock types. Till characteristics such as texture (particle sizes) and consolidation (or bulk density) vary according to specific processes of deposition by glacier ice (e.g., subglacial vs. supraglacial tills).

Highly consolidated and cohesive basal (subglacial) till is widespread throughout the study area on all but the steepest slopes. It is generally between 0.5 to 1.5 m in thickness, and its thickness may vary abruptly over short distances (Mw). Till less than 1 m in thickness (Mv) is present on convex slopes, spurs, and the crests of small hills (e.g., site B97), and till up to a few metres in thickness

(Mb) underlies concavities and depressions. On flat and gently rolling terrain, bedrock mounds and hummocks have been partially buried by till, so that till is thin or absent on rises and thicker in depressions (Mw) (e.g., site B84).

Till texture varies with the texture of the bedrock or older unconsolidated deposits from which it was derived. Till derived from the volcanic rocks of the Spences Bridge Group typically consists of subrounded pebbles (2-64 mm), cobbles (64-256 mm) and less commonly, boulders (>256 mm) within a matrix of muddy sand (mud=silt + clay). Clast content ranges from 30 to 40% and the typical till Munsell colour is dark reddish-brown (5YR3/2) to dark brown (7.5YR3/2).

The basal till is typically dense, and has very low permeability, which could hinder drainage and promote erosion and instability at wet sites. On slopes >65% (33°), thin till may slide during and following wet weather and snowmelt. Where roadcuts intersect the contact between till and bedrock, seepage may cause sloughing and recession of cut slopes.

(4.2) Colluvium (C)

Colluvial materials have accumulated during post-glacial time as a result of gravity-induced movements such as soil creep, rockfall and landslides, and as a result of slope wash by running water. The physical characteristics of colluvium are closely related to its site, mode of accumulation and source material.

On slopes that are steeper than about 60% (31°) and downslope from bedrock outcrops, bedrock and till are commonly overlain by a thin covering of colluvium (Cv and Cvb). This material typically consists of loosely packed rubble, or a mixture of rubble and blocks, with interstitial silty sand. It results from disintegration of local bedrock due to weathering, and slow downslope creep (rock creep) of the detached material. In the study area, colluvial materials are widespread. Colluvium in Cv terrain polygons is non-cohesive, highly porous and permeable.

Talus slopes (Ck) are accumulations of angular fragments that stand at the natural angle of repose, about 67% (34°), at the base of cliffs. Talus was mapped along Murray Creek tributaries at the north and west corners of the study area. Talus material is similar to that of colluvial veneers (Cv), but much thicker and with less near-surface fines. Such terrain is relatively well-drained, dry and sparsely vegetated, thus regeneration and replanting here will be difficult.

Colluvial fans (Cf) and colluvial cones (Cc) are formed at the foot of gullies, the fans by the accumulation of materials moved by debris flows and small steep creeks, and the cones by rockfall. In the study area, colluvial fans and cones were mapped below the cliffs along the west and southwest border of the study area. These colluvial slopes commonly include relatively damp sites, particularly on the lower parts of fans or colluvial cones where the water table lies relatively close to the surface. Colluvial fans typically comprise stability class II terrain; and colluvial cones are stability class III.

(4.3) Fluvial Materials (F, F^A)

Fluvial (alluvial) gravels have been deposited in post-glacial time by streams. Most of the study area drains to the east via tributaries of Murray Creek. Steep slopes on the west side of the study area are drained by the tributaries of Laluwissin Creek, which are generally narrow (approximately 3-5 m wide), gravel-bed streams. Fluvial gravels and sands are loose, non-cohesive, and highly porous and permeable. Associated terrain units that are close to stream-level, such as floodplains and parts of fans, have high water tables and are moderately to imperfectly drained. Fluvial terraces stand above present day creek-levels and are relatively well drained and dry, and good locations for roads and landings. Fluvial materials commonly comprise stability class I and II terrain.

(4.4) Organic Materials (O)

Organic soils (Ov, Op: peat bogs, swamps) form where decaying plant material accumulates in very poorly drained areas. In the study area, small pockets of organic soils were mapped along the west side of proposed cut block 8, and at the end of the access road within proposed cut block 1. Drainage is impeded by the underlying substrate (basal till and bedrock). At other locations, organic soils have developed at poorly drained sites that are too small to show on the terrain map. These are gully floors, hillside concavities, and depressions on effectively impermeable bedrock and till. Organic materials typically underlie stability class I and II terrain.

(4.5) Bedrock (R)

Bedrock is shown on the terrain map where it outcrops or lies very close (less than a few centimetres) to the land surface. Bedrock outcrops are also common in terrain units shown as Cv, Mv, Mvb, and Mw.

(5) ACTIVE GEOMORPHOLOGICAL PROCESSES

(5.1) Rapid Mass Movement (-R, -R")

Rapid mass movement includes falling, bouncing, rolling, sliding, or flowing of dry, moist or saturated debris derived from surficial material or bedrock. The process symbol -R" is used to indicate initiation zones, and -R is used for runout zones. Rock slides (-R"r, -Rr) and rockfall (-R"b, -Rb) appear to be the only active mass movement processes occurring within the study area. These were mapped along the west and southern edge of the study area where small masses of blocky rubble have collected at the base of rock cliffs.

(5.2) Gully Erosion (-V)

Gullies are small ravines with a V-shaped cross section formed in drift and bedrock. In most places, gullies are vegetated and presently "inactive". Their presence is an indicator of former slope erosion however, and thus the symbol -V serves to identify potentially erodible materials such as till (e.g., Mb-V). Gully erosion was commonly mapped on steep, rocky slopes (stability classes IV and V) with a veneer of colluvium (e.g., Rs/Cv-V).

(6) INTERPRETATIONS FOR SLOPE STABILITY AND EROSION POTENTIAL

Ratings for slope stability (5-class system, Forest Practices Code, 1995) and potential surface erosion are presented on a map overlay. "Slope stability" refers to gravitationally-induced mass movement, i.e., slumps, slides and debris flows; "erosion" refers to the removal of material particle by particle by running water. Criteria used to assess slope stability and potential erosion are shown in Tables 6.1 and 6.2. Definitions for slope stability and erosion potential classes are shown in Table 6.3.

General criteria are based on slope steepness, soil drainage, and material texture. It should be noted, however, that general criteria were used as guidelines only: each terrain polygon was rated individually in order to permit additional local conditions to be taken into account when necessary. These include:

- *Slope smoothness/irregularity*: The "bumps" on irregular slopes are usually formed by near-surface bedrock. This acts to pin surficial materials in place and restrict runout distances. Thus the potential for instability is less on an irregular slope than on a slope of similar overall steepness but with a smoother profile.

- *Moisture*: In general, wet slopes are more unstable and more erodible than dry ones. High pore water pressure, such as that which develops in a perched water table in weathered till, leads to reduction in normal stress and slope failure. Overland flow, which develops more readily in wet than dry areas, leads to surface erosion.

- *Slope position*: In general, lower slopes and concavities are relatively wet because they receive moisture from a large area upslope. Thus they tend to be potentially unstable if steep, and erodible even on moderate slopes.

In general, with regard to slope stability, the majority of polygons are rated as stability class IV, but as a percentage of total area, stability classes II and III are most extensive. Steep slopes, and areas of complex topography that include short steep slopes, are rated as class IV. Class V terrain is located on steep cliffs that are affected by rock slides along the west and south parts of the study area.

With regard to surface erosion potential, ratings indicate the erosion potential of bare soil, not the presently forested slopes. Most of the study area was rated as having moderate to high erosion potential. In general, high ratings were given to polygons with slope steepness class 3 or higher, fine textured materials (e.g., till), and moist sites. Very high ratings were given to polygons with slope steepness class 4 or 5, affected by active mass movements and underlain by fine textured materials.

Table 6.1: Guidelines for Assessment of Slope Stability

<table>
<tr><th>Slope Stability Classes</th><th>Dominant Slope Class*</th><th>Material and Landforms</th><th>Dominant Texture</th><th>Active Processes</th><th>Soil Drainage</th><th>Slope Morphology</th></tr>
<tr><td rowspan="2">I</td><td>1 and 2</td><td>Cf; Ff</td><td>g; sr, g</td><td>none</td><td rowspan="10">poorly drained and wet soils are relatively susceptible; polygons with slopes within 5 or 7% of an upper class boundary may be assigned to the next highest class</td><td rowspan="10">slopes with irregular or benched topography controlled by bedrock are relatively stable; polygons with slopes close to a lower class boundary may be assigned to the next lowest class.</td></tr>
<tr><td>1&2 mixed</td><td>Mv, Mb; Cv; R</td><td>$s, s; sr</td><td>none</td></tr>
<tr><td rowspan="2">II</td><td>2</td><td>Mv, Mb</td><td>s$</td><td>none</td></tr>
<tr><td>2 and 3</td><td>Cf; R</td><td>sr; g;</td><td>none</td></tr>
<tr><td rowspan="2">III</td><td>3</td><td>Mv, Mb; Cv</td><td>$s; sr</td><td>none</td></tr>
<tr><td>4</td><td>Ca, Ck, R</td><td>sr, x; g</td><td>none</td></tr>
<tr><td rowspan="2">IV</td><td>4 and 5</td><td>Mv, Mb, Cv, Cb</td><td rowspan="2">all</td><td rowspan="2">-V, -R"b</td></tr>
<tr><td>4 and 5</td><td>Rk, Rs</td></tr>
<tr><td rowspan="2">V</td><td rowspan="2">any gradient</td><td rowspan="2">all</td><td rowspan="2">all</td><td rowspan="2">-R"r
**</td></tr>
<tr></tr>
</table>

* Slope classes are defined as follows: Class 1: 0-5% (0-3°); Class 2: 5-27% (3-15°);
Class 3: 27-49% (15-26°); Class 4: 49-70% (26-35°); Class 5: over 70% (35°).

** Refers to the initiation zone of active gullies and rapid mass wasting

Table 6.2: Guidelines for Assessment of Erosion Potential

		Slope Steepness Classes				
Dominant Texture* or Material	Typical Material*	1 (0-5%)	2 (5-27%)	3 (27-49%)	4 (49-70%)	5 (>70%)
organics	Op, Ob	VL	L	-	-	-
c, m	W^{G}v, L^{G}v	L,M	M	H	VH	VH
fine s, coarse $	L^{G}, Mv, Mw, Cv	L,M	M	H	VH	VH
coarse s, xs	Cv, F, F^{G}, Mv, Mw, Mb, Vv	VL,L	L,M	M,H	H	H,VH
d$s	Mw, Mb, Mv	VL,L	M	M	M,H	H
g, ds, r	F, F^{G}, Mv, Mb	VL,L	M	M	M,H	H,M
a, b	Ck, Cv, Cb	VL	VL	L	L	M,L
R (resistant rock)	R	VL	VL	VL	VL	VL

* Refer to Appendix 2 for definitions of texture symbols and material types.

Table 6.3: Implications of Slope Stability and Erosion Potential Classes

SLOPE STABILITY CLASSES	
I	No problems of instability expected.
II	No significant problems of instability expected.
III	Minor instability problems may develop in some areas; wet areas should be treated with caution.
IV	Moderate likelihood of slope failure as a result of logging activities. Terrain polygons include potentially unstable terrain; special precautions necessary. Site inspection by a slope stability specialist is required.
V	High likelihood of slope failure as a result of logging activities. Terrain polygons include unstable terrain; avoid these areas or require assessment by a slope stability specialist.

EROSION POTENTIAL CLASSES	
VL (very low, none)	No problems of erosion expected on flat or gently sloping terrain, organic soils and floodplain. Erosion of banks and channels may be initiated by the disturbance of streams.
L (low)	Chances of rilling or sheet erosion and subsequent sedimentation of lakes and streams are generally low, although care is required to avoid erosion along ditches with steep gradients. No significant problems of erosion expected.
M (moderate)	Problems of erosion associated with logging are similar to but less than terrain rated "high", although problems may develop if water flows unchecked along steep ditches, roadways, or on other bare soil surfaces. Avoid exposing fine textured till near creeks.
H (high)	Expect problems of erosion to develop on bare soils and compacted surfaces along roads and ditches, cut slopes adjacent to landings, and disturbed soil in cut blocks. Take appropriate precautions to minimize erosion, such as immediate reseeding of exposed mineral soil. Site inspection by geomorphologist recommended.
VH (very high)	Natural movement of fine sediments into adjacent creeks. Potential erosion more severe than in "high" category. Site inspection by geomorphologist recommended.

(Source: modified from Forest Practices Code, 1995).

When using these ratings for stability and erosion, it is essential to bear in mind that conditions are locally variable. The ratings (and information on the terrain map) indicate the mapper's impression of typical conditions for each terrain polygon, but locally steeper slopes, wetter soils, emergence of water from seepage zones, and clayey materials give rise to areas that are potentially more unstable and/or more erodible than their surroundings. Consequently, persons marking road alignments and cutblock boundaries should recognize and take account of these local conditions.

In complex terrain with both gentle and steep slopes, more than one stability and/or erosion potential class may have been used. In such a case, the higher class applies to areas of relatively steep slope.

(7) RECOMMENDATIONS

(7.1) General Recommendations

Recommendations that are standard for erodible or unstable terrain are listed below.

(1) Bare, compacted surfaces, such as cat tracks and skid trails, even on gentle slopes, are particularly vulnerable to erosion by running water. Care should be taken to avoid leaving tracks and drag marks (i.e., depressions) aligned downhill, because they will channel runoff water and initiate gully erosion. Scarification of smoothed and compacted surfaces will increase infiltration rates and reduce erosion hazard.

(2) Grass seeding is an effective means of reducing erosion potential on bare surfaces such as unused landings, cut banks, and other disturbed areas.

(3) Sloughing of cut banks along roads may develop due to emergence of shallow subsurface water. Ditches should be inspected regularly and cleaned or otherwise maintained when necessary.

(4) Construction of roads on steep slopes (>60%) should be minimized, but where unavoidable, all appropriate measures should be used to prevent soil and site degradation (full bench, excess materials end-hauled, no diversion of natural drainage paths).

(5) Road construction should be avoided during wet weather and when the ground is wet due to snowmelt. Trafficability (capacity to support moving vehicles) of wet soils, particularly, fine textured tills will be low.

(6) Where class IV terrain is included within areas where forestry operations are planned, on-site inspections by a slope stability specialist should be carried out in order to determine more precisely the nature of the instability and the extent of the unstable areas.

(7) Class V terrain is unstable and should be avoided.

(7.2) Specific Recommendations

In general, the proposed road alignment in the Pasulko Lake area is located on stable (class II and III) terrain with moderate to high surface erosion potential. All proposed cut blocks are located on stability class II or III terrain, with the exception of block 3 which is mapped as class III and IV. The lower and mid-slopes of this block are stable (class III), however, the terrain along its upper boundary is relatively moist and may be class IV terrain. Here, the terrain is underlain by a veneer of gullied colluvium. The upper block boundary should be shifted downslope to exclude the moist sites and avoid including any part of the steep polygon upslope.

The cliffs of volcanic rock located west of proposed cut block 1 and at the south corner of the study area are mapped as stability class V although they have low to very low erosion potential. Along the western block boundary, a "no machinery zone", one tree height wide, should be defined. Undamaged, living understory and all small (< 20 cm) windfirm trees should be retained here in order to prevent erosion and maintain slope stability.

For most of the study area, surface erosion potential is moderate to high because of the presence of fine textured material (till) which is more susceptible to surface erosion than coarser materials. Logging activity in areas of high erosion potential must be carefully planned to avoid unnecessary soil loss. Wet soils and organic soils are rated as moderate erosion potential, even on relatively gentle slopes because surface runoff is more likely to occur at such sites than elsewhere. Erosion hazard can be offset by adequate planning of erosion prevention measures along roads and ditches, and minimizing disturbance of soil. Road construction techniques and drainage installations should be appropriate to local conditions.

(8) CONCLUSIONS

Field and air photo observations suggest that terrain in the Pasulko Lake area is more susceptible to erosion than to instability. In general, the proposed road alignment and cut blocks in the Pasulko Lake area are located on stable terrain with moderate to high erosion potential. Moderate to high erosion potential ratings are common because of the presence of fine textured materials. Class V terrain is restricted to cliffs with evidence of recent rockfall and rock slides.

ACKNOWLEDGMENTS

The author would like to thank June Ryder for entrusting him with the responsibility to carry out this project, Blythe Killam for leading the field crew, Jason Barraclough and Deepa Spaeth for assisting in the field, Jason Barraclough for helping in the office, Janet Kidnie for reviewing the first draft report, Bruce Hupman, R.O.E. of the B.C. Forest Service, Lillooet Forest District, for providing the 1:5000 scale base maps and helicopter support for field work, Peter of Cariboo-Chilcotin Helicopters in Lillooet, and John Bunning of Hugh Hamilton Ltd. for digitizing the map overlays. J.M. Ryder and Associates, Terrain Analysis Inc. thanks Bruce Hupman for the opportunity to carry out this project.

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APPENDIX 1: TERRAIN MAP LEGEND - PASULKO LAKE AREA

(1) TERRAIN UNIT SYMBOLS

Simple Terrain Units: e.g., texture aCk-R process
surficial material surface expression

Note: Two letters may be used to describe any characteristic other than surficial material, or letters may be omitted if information is lacking.

Composite Units: Two or three groups of letters are used to indicate that two or three kinds of terrain are present within a map unit.

e.g., Cv·Rs indicates that "Cv" and "Rs" are of roughly equal extent

Cv/Rs indicates that "Cv" is more extensive than "Rs" (about 2/1 or 3/2)

Cv//Rs indicates that Cv is much more extensive than Rs (about 3/1 or 4/1)

Stratigraphic Units: Groups of letters are arranged one above the other where one or more kinds of surficial material overlie a different material or bedrock:

e.g., Mv/Rr indicates that "Mv" overlies "Rr".

/Mv/Rr indicates that Rr is partially buried by Mv

Slope Stability and Erosion Potential: Roman numerals for slope stability and upper case letters for erosion potential separated by a ".", e.g., I.L

(2) MATERIALS

C	Colluvium	M	Till
F	Fluvial sediments	O	Organic sediments
F^A	"Active" fluvial sediments	R	Bedrock

(3) TEXTURE

c	clay	m	mud	g	gravel	a	blocks
z	silt	p	pebbles	b	boulders	d	mixed g, b, r, a
s	sand	k	cobbles	r	rubble	x	angular fragments

(4) SURFACE EXPRESSION

a	moderate slope(s)	k	moderately steep slope	s	steep slope(s)
b	blanket	l	lobe	t	terrace(s)
f	fan	m	rolling topography	u	undulating topography
h	hummocky	p	plain	v	veneer
j	gentle slope(s)	r	ridges	w	variable thickness

(5) GEOLOGICAL PROCESSES AND MASS MOVEMENT SUB-CLASSES

R	Rapid Mass Movement	Rb	Rockfall	V	Gully Erosion
R"	Rapid Mass Movement (Initiation Zone)	Rr	Rockslide		

(6) SOIL DRAINAGE CLASSES

r	rapidly drained	m	moderately well drained	p	poorly drained
w	well drained	i	imperfectly drained	v	very poorly drained

Where two drainage classes are shown, e.g., "wi", then no intermediate classes are present; if the symbols are separated by a dash, e.g., "w-i", then all intermediate classes are present.

(7) SLOPE CLASSES

1	0-3^{o} (0-5%)	**3**	15-26^{o} (27-49%)	**5**	>35^{o} (>70%)
2	3-15^{o} (5-27%)	**4**	26-35^{o} (49-70%)		

(8) ON-SITE SYMBOLS AND BOUNDARY LINES

Boundary lines:	definite boundary ————	indefinite boundary – – – –	assumed or arbitrary boundary	study area boundary ————

On-site Symbols:

⊙ B85 observation site

Δ visual inspection site

meltwater channels: small (flow direction unknown)

landslide scars: headwall scar only

small landslide: headwall scar and track

APPENDIX 2: FIELD DATA FORMS