ALASKA HIGHWAY CORRIDOR LANDSLIDE HAZARD STUDY

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INTRODUCTION

The Alaska Highway corridor spans nearly 1000 km in Yukon and is critical for transportation, tourism and resource development in northwestern North America.

This geologically complex region covers surficial deposits that record the most recent continental glaciation and subsequent events, and spans several climatic zones, intermittent permafrost, and tectonically active areas along major fault systems.

In addition, the corridor borders the largest non-polar ice field in the world. Each of these factors greatly influence the occurrence of landslides along the corridor.

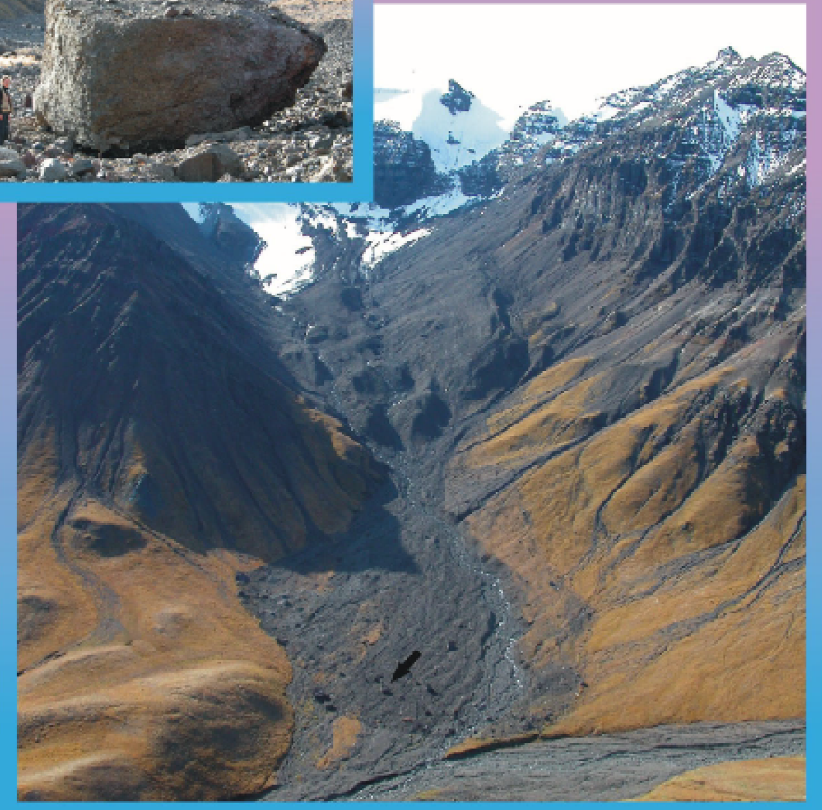
This study aims to characterize the different types of landslide hazards within the corridor and to examine the roles that various physiographic factors play in their distribution.

1 **Beaver Creek**

Embankment failure along new highway upgrades caused by thaw of a massive segregated ice lense. The ice lensing formed by groundwater discharge at the base of a bedrock valley wall into permeable glaciofluvial sands, gravel, and silt. Inset shows magnitude of ground movements.

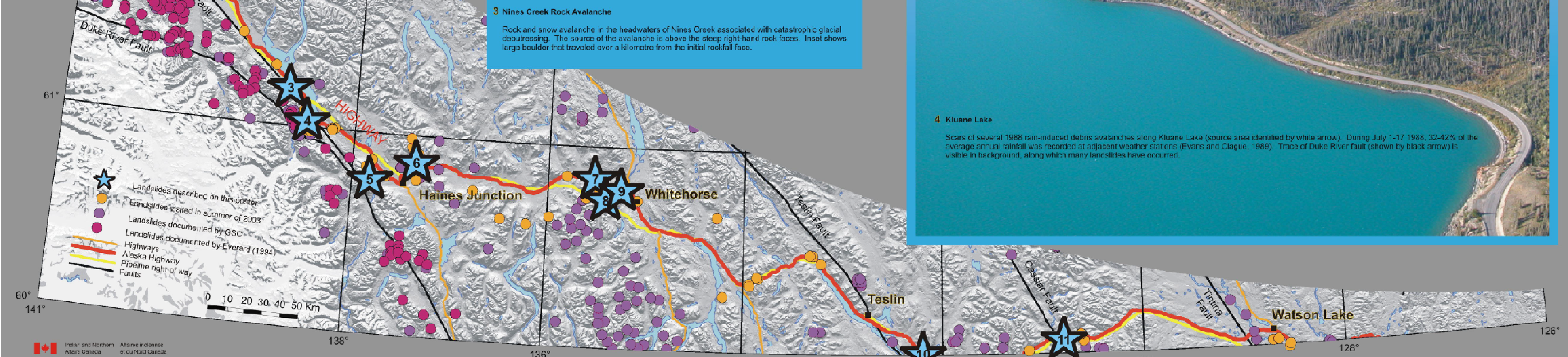
2 **Beaver Creek**

Permafrost subsidence in abandoned gravel pit adjacent to Alaska Highway. Subsidence is related to thermokarsting caused by gravel and vegetation removal adjacent to highway.



3 **Nines Creek Rock Avalanche**

Rock and snow avalanche in the headwaters of Nines Creek associated with catastrophic glacial debuttressing. The source of the avalanche is above the steep right-hand rock faces. Inset shows large boulder that traveled over a kilometre from the initial rockfall face.



Southern Yukon Territory showing the Alaska Highway corridor, documented landslides, highways, pipeline right of way, and major faults systems.

Indian and Northern Affairs Canada / Affaires indiennes et du Nord Canada
Knowledge & Innovation Fund

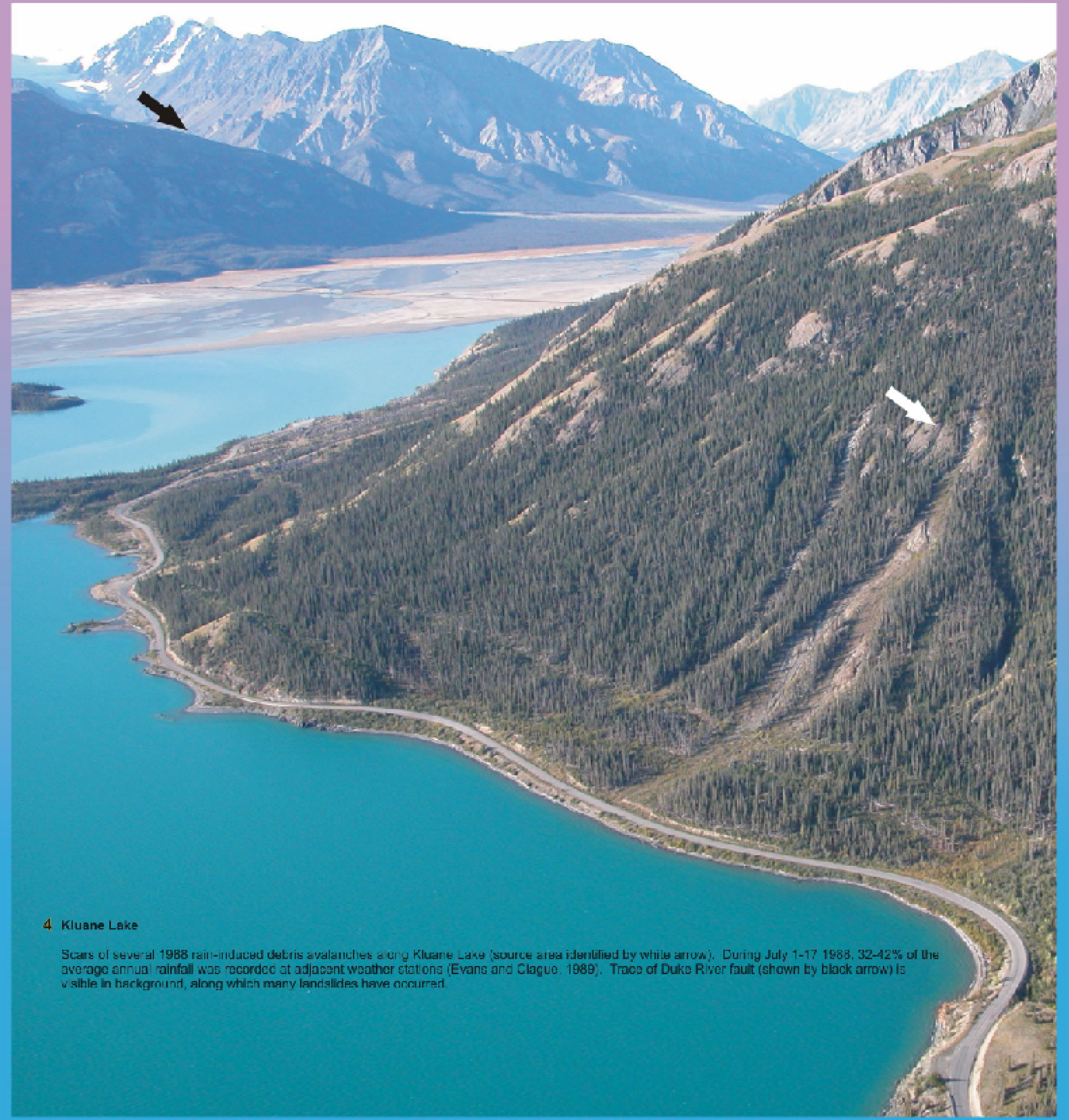
PROJECT GOALS

The landslide hazard identification project aims to characterize the setting of current and future landslide hazards along the Alaska Highway corridor. This objective entails:

- assessing the potential impacts of climate change on landslide processes
- investigating the influence of permafrost on slope stability
- raising awareness of hazards amongst other governmental agencies, local Jurisdictions and private industry

5 **Mount Archibald Rock Glacier**

Ice-rich colluvium in alpine basins provides a major source of material for debris flows that transport debris down to the valley bottom.



4 **Kluane Lake**

Scars of several 1988 rain-induced debris avalanches along Kluane Lake (source area identified by white arrow). During July 1-17 1988, 32-42% of the average annual rainfall was recorded at adjacent weather stations (Evans and Clague, 1989). Trace of Duke River fault (shown by black arrow) is visible in background, along which many landslides have occurred.

6 **Marshall Creek**

A collection of post-fire debris flows in Marshall Creek basin. Forest fire related thaw since 1998 has caused forty-one failures in the 37 km² burn.

7 **Takhini River**

Abandoned retrogressive ground ice slump in the Takhini River Valley adjacent to Alaska Highway. Note new cracks in highway fill as headwall stabilizes (arrow). Permafrost thaw related to river undercutting, forest fire, proximity to highway, and forest cover removal in adjacent agricultural fields all may contribute to permafrost degradation and the failure. Dashed line highlights remnant headscarp.

METHODOLOGY

Research methods consisted of compiling and characterizing both previously documented and newly discovered landslides. Three months of fieldwork involved:

- site investigations of existing landslides to determine factors contributing to instability and determination of impacts
- investigation of the nature of hillslope permafrost throughout the corridor
- use of GIS to model landslide settings

8 **Mount Sumanik**

Oblique aerial view of thaw-related debris flows on Mount Sumanik. A 60 cm saturated soft plastic layer was discovered on top of the frozen soil above the initiation zone of the flows.

9 **Haeckel Hill**

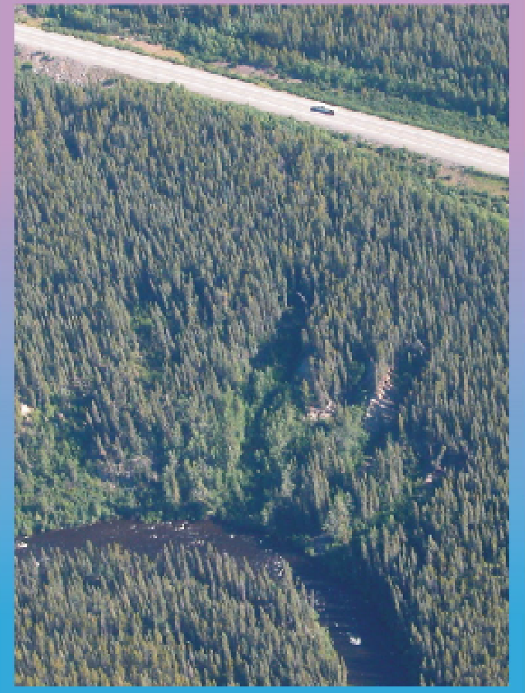
Permafrost encountered in soil pit on northern Haeckel Hill, where numerous landslides occurred after a forest fire in 1991. Rapid melting of this structure causes loss of soil strength and promotes failures.

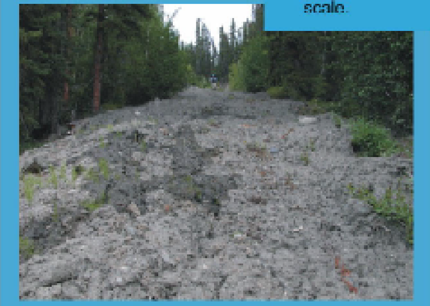
CLIMATE CHANGE

Current predictions of climate change are forecasting increased temperatures and precipitation for the Yukon in the next century. Permafrost cover has a delicate existence within the current climate regime.

If climate predictions prove accurate, permafrost will degrade and lead to terrain destabilization including landslides and ground subsidence. Instabilities can also be expected from a predicted increase in rainfall and glacier recession.

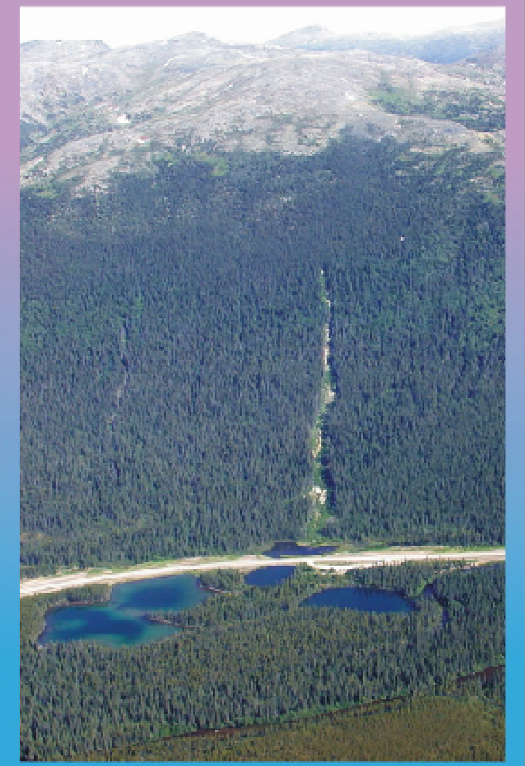
To date, no comprehensive assessment of climate change related terrain hazards has been undertaken on the Alaska Highway Corridor. This study will characterize these hazards along the Yukon portion of the corridor.





10 **Morley River**

Debris flows in basal till along the Morley River. Inset photo taken in debris flow channel. Person at top of channel for scale.



11 **Rancheria**

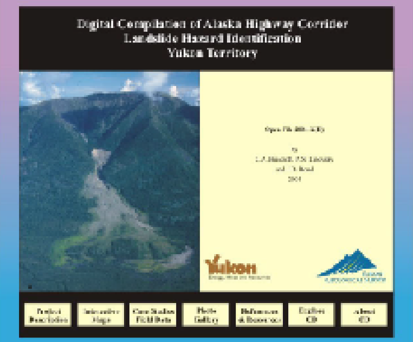
Debris flow on south-facing slope near Rancheria, induced by intense rainstorm in 1988. Alaska Highway in foreground.

FINAL PRODUCTS

In April 2004, an open file will be released to the public, summarizing the results and recommendations derived from the study.

An interactive digital compilation will also be produced on CD-ROM including:

- a digital copy of the open file report
- field data and photos collected from case study investigations
- GIS maps for interactive viewing of landslide locations and environments
- a database of selected landslide occurrences along the Alaska Highway corridor
- a compilation of relevant references pertaining to terrain instability in the corridor



Mock up of opening screen for interactive digital compilation CD, to be available April 2004.