Newfoundland Labrador
Department of Energy and Mines

Mineral Lands Division Information Resource

Slope Hazards in Newfoundland and Labrador

(sheet 1 of 3)

INTRODUCTION

The Mining and Mineral Development Branch of the Department of Energy and Mines provides the following comments and recommendations on the potential for slope hazards in the province of Newfoundland and Labrador. These comments and recommendations are provided solely for information purposes. The intended audience includes individuals and companies planning to develop on or near slopes or seeking to obtain title to land on or near a slope, municipalities with planning authority, and planning consultants.

The term geological hazard is used to describe a scenario that may result in a geological disaster. A geological disaster occurs when a geological process causes damage, injury, loss of life, or economic loss. Recognition of past geological disasters and potential future hazards is integral to constructive land-use decisions by municipal and provincial planners. The GSNL supports the municipal planning process by highlighting potential hazards in or near communities, typically by request. For more information on geological hazards and historical disasters in Newfoundland and Labrador, visit https://www.gov.nl.ca/iet/mines/publicoutreach/geologicalhazard/.

LANDSLIDES

The term “landslide” describes the gravity-driven downslope movement of unconsolidated material (rock, sediment, soil). Material may fall, topple, slide, slump, or flow; each type of mass movements occurs under different conditions (slope angle, sediment water content, sediment texture, failure depth). Landslides occur in locally steep terrain in Newfoundland and Labrador, in both inland and coastal areas.

- **Slump** and **slide** describe gravity-driven, downslope movements of material (soil, sediment, bedrock). Slides may occur as avalanches of unconsolidated or semi-consolidated material along a slip plane (translational slide) or a curved to circular failure surface (rotational slide or slump). Slumps and slides are a documented cause of damage to the built environment in Newfoundland and Labrador, and are of particular concern along unconsolidated coastal cliffs, bluffs, or river banks. Slope saturation by rainfall or snowmelt is a common trigger for slides; saturation can cause a loss of internal sediment shear strength and lubricate the sliding surface. Permafrost thaw may increase the risk of slumps and slides where permafrost is present. Wildfire and windfall in the preceding weeks, months, or years may also increase slide or slump risk in steep topography.

- **Debris flows** are gravity-driven slurries of rock, sediment, and water that travel in pulses with coarse debris snouts and watery tails. Debris flows are fast-moving and can travel long distances in confined spaces such as stream channels. They are capable of significant erosion and can transport large volumes of rock and other debris. Small debris flows have been documented in Newfoundland and Labrador. Wildfire in the weeks, months, or years before heavy rainfall can increase the risk for debris flows.

- **Rock falls** are the rapid downslope movement of rock fragments (up to boulder-sized), either by free fall from cliffs, or rolling or sliding down slopes. Rocks may be dislodged by freeze-thaw activity, erosion beneath boulders, bedding plane failure, or through human activity. Rock falls may trigger landslides on the slope below, where the debris lands. Over time, repeated rock fall may form a talus cone of rock debris at the foot of a steep slope or cliff.

- **Creep** is the relatively slow, downslope movement of unconsolidated surface materials. Creep can be identified by its effects, such as curved tree trunks, bent fences or poles, or contour-parallel ridges on surface soils. Creep is common in Newfoundland and Labrador and may be seasonal or continuous.

Human activities, such as development near steep slopes, may increase landslide risk by altering surface hydrology, removing vegetation that stabilizes slopes, or changing local slope angles. Any development proposed on or near the base or the top of a steep slope should consider the potential risks of slope movement. Steep slopes may present a hazard for slope movements (e.g., landslide, rockfall), particularly in areas where there is thick unconsolidated, surficial sediment, or steep bedrock slopes. Mass movements can be triggered on slopes with relatively low slope angles (e.g., < 15°) with vulnerability increasing as the slope angle increases (Batterson and Stapleton, 2011).

AVALANCHES

Avalanches are rapid downslope movements of snow and ice that may also entrain sediment, rock, and vegetation. Avalanches typically initiate on steep (> 30–50°) snow-covered slopes. Avalanches are usually triggered when heavy snowfall slides along a smooth, internal snow or ice surface. This internal smooth plane may form during a rapid fall in temperature in the days preceding the overlying snowfall, or from a period of freezing rain or burial of a weak snow layer. High wind can also contribute to avalanches; wind-sculpted snow on ridges or mountaintops may develop into a mass of hardened, overhanging snow (cornice) that can fall and trigger an avalanche on the slope below it.

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CLIMATE CHANGE AND FUTURE HAZARDS

The intensity of landscape change and the frequency of geological hazards will likely increase in the future. Geological disasters may occur more frequently or become relevant for new locations within the province. Regional climate projections predict that by 2070 the province will be warmer (especially in winter) and wetter (in terms of both precipitation intensity and duration; Finnis and Daraio, 2018). Extreme precipitation events will be more common and some areas will see increased snowfall, leading to increased risk for landslides and avalanches. Additional resources and updated climate projections for Newfoundland and Labrador are available online at https://www.gov.nl.ca/ecc/occ/climate-data/.

RECOMMENDATIONS

Municipal planning and development should consider a 100-year planning period and incorporate the impacts of climate change on potential slope hazards. Proposed development on, above, or below steep slopes (>15°; 26.8%) and excavations into the toe of steep slopes should be evaluated to assess the risk of slope movements, particularly near slopes in unconsolidated materials or unstable bedrock. Evaluations should be conducted on a case-by-case basis, as factors that could increase the risk (e.g. bedrock type or amount of overburden) will vary along a designated steep slope and may change over time. Planners should consider all risks associated with development in steeply sloping areas; a comprehensive risk assessment from a geotechnical engineer or other qualified professional may be warranted. Vegetative buffers and engineering solutions that will mitigate potential adverse effects and limit erosion near steep slopes should be considered. Municipalities with planning authority may choose to remove areas susceptible to slope-related hazards from future development through re-zoning.

RESOURCES

Batterson, M.J. and Stapleton, N. 2011; Report on vulnerability to geological hazards in the town of Conception Bay South. Newfoundland Department of Natural resources, Geological Survey, Geological hazards Series, Report No1, Open File 001N/0884, 24 pages. https://www.gov.nl.ca/em/files/mines-geoscience-publications-openfiles-of-001n-0884.pdf

Finnis, J. Daraio, J. 2018: Projected impacts of Climate Change for the Province of Newfoundland and Labrador: 2018 Update. Memorial University of Newfoundland. Pages 198. https://www.researchgate.net/publication/336778239_Projected_Impacts_of_Climate_Change_for_the_Province_of_Newfoundland_and_Labrador_2018_Update