# Landslide risk management in the District of North Vancouver



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## ABSTRACT

The District of North Vancouver has taken a qualitative risk assessment approach to landslide and debris flow hazards. Quantitative risk is discussed with stakeholders by comparing risk from natural hazards with other mortality rates as a communication tool to understand hazards and their associated risks. The District is in the process of establishing risk tolerance criteria to aid planning and mitigation decisions.

#### RÉSUMÉ

La municipalité de Vancouver du nord a adopté une approche qualitative d'évaluation des risques aux risques d'éboulement et d'écoulement de débris. Le risque quantitatif est discuté avec des parties prenantes en comparant le risque des risques naturels à d'autres taux de mortalité comme outil de communication pour comprendre des risques naturels et leurs risques associés. La municipalité est en cours d'établir des critères de tolérance de risque pour faciliter des décisions de planification et d'atténuation du risque.

#### 1 NATURAL HAZARDS MANAGEMENT PROGRAM

The District of North Vancouver is sandwiched between the Coast Mountains and the Pacific Ocean, prone to frequent, concentrated precipitation and strong winds. The fatal 2005 Berkley landslide triggered a new approach to landslide and debris flow risk management in the District. The Natural Hazards Management Program was initiated in 2006, allocating funding to risk assessment and mitigation, and providing greater public access to hazard and risk information. The District utilizes the CAN/CSA Q850-97 risk management framework to manage natural hazards. In 2006, interim risk tolerance criteria, based on criteria used in other countries, were utilized to manage landslide risk on and below the Berkley escarpment. In February 2007, Council held a workshop to review the natural hazards program and approved a plan which included, "establish a process to adopt risk tolerance criteria".

#### 1.1 Identifying Landslide Hazard and Risk

Many District neighbourhoods are built along creeks and steep ravines. The District hired geotechnical engineering consultants to conduct preliminary landslide hazard assessments along identified escarpment areas. Those areas requiring more detailed assessment have been categorized and prioritized. The District is now in the process of undertaking detailed quantitative risk assessments of high priority areas and reviewing risk control options. A quantitative risk assessment was completed for debris flow basins in 2005.

#### 1.2 Hazard Database

A challenge was identified in maintaining and locating accurate and detailed historical records, both in general as well as specific to individual properties. A GIS-based hazard database has been developed to compile hazard and risk reports and related information. The database is currently accessible to municipal staff to aid planning decisions, and to track progress on mitigation and maintenance work being performed in identified hazard areas.

#### 1.3 Pre-warning Systems

In some cases, structural mitigation options recommended to manage natural hazard risk were found to be cost-prohibitive within the municipal budget. The District is working with a geotechnical engineering consultant to design and install situation-monitoring equipment and pre-warning systems, with the intent to reduce the temporal probability factor in the risk equation, thereby reducing risk to tolerable levels.

### 2 ESTABLISHING RISK TOLERANCE CRITERIA

There is increasing interest in British Columbia in the utilization of quantitative risk assessment (QRA) relating to the risk to human life as a development planning tool in hazard areas. QRA is subject to a degree of uncertainty due to required estimation of some factors, but is generally considered more accurate than qualitative methods. QRA allows for risk comparison between different types of hazards and widely acceptable everyday risks such as driving.

As far as we know, no other municipalities or government agencies in Canada have adopted policies for risk tolerance criteria or levels of safety to apply to QRAs. Various jurisdictions in Australia, the United Kingdom, Hong Kong and the Netherlands, among others, have adopted similar risk tolerance criteria to manage either natural or industrial hazards. These criteria were used as the starting point for discussion, and, ultimately, are the criteria proposed for the District of North Vancouver.

### 2.1 Risk Tolerance Task Force

A public task force was formed to seek public input regarding risk tolerance criteria and make recommendations to Council. The task force reviewed relevant literature, received education sessions from subject matter experts and solicited public input before making their recommendations to Council in April, 2008. Before adopting the criteria as policy, the next step will be to develop a comprehensive implementation plan, considering implications to permitting and community planning. The risk tolerance criteria can then be applied to the QRAs with the intent to guide development and aid in risk control decisions in developed areas.

The criteria of 1:10,000 risk of death per year for individuals is comparable to the average Canadian's risk of dying in a motor vehicle accident, considered broadly "acceptable" by many people. When the task force asked the public for their opinion on acceptable risk, 72% of questionnaire respondents placed the tolerable level of risk between 1:10,000 and 1:100,000 risk of death per year from natural hazards, supporting the recommendations of the task force.

Questions were raised during the public process regarding responsibility for mitigation on private land, particularly where development currently exists. The task force proposes two-tiered risk tolerance criteria because it is generally more attainable to reduce risk for new developments by altering building location and design features.

#### 2.2 Application of Risk Tolerance Criteria

The majority of work for the District will be in developing an implementation plan for applying risk tolerance criteria that takes into consideration aspects of the hazards to be included, development permit implications, community planning, and fiscal implications. A strong public communication process providing clear information about hazards and their associated risks, options for avoidance or mitigation, resident and municipal responsibilities and administrative processes is essential for public policy acceptance and a successful Natural Hazard Management Program.

#### ACKNOWLEDGEMENTS

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