Queen's University

M.Sc. or Ph.D. Student Positions in Slope Geohazards

In July 2027, Queen's University will establish an Eddie Goldenberg Research Chairs of Canada Program focused on *Slope Geohazard Management for Infrastructure and Mining in a Changing Climate* under the direction of incoming Chairholder Dr. Gabriel Walton. To support this ambitious new research program, Dr. Walton is recruiting up to ten graduate students (Master's and PhD) to contribute to the program's research mission starting in the Fall 2027 semester. Members of equity-deserving groups are encouraged to apply.

Research Program Description

Slope Geohazard Management for Infrastructure and Mining in a Changing Climate

As a result of climate change, Canada must anticipate and prepare for an increase in both the frequency and severity of slope geohazards, such as landslides, rockfalls, and debris flows. Each year, slope failures across Canada cause direct and indirect losses that total in the hundreds of millions of dollars, with disproportionate impacts on rural, northern, and Indigenous communities. These hazards are increasingly threatening critical infrastructure, resource development, and the property and safety of Canadians, with devastating functional and financial consequences. Climate change is expected to amplify the severity and socioeconomic impact of these hazards due to increased permafrost thaw, extreme precipitation events, and wildfires. To address this growing challenge and mitigate the negative impacts of slope geohazards, innovative solutions will be co-created in partnership with civil infrastructure owners, engineering design experts, mine operators, and local communities to improve geohazard characterization, forecasting, and data-informed risk mitigation.

The Research Chair will establish Canada as a global leader in slope geohazards and foster collaboration with partners internationally, while training the next generation of engineers and geoscientists in hazard management and infrastructure design for climate resilience. The research program will contribute tangible economic and societal benefits to Canada, including: (1) helping to ensure the continued functionality of critical infrastructure relied upon across Canada through the development of new tools for improved hazard identification and management; (2) contributing to Canada's Arctic sovereignty through community-scale hazard studies to support safer infrastructure development and risk-informed planning in northern regions; (3) supporting policymakers in prioritizing investments and strengthening infrastructure resilience under future climate conditions through the development of climate-informed hazard projections; and (4) supporting Canada's critical minerals supply chain and the transition to clean technologies through an improved understanding of slope behaviour to inform engineering design practices that enhance mine safety and efficiency.

Why Join the Chair's Research Team?

This represents a unique opportunity to participate in engineering research with real-world impact while receiving exceptional training and mentorship. As one of the first members of the Chair's group at Queen's, your contributions will be critical to setting the foundation for the program's culture and future endeavours.

The Research Chair program will be conducted in close partnership with a variety of industry and community stakeholders, giving team members a chance to interact with and learn from potential future employers and collaborators during their research. Dr. Walton's mentees have a strong track record of job placement.

Graduate students will receive competitive funding. Including compensation for teaching assistant duties, Master's students will receive at least $35,000 CAD per year, Ph.D. students will receive at least $38,000 CAD per year.

Graduate Student Expectations and Qualifications

Applicants should possess, or be completing, a Bachelor's degree; a prior Master's degree is preferred for Ph.D. applicants.

Students with backgrounds in Geological Engineering, Geology, Geophysics, Civil Engineering, and/or Mining Engineering are welcome to apply. Strong time management and communication skills are required. A background in quantitative methods (including programming, machine learning, and numerical modeling) is considered an asset but not required.

Graduate student researchers are expected to pursue and publish self-directed thesis research under the guidance of the Chairholder while also completing required coursework (a minimum of four term-length courses) and fulfilling Teaching Assistant duties (approximately 120 hours per year). Varying degrees of travel within Canada for fieldwork will be required for most projects.

How to Apply

The Chairholder invites applications from all qualified individuals. Queen's is strongly committed to equity, diversity and inclusion and encourages applications from Black and racialized individuals, Indigenous Peoples, women, persons with disabilities, and individuals from 2SLGBTQIA+ communities.

Queen's is committed to providing support and accommodation for applicants with disabilities at all stages of the recruitment process. If you require accommodation for submitting your application or during the interview process, please contact the Department of Geological Sciences and Geological Engineering (Sara Bernard; bernards@queensu.ca).

Preliminary expressions of interest should be submitted to g.walton@queensu.ca with the subject line "Eddie Goldenberg Program Application" by no later than **November 15, 2026**.

Interested applicants should submit:

- A cover letter describing their research interests (including an indication of all potential projects of interest from the list below) and relevant experience.
- Curriculum vitae
- Unofficial academic transcripts

Shortlisted candidates will be contacted by early December with encouragement to submit a complete application by **January 10, 2027** (note that this is earlier than the general application deadline for graduate programs at Queen's). Formal decisions will be released in February-March 2027.

Example Projects *(some Masters-level projects may have the opportunity to expand to Ph.D.-level scope)*

Masters Level – Improving Automated Point Cloud Registration: Existing approaches for point cloud registration rely on an initial coarse registration step that is typically highly sensitive to one or more input parameters, depending on the algorithm used. Input parameters that result in an appropriate registration may vary between sites or even between distinct point clouds (e.g. individual lidar scans) collected at the same site. This project will develop improved metrics for registration performance and use these to implement a concept for an iterative coarse registration approach that will automatically select optimal algorithm input parameters.

Masters Level – Developing a Framework for Slope Monitoring Using Photographic and Point Cloud Techniques: Photographic and point cloud (e.g. lidar, photogrammetry) monitoring techniques are increasingly common for evaluation of slope hazards, but unlike more traditional monitoring technologies, guidelines for their use are not well established or documented. This project will contribute to the design of a nationwide monitoring network and combine lessons learned from this process with critical analysis of the literature and interviews with practitioners to compile best practices for monitoring program design.

Masters Level – Improving Approaches for Rockfall Detection from Photographic Monitoring: Photographic timelapse monitoring of rock slopes can provide a cheap and simple alternative to other approaches such as fixed photogrammetry or repeat laser scanning. While techniques for automated detection of rockfalls by comparison of sequential photos exist, their performance can be inconsistent and require substantial manual intervention to limit false positives, particularly when the goal of monitoring is to detect relatively small rockfalls. This project will focus on evaluating alternative approaches for automating rockfall detection in the context of photographic monitoring and will ultimately develop improvements to more effectively differentiate small rockfalls from noise.

Masters Level – Evaluating the Influence of Rockfall Fragmentation Characteristics on Runout and Implications for Slope Design: Rockfall blocks often break apart as they travel downslope, which can significantly influence their movement and final stopping locations. Despite this, most rockfall runout analyses do not account for fragmentation effects. Recent advances have enabled fragmentation processes to be incorporated into commercial rockfall modeling software, but the implications for hazard assessment and mitigation design remain poorly understood. This project will use case studies and numerical modeling to investigate how rockfall fragmentation affects predicted runout behaviour and how uncertainty in fragmentation parameters influences estimates of rockfall hazard.

Masters Level – Evaluation of Rockfall Trends for a Large Natural Slope at a Hydropower Site: A large natural rock slope sits above the abutment of a dike at a hydropower site in Quebec. This represents a risk to the infrastructure below, and while previous analyses have been conducted to assess risk, quantitative information regarding the underlying rockfall hazard is limited. This project will use a combination of field mapping and analysis of lidar monitoring data (both historical and newly collected during the project) to quantitatively assess the frequency-magnitude distribution of rockfalls at the site and their implications in a risk framework.

Masters Level – Slope Instability Mechanisms at Pink Mountain, BC: Pink Mountain has many actively deforming slopes and is located in a region where permafrost degradation and climate-driven changes may influence long-term slope stability. Although ongoing deformation has been identified, the geological and thermo-hydro-mechanical processes controlling instability remain poorly understood. This project will combine field mapping, remote sensing data analysis, and slope stability analyses to investigate the mechanisms governing slope deformation and assess potential future changes in slope stability.

Masters Level (co-supervisor – Dr. Renato Maciotta) – Evaluating the Influence of Rockmass Quality and Heterogeneity-Influenced Damage Zones on Rockfall Hazard: It is generally established that rockmass quality variations both within and between slopes are directly tied to corresponding variations in rockfall activity and characteristics. There are limited number of existing studies, however, that evaluate these relationships in detail. This project will use multiple years of existing repeat lidar monitoring data at two slopes in the Canadian Rockies to study how rockmass characteristics and localized heterogeneity-influenced damage zones affect rockfall hazard.

Masters Level – Preliminary Canada-Wide Slope Hazard Characterization: Recent efforts have led to the development of a Canada-wide landslide database (Brideau et al., 2026). While this represents a major step forward in the characterization of hazard, most the inventoried hazards do not have recorded timing or size information. As a complement to this existing database, this project will survey the literature and use historical imagery and remote sensing data to quantify slope hazards in a frequency-magnitude framework and ultimately to develop a preliminary and approximate extrapolation of hazard at the nation-wide level.

Ph.D. Level – Development of Approaches for Geotechnical Applications of Hyperspectral Data in Open-Pit Mining: Hyperspectral data are now commonly collected at open-pit mining sites to support geological characterization activities, but limited research has been conducted to fully develop the potential of these data to support geotechnical characterization and design. Through partnerships with operating mines and engineering consultants, this project will advance knowledge of how hyperspectral data map to geotechnical characteristics and will develop practical guidance for their integration into geotechnical workflows. Early efforts will involve site-level core-scale data analysis, but opportunities exist to expand into research evaluating multi-site generalization of findings, as well as potential evaluation of field-scale hyperspectral data and comparative analysis across scales.

Ph.D. Level – Development of a Framework to Evaluate the Contribution of Permafrost Thaw to Progressive Instability of Rock Slopes (co-supervisor – Dr. Stephan Gruber, Carleton University): Many permafrost landslides in fractured rock exhibit complex movement mechanisms. In such cases, it is difficult to disentangle the contributions of various factors (e.g. permafrost thaw, variations in precipitation and groundwater, time-dependent progressive damage) to changes in slide movement and stability over time. This project will involve the development and testing of a framework for evaluating the role of permafrost degradation in controlling slide behaviour through the characterization of rockmass characteristics and permafrost conditions at multiple sites in northern Canada. Additionally, numerical simulation of a limited number of cases will be used to evaluate statistical trends derived from analysis of field data and to establish a range of potential future scenarios for landslide behaviour under forecasted permafrost conditions.

Ph.D. Level – Centrifuge Scale-Modelling of Fractured Rock Slope Instability Under Permafrost Degradation (co-supervisor – Dr. Greg Siemens, RMC): Making use of the state-of-the-art CASTLE facility at Queen's University, this project will develop scale models intended to simulate open pit mine slopes experiencing permafrost degradation and test them in a geotechnical centrifuge. The project will involve experimental design (including model material and monitoring techniques) and analysis of results from increasingly complex physical models to evaluate interactions between thawing ice, pre-existing fractures, intact rock damage, and external hydrological forcing in controlling progressive evolution of slope instability.

Ph.D. Level – Quantitative Assessment of Debris Flow Hazard in British Columbia (co-supervisor – Dr. Scott McDougall, UBC): Debris flows are a common hazard in British Columbia. Many prior studies have been conducted to understand these hazards in specific local areas, but the overall degree of hazard at the province-wide scale is not well-constrained. To facilitate large-scale characterization of debris flow hazard, this project will involve the development of a semi-automated approach for debris flow identification from historical satellite remote sensing data. Using this approach, debris flow hazard will be quantified at the provincial level and studied to better understand how temporal variations in hazard relate to broad-scale weather patterns.