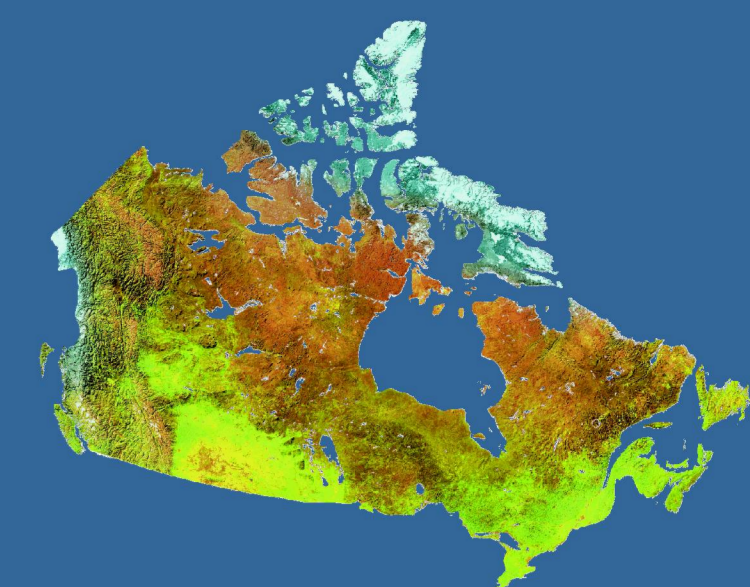




# COMMUNITY-SCALE HAZARD MAPPING IN THE CANADIAN ARCTIC: A CASE STUDY OF CLYDE RIVER, NUNAVUT

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## Mapping hazards

Hazards are potential risks to human life or infrastructure, ranging from slope instability to flooding. Not only can communities themselves be affected, but surrounding areas, such as hunting and fishing grounds and traveling routes can be adversely impacted.

*Storms and wave action causes erosion, threatening buildings along the coast.*



*Uneven ground subsidence can result from permafrost thaw, damaging infrastructure.*

Northern communities, generally located on permafrost landscapes in coastal environments, are subjected to harsh climates, with strong seasonal contrasts in temperature, wind and precipitation. These climate cycles also drive seasonal changes in the landscape, creating instability and hazards. For example, rapid snowmelt on frozen ground may cause flooding; saturated, non-frozen ground may fail on moderate to steep slopes causing landslides; thawing of ice-rich permafrost results in ground subsidence; and sea-ice free coasts permit increased wave energy, producing coastal flooding and shoreline migration.

Hazard mapping provides communities with a practical tool that can aid in guiding future community planning. Hazard maps illustrate the link between stability, geology, surficial material. Thus, landscape stability can be investigated and the identification of areas most sensitive to surface disturbance can be determined. The integration of the final hazard layer in the GIS with community technological and social adaptive strategies can aid in directing adaptation policies.

This study is based in Clyde River, or Kangirtualluq, meaning “nice little inlet”, which is located at the head of Patricia Bay on the East coast of Baffin Island. The hamlet is situated on primarily flat, low-lying terrain surrounded by fjords.

## Mapping hazards in Clyde River

During the 2007 field season, research had a focus on surficial mapping, ground truthing, soil sampling, thaw depth analysis, and RTK surveying.

*Real Time Kinematic (RTK) surveying was conducted to obtain centimeter precision measurements of various features. Thaw depth was measured at 50 locations, and the mean depth was 0.61m, with a SD of 0.18 m.*



Quickbird image of Clyde River, 2006

Based on the 2007 field season, preliminary results can be concluded. Certain physical characteristics of Clyde River increase its susceptibility to landscape hazards. As the town is situated below marine limit, its underlie with continuous permafrost with a high saline content and fine marine sediments, which erodes easily, is found under many sections. The primary landscape hazards in Clyde River include differential subsidence, causing damage to infrastructure, especially in the low lying Eastern areas of town. Thermal erosion is resulting in bank erosion, threatening houses along the creek. Surface run-off is causing flooding, gulling, and erosion.

## Partners in mapping

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## Communicating hazards

Through airphotos, satellite imagery and field surveys, a hazard map is being created for Clyde River. The map will be a multilayered GIS, where areas will be identified and classified based on their susceptibility to natural hazards. The map will be comprised of various layers representing causative factors that can induce instability. Layers will include surficial geology, hydrology, active processes, slope and deposit type. Layers will be classified individually, using a five category classification scheme ranging from high to low. The layers will then be combined through a weighted overlay, resulting in a final classification layer with areas zoned one to five.

Factor	Category	Rating
Surficial	Morain	Low
	Alluvial fan	High
	Raised river terrace	Low
	Bedrock	Low
	Weathered bedrock	Low
Slope	Till blanket	Low
	<10°	Low
	10°-15°	Med-low
	15°-20°	Medium
	20°-25°	Med-high
	>25°	High

*An example of causative factors and their rating. Layers such as these will contribute to the final hazard layer classification*



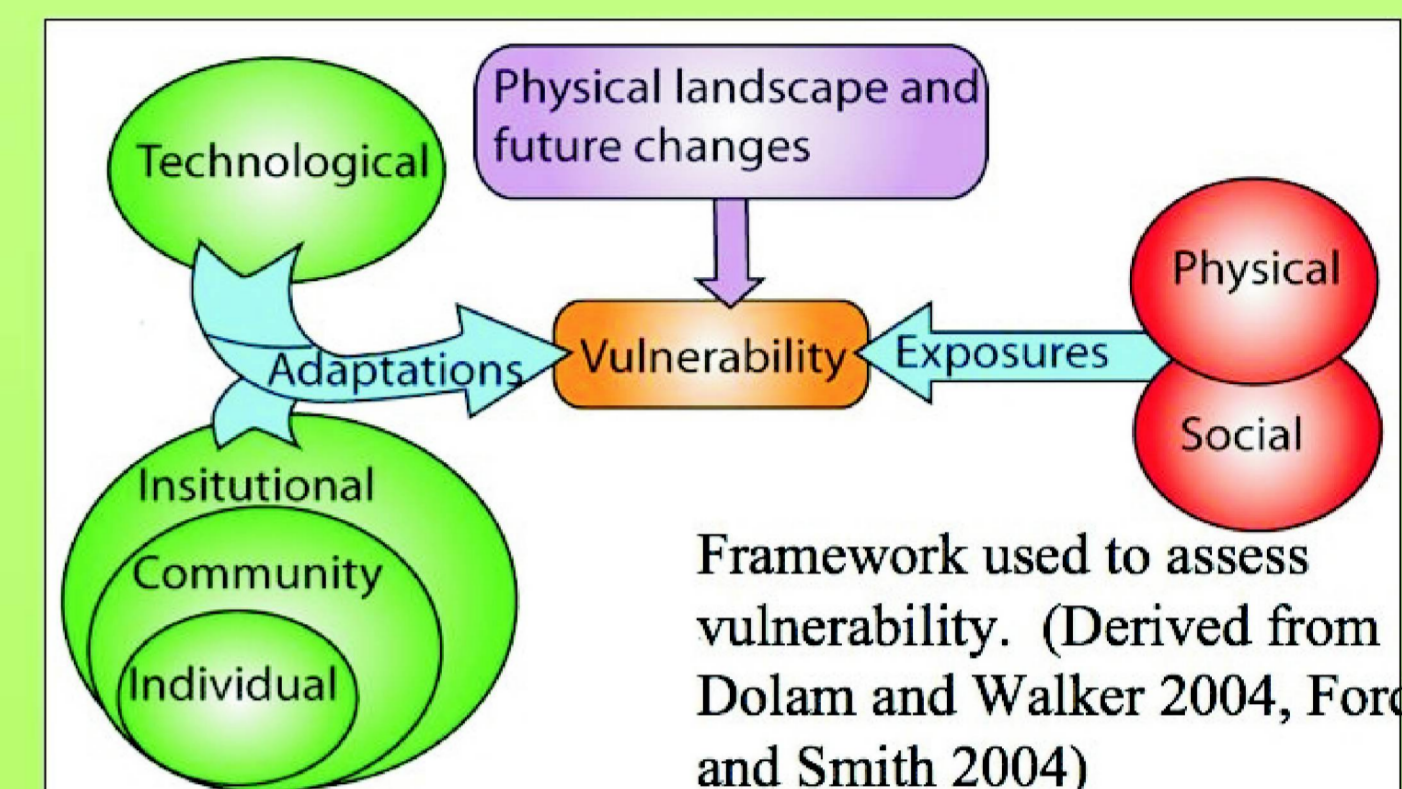
*Marine sediment constitutes a causative factors causing landscape instability.*

Classification	Hazard probability
1: Negligible	The probability is very low
2: Minor	Low probability, flat slopes, active processes are not a concern.
3: Moderate	Moderate probability, near areas of high hazard.
4: High	High probability, slopes moderate, effected by active processes and/or on marine sediment.
5: Extreme	Very high probability, steep slopes, unstable, highly influenced by active processes.

Final hazard layer classification scheme

## Coping with hazards

Vulnerability is a function of both the exposures or sensitivities facing the community, and the ability of the community to cope with the hazards. Various economic, social and political factors can increase or hinder adaptive capacity. In addition, adaptive capacity exists at the individual, community, institutional and technological levels.



*An example of a local, structural adaptation in Clyde River to cope with snow drifting.*



With the potential future climatic changes predicted for the North, such as increases in storm events, a decrease in sea ice extent and changes in precipitation patterns, the frequency and magnitude of landscape hazards may rise. Population increase will be an additional stress influencing Arctic regions. For instance, in Clyde River, the population is expected to rise by 20% in the next four years. This will result in an increase in demand of infrastructure, thereby affecting the adaptive capacity.

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