Newfoundland Labrador
Department of Energy and Mines

Mineral Lands Division Information Resource

Coastal Hazards in Newfoundland and Labrador

(sheet 1 of 5)

INTRODUCTION

The Mining and Mineral Development Branch of the Department of Energy and Mines provides the following comments and recommendations on the potential for coastal hazards, including erosion and flooding, 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 the coast or seeking to obtain title to land on the coast, municipalities with planning authority over coastal areas, and planning consultants.

The following comments and recommendations are general in nature and not intended to convey site-specific information concerning the potential for hazards or level of risk. Some information in this document may not be relevant to the location or community being considered.

The term “geological hazard” is used to describe a scenario that may result in a geological disaster. A “geological disaster” occurs when a natural geological process causes damage, injury, loss of life, or economic loss. Knowledge of past geological disasters and a recognition of the potential for future disasters are important factors that should be considered when making decisions about development, land use, and planning. For more information on geological hazards and disasters in Newfoundland and Labrador, visit https://www.gov.nl.ca/em/mines/publicoutreach/geologicalhazard/

FLOODING

Flooding can affect both inland and coastal areas and is the most common natural hazard in the province. Inland of the coast, flooding occurs when water flow exceeds the capacity of a water channel or the channel is blocked or impeded. During a river flood event, water may flow out onto the floodplain (the low, flat area adjacent to the river). Flooding on rivers can occur during high precipitation events, from spring snow melt, or as a result of ice jams or debris dams. Coastal areas near river mouths are also particularly vulnerable to flooding during periods of unusually high tides, when river outflow into the ocean is obstructed by sea water.

The Water Resources Management Division (WRMD), Department of Environment, Conservation and Climate Change (ECCC), is the provincial authority for flood management strategy. Flood-risk maps for many areas of the province are available from ECCC or Environment Canada. These maps document historical events and outline areas of potential threat from floods. Interested parties are advised to consult WRMD in relation to proposed developments near any body of water, including rivers and ponds. For more information, please visit https://www.gov.nl.ca/eccm/waterres/flooding/

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Coastal flooding occurs when low-lying coastal areas are inundated by the sea. This occurs when natural protection against waves (e.g., geological features such as beaches and dunes) is breached. Waves are controlled by numerous factors, including:

- **weather** (e.g., stronger winds produce larger waves);
- **fetch** (the distance of open-ocean over which the wind can blow with constant speed and direction; larger fetch can produce larger waves);
- **nearshore bathymetry** (a gently sloping sea floor near the shore can lead to larger waves than a steep sea floor);
- **tides** (large waves on a high tide will have more impact on the coastline than the same waves on a low tide); and
- **storm surge** (increase in mean water level produced by a combination of water pushed ashore by wind during a meteorological event (e.g., a hurricane or major depression), and the elevation of sea level in a low pressure area. In combination with normal tidal activity, storm surge can increase local sea level by 5 m or more. The most damaging storm surges occur during a high tide).

Human activities may have direct and indirect impacts on coastal flooding hazards. Modifications of the environment may unintentionally enhance flooding. Environmental degradation in the coastal zone may significantly enhance the risk of coastal flooding. All-terrain vehicle (ATV) traffic on dunes and barrier beaches can cause erosion and enhance blowouts. Degradation to these natural coastline protection features can increase susceptibility to over-washing and breaching by the sea.

COASTAL EROSION

Steep shoreline cliffs, a common feature along the coast of Newfoundland, are susceptible to erosion. The rate of erosion can be affected by several factors, including wave impact, cliff composition (geology), surface runoff, groundwater flow, wind, and/or beach width and height. Cliffs composed of unconsolidated materials generally erode more rapidly than bedrock cliffs. Many of the Island's unconsolidated cliffs are composed of till (sediments characterized by a wide range of grain sizes, deposited by a glacier); however, cliffs composed of sand, sand and gravel, or silt and clay are also found.

The actions of wind and water—surface-water flow, groundwater, wind, and/or waves and wave action—will erode unconsolidated cliffs, especially when there is no vegetation cover to stabilize the sediment. Surface-water flow can carve gullies and rills into the cliff face/slope. Groundwater will flow along impervious layers within the cliff sediments and can erode the cliff material at discharge points along the cliff face or steep slope. Wind can remove fine sediments from the cliff

face. Cobbles or boulders in the unconsolidated material in the cliff face may be released by erosion and roll down to the base of the cliff. In the short term, cobbles and boulders may provide some protection against wave erosion at the cliff base.

Wave action and high tides may contribute to erosion at the base of cliffs. This process undercuts the base of the cliff, which leads to over-steepening of the cliff face. Over-steepening may trigger a landslide (the rapid, downward movement of material due to gravity) or other mass movements. Wave erosion can therefore result in significant loss of coastal cliffs (meters to tens of meters) within a short time. The rate of wave erosion at the base of cliffs is controlled by the distribution of wave height, period (space between waves), and direction, and the width and shape of the beach: low-lying, narrow beaches may experience greater wave erosion than wide, steep beaches.

Human activities may have direct and indirect impacts on coastal erosion, and modifications to the natural environment may unintentionally enhance erosion. Examples include, but are not limited to:

- **Interruption of longshore drift**: Solid structures such as groins or jetties decrease longshore drift (the current running parallel to the shore generated by obliquely incident waves), resulting in the accumulation of sediment on the up-drift side, and erosion on the down-drift side of the structure;

- **Coastline hardening:** modifying or “hardening” the coastline through the addition of boulders, concrete, or other solid materials. This practice can reduce sediment supply to down-drift beaches, which may change their potential for erosion;

- **Cliff vibration:** the vibrations from vehicles or construction operations can trigger a landslide in unconsolidated cliff materials;

- **Vegetation clearing**: the removal of vegetation from the face or the top of a cliff will increase its susceptibility to erosion from surface water runoff, groundwater discharge, and wind. Roots are important for stabilizing loose sediments; and

- **Changes to local hydrology:** residential, industrial, or agricultural development can change the characteristics and quantity of surface-water or groundwater flow. Irrigation, vegetation removal, and paving of naturally permeable surfaces will increase surface-water runoff and the risk of erosion.

Interested parties are advised to consult the Coastal Change in Newfoundland and Labrador website at:
https://gnl.maps.arcgis.com/apps/MapSeries/index.html?appid=7e08dc1738204c92a5bff19d640ee760

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FUTURE GEOLOGICAL HAZARDS

The intensity of landscape change and the frequency of geological hazards will likely increase in the future. Potential hazards may increase or become relevant for new locations within the province, due to the following:

(1) Regional climate projections for the province indicate that the climate will become warmer (especially in winter) and wetter (in terms of both precipitation intensity and duration). Extreme precipitation events and flooding may be more frequent. Storm surges are also forecasted to increase in intensity and frequency. View provincial climate change projections and related resources here: https://www.gov.nl.ca/eccc/occ/publications/

(2) Sea level is rising is globally. Thermal expansion of the ocean and an increase in water supply from melting glaciers and ice sheets both contribute to this rise. Sea level between Cape Anquille and Port aux Basques in the year 2100 is predicted to be between 140-160 centimeters (cm) higher than the level in 2000. Other areas of the Province are experiencing a less rapid, and overall smaller, sea level rise by 2100: 120-140 cm from the Bay of Exploits southeast including the Avalon Peninsula, the south coast and west coast (north of Cape Anquille) of Newfoundland; 100-120 cm along the Northern Peninsula; and 80-100 cm in most of Labrador (*see* James et al., 2021). In our province, the land is also slowly rising due to *isostatic rebound*, the rise of landmasses that were depressed under the weight of ice sheets during the last ice age. Isostatic rebound will partially offset global sea level rise caused by climate change in some areas. For more information about sea level change, refer to visit Batterson and Liverman (2010) and James *et al.* (2021).

RECOMMENDATIONS

Municipal planning decisions should consider a 100-year planning period. Development in coastal areas should be managed and regulated and include appropriate measures such as coastal protection plans or engineering solutions that will mitigate potential losses and limit erosion resulting from human activities and climate change. Municipalities with planning authority may choose to restrict future development on or near coastal cliffs or other areas susceptible to coastal erosion through re-zoning efforts.

The Mining and Mineral Development Branch recommends a combined buffer on new development in coastal areas that combines the following two types of setbacks:

1) **minimum 30 m inland development setback from the top of coastal cliffs and embankments or the high tide mark for beaches or shorelines without cliffs**, and

2) **restrict development in areas below, at a minimum, the 4 m contour.** Areas below the present 4 meter contour are generally highly vulnerable to coastal flooding from storm surge.

These setbacks should be considered provincial minimums; setbacks may be larger in areas where documented coastal erosion rate exceeds 15 cm/yr or where documented storm surges have exceeded 4 m high.

Where the average annual erosion rate is known, the suggested inland development setback for a specific location is calculated as twice the average annual erosion rate, multiplied by 100. Example: A shoreline with a measured erosion rate of 15 centimeters per year (cm/yr) should have at least a 30 m setback for new development. This is written out as (2 x 15 cm/yr) x 100 yr = 3000 cm or 30 m.

This combined buffer approach will result in a variable total setback distance from the top of cliffs and embankments and from the high tide mark for areas without coastal cliffs within the municipal planning area. The combined approach is recommended to mitigate potential risks associated with both coastal erosion and coastal flooding. Disturbances within the setback area, including changes to the ground surface and the removal of sediment or natural vegetation, should be avoided.

RESOURCES

Batterson, M. 2020: Coastal change in Newfoundland and Labrador a handbook for policy makers and the public. Department of Municipal Affairs and Environment, Government of Newfoundland and Labrador. 48 pages. https://www.gov.nl.ca/eccc/files/Handbook_Sept21_2020.pdf

Batterson, M., and Liverman, D. 2010: Past and future sea-level change in Newfoundland and Labrador: guidelines for policy and planning. *In* Current research, Newfoundland and Labrador Department of Natural Resources, Geological Survey, Report 10-1, pages 129-141. https://www.gov.nl.ca/em/files/mines-geoscience-publications-currentresearch-2010-batterson-liverman.pdf

James, T.S., Robin, C., Henton, J.A., and Craymer, M. 2021: Relative sea-level projections ofr Canada based on IPCC Fifth Assessment Report and the NAD83v70VG national crustal velocity model. Geological Survey of Canada, Open File 8764. 1 zip file, https://doi.org/10.4095/327878